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Caj Södergård (ed.)

Mobile television - technology and user experiences

Report on the Mobile-TV project

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Keywords user interface, portable terminals, mobile terminals, visualisation tests, interactive television, TV-Anytime, mobile digital television

Abstract

Watching television from a wireless pocket-sized terminal or phone is interesting in many situations. Public and private transportation vehicles and public places are potential environments for mobile television services. Even in homes, mobile television handsets are interesting, both as a personal television set and as a tool to establish a closer interaction with the television programs. In addition to these possibilities for enriching viewer experience, mobile television offers the broadcaster new audiences, the teleoperators a new distribution channel and the equipment manufacturer new receiver product possibilities. In fact, television is the only major media missing from today´s mobile phones.

In this study we empirically investigated people´s *real* interest in mobile television by interviewing a large population and by building and trialling a prototype system. The system combines several types of wireless networks in a 4G fashion. It takes digital terrestrial television broadcasts from the air and delivers them over the Internet to mobile terminals in hot-spot areas covered by Wireless Local Area Networks (WLAN). Content is also delivered over the GPRS cellular network. Two types of terminals are used – a pocket-sized PDA and an A5-sized tablet PC. The digital television signal is transcoded down to a bit rate suiting these terminals. In the field trial the user could watch almost the complete program content of the three leading Finnish TV channels. The user could also access all programs transmitted during the previous week from the media server (TV-Anytime feature).

Ordinary families, leisure users, workers and students participated in the trial. Each user tried the service at WLAN hot-spots during one month. The users clearly considered the service to be television, not wireless multimedia. This underlines that new services should be rooted in known user interfaces. The most liked feature was the ability to watch programs from the archive whenever the individual wanted. Typically, the user surfed through the program lists and

checked what had passed unnoticed. The users normally watched short programs or pieces from longer programs. Children in particular – even preschoolers - liked the service; in some cases even so much that it replaced the ordinary television. News programs were most popular among the adults. Additional information was seldom retrieved and searches were even more rare. Typical use would be when waiting for something or when killing time or more generally in the same situations, where one would normally read an evening newspaper. The users were prepared to pay about the price of a newspaper for the service.

This study clearly indicated that the mobile device is, in many respects, better suited to interactive applications than normal television. This notion is the starting point for a follow-up project. Another topic for future research is how to remake television content so that it optimally suits mobile devices.

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Avainsanat user interface, portable terminals, mobile terminals, visualisation tests, interactive television, TV-Anytime, mobile digital television

Tiivistelmä

Television katselu langattomalta taskukokoiselta laitteelta tai matkapuhelimelta on kiinnostavaa monessa tilanteessa. Julkiset ja yksityiset kulkuvälineet ja julkiset tilat ovat mobiilitelevision potentiaalisia käyttöympäristöjä. Myös kodeissa ovat pienikokoiset mukana kulkevat TV-päätteet kiinnostavia sekä henkilökohtaisena televisiona että välineenä läheisempään vuorovaikutukseen televisio-ohjelmien kanssa. Paitsi että mobiilitelevisio tarjoaa mahdollisuuksia rikkaampaan katselukokemukseen, se tarjoaa televisioyhtiölle uusia katseluryhmiä, teleoperaattorille uuden jakelutien ja päätelaitevalmistajalle potentiaalisia tuotteita. Televisiohan on ainoa päämedia, joka vielä puuttuu nykyajan puhelimista.

Tässä työssä on kokeellisesti tutkittu ihmisten *todellista* kiinnostusta mobiilitelevisiota kohtaan haastattelemalla iso määrä ihmisiä, sekä rakentamalla ja kokeilemalla prototyppijärjestelmää. Järjestelmä yhdistää useantyyppisiä langattomia verkkoja 4G-tapaisesti. Se poimii digitaaliset maanpäälliset lähetykset ilmasta ja jakelee niitä eteenpäin Internetissä yli mobiilipäätteille langattomien lähiverkkojen (WLAN) kattamilla alueilla. Sisältöjä voidaan myös siirtää GPRS-solukkoverkon yli käyttäjille. Kahdentyyppiset päätelaitteet ovat käytössä – taskukokoinen kämmentietokone (PDA) ja A5-kokoinen Tablet-PC. Digitaaliset televisiosignaalit transkoodataan bittinopeuteen, joka sopii näille päätteille. Kenttäkokeessa käyttäjä pystyi katsomaan melkein kaikkea, mitä Suomen johtavat kolme TV-kanavaa lähettivät. Käyttäjä pystyi myös hakemaan arkistosta katsottavaksi kaikki ohjelmat, jotka oli lähetetty viime viikon aikana (TV-Anytime piirre).

Normaalit perheet, vapaalla olevat, työntekijät ja opiskelijat osallistuivat kenttäkokeeseen. Jokainen käyttäjä kokeili palvelua WLAN-hot spotien alueilla kuukauden ajan. Käyttäjät olivat yksiselitteisesti sitä mieltä, että palvelu oli televisiota, ei langatonta multimediaa. Tämä tukee näkemystä, että uusien palvelujen olisi perustuttava vanhoihin tuttuihin käyttöliittymiin. Eniten pidetty

piirre oli mahdollisuus katsoa ohjelmia arkistosta milloin tahansa. Tyypillisesti käyttäjä selaili ohjelmalistoja läpi ja tarkisti, mitkä ohjelmat olivat menneet ohi huomioitta. Käyttäjät katsoivat yleensä lyhyitä ohjelmia tai osia pidemmistä ohjelmista. Erityisesti lapset – jopa esikoululaiset – pitivät palvelusta; joissain tapauksissa jopa niin paljon, että se korvasi normaalin television. Uutisohjelmat olivat suostuimmat aikuisten keskuudessa. Lisätietoja haettiin harvoin, ja hakuja tehtiin vielä harvemmin. Tyypillinen käyttö oli odotellessa tai kuluttaessa aikaa, yleisemmin tilanteissa, joissa normaalisti luetaan iltapäivälehteä. Käyttäjät olivat valmiita maksamaan palvelusta saman verran kuin sanomalehdestä.

Tämä tutkimus antoi selvän osviitan, että mobiilipääte sopii monessa mielessä paremmin vuorovaikutteisiin sovelluksiin kuin normaali televisio. Tämä havainto on lähtökohta jatkoprojektille. Toinen aihe jatkotutkimuksiin on, kuinka televisiosisältöjä voidaan muokata siten, että ne sopivat mahdollisimman hyvin mobiililaitteille.

Preface

This publication contains the results of the project "Mobile television in fourth-generation networks (Mobile-TV)". The two-year project was part of a technology programme "Networks of the Future" (NETS) run by the National Technology Agency (Tekes). The aim of the project was to *study, develop and test in user trials* mobile television applications that use multiple delivery networks. This publication compiles the main findings that have already been partly introduced in lectures, articles, working papers, interviews and demonstrations. The most important result is a prototype system that around 80 people tested over one month.

Besides the main funders, Tekes and VTT, seven companies financed the project and were represented in the project management group. By the end of the project the group comprised Juha Mustonen (*Alma Media*, Chairman), Janne Aaltonen (*Nokia*, earlier Matti Lipsanen), Ari Heinonen (*University of Tampere*), Erkki Hietanen (*Tekes*), Helene Juhola (*VTT*), Pauli Kuosmanen (*Elisa Communications*, earlier Jan Enlund), Martin Mäklin (*TeliaSonera*, earlier Heikki Äyväri), Esko-Ensio Pipatti (*SanomaWSOY*), Mikael Roos (*Malibu Telecom*, earlier Joonas Holtari), Kalle Sihvola (*Digita*, earlier Riku Salminen) and Caj Södergård (*VTT*). The group made a great effort on behalf of the project.

VTT Information Technology and the University of Tampere carried out the project. The project group members contributing to this publication were Caj Södergård (Sections 1, 5.7, 5.9, 7), Matti Aaltonen (6.4, 6.6), Elina Noppari (2.1, 3), Sonja Kangas (5.8), Timo Kinnunen (5.4, 5.5), Mikko Kojo (5.2, 5.5, 5.5), Sari Lehtola (2.2, 2.3, 2.4, 4.2, 4.3, 4.4, 6.2, 6.3, 6.5, 6.6), Sari Mokka (2.2, 2.3, 2.4, 4.2, 4.3, 4.4, 6.3, 6.6), Nan Ning (5.6, 5.7), Ville Ollikainen (5.1), Katri Saarinen (6.6), and Antti Tammela (4.1, 6.1, 6.6). In addition to the authors, Mika Hakkarainen, Auli Harju, Ari Heinonen, Timo Järvinen, Magnus Melin and Katja Rentto have contributed to the project.

Mobile television holds clear promise. Hopefully, this publication will provide some new insights and guidance in this new field.

Espoo 15.9.2003
Caj Södergård
Project leader
VTT Information Technology

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List of acronyms and symbols

ADSL	Asymmetric Digital Subscriber Line
API	Application Programming Interface
ASX	Windows Media metafile
DHCP	Dynamic Host Configuration Protocol
DVB	Digital Video Broadcasting
DVB-H	DVB-Handheld
DVB-T	DVB-Terrestrial
DVB-J	DVB-Java
EPG	Electronic Program Guide
GPRS	General Packet Radio Services
HAVi	Home Audio Video Interoperability
HSCSD	High-Speed Circuit-Switched Data
HTTP	Hypertext Transfer Protocol
IEEE	Institute of Electrical and Electronics Engineers
ICT	Information and Communication Technologies
ITV	Interactive Television
JDBC	Java Database Connectivity
JMF	Java Media Framework
JNI	Java Native Interface
JPEG	Joint Photographic Experts Group
JRE	Java Runtime Environment
MHP	Multimedia Home Platform
MPEG	Motion Pictures Experts Group
PAT	Program Association Table
PC	Personal Computer
PCI	Peripheral Component Interconnect
PCMCIA	Personal Computer Memory Card International Association
PDA	Personal Digital Assistant
PID	Packet Identifier
PMT	Program Map Table
PVA	Audio and video format used by Technotrend
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RDBMS	Relational Database Management System

RMI	Remote Method Invocation
SDK	Software Development Kit
SMS	Short Message Service
UMTS	Universal Mobile Telecommunications Service
URL	Uniform Resource Locator
WLAN	Wireless Local Area Network
WMV	Windows Media Video
XHTML	Extensible Hypertext Markup Language

1. Introduction

Being able to watch television on the move from a wireless pocket-sized portable screen has a value in many situations. In public transport vehicles, such as on the train, on the bus, on the ferry, television is an entertaining way to spend your time. The same goes for public spaces, like cafeterias, railway stations, bus stops, entrance halls, queues in supermarkets and waiting rooms. There is also a need for more mobility in private places: in the backyard at home, at the summer house, in a taxi or a private car, the "TV-Anywhere" opportunity is interesting. Some family members may even wish to have their own personal mobile television at home. In fact, television is the main service missing from today´s mobile handsets that already have voice, messaging, Internet browsing, radio, and still and video camera.

In addition to these possibilities for enriching the content experience for the mobile end-user, mobile television offers a lot of business opportunities. For the broadcaster, it provides a new way of reaching its audience while they are on the move; for cellular operators it provides a cost-efficient way of delivering data to a large number of recipients in a single DVB datacast; for the chip and equipment manufacturer, it offers a new product.

However, it is clear that mobile television is only a supplement to the normal “dining room” television. This is because this form of television offers the ultimate watching quality, with crisp stereo or surround sound and a big-screen video picture. Watching television is also very much a social activity – not a personal one.

Mobile analog television receivers have been on the market for years – especially in Eastern Asia [1]. They have not been a huge success, which may be due to fact that they do not have any new features over the normal television. The new interactive television that is a part of digital television is a different thing however. It can be argued that this interactivity is more natural for a user of a personal portable terminal than for a normal television watcher on his/her sofa. If that is so, the interactive parts of digital television are likely to migrate to

[1] There is currently at least one mobile phone on that market which has an integrated analog television receiver. It is too early to evaluate its success.

mobile terminals. In a far-ahead scenario, the mobile terminal could merge with the remote controller of the television, taking over the interactive parts of television viewing.

The current technology development offers good tools to realise mobile television. Mobile phones are developing into multimedia devices with good video display facilities. Personal Digital Assistants - PDAs – are in wide use, because of their penetration in work places. The same goes for the new brand of tablet PCs. These devices are good candidates as terminals for mobile television, enabling "Television Anywhere". Because mobile television clearly needs novel features in order to compete successfully with other media, we decided to include access to archived TV material - "TV-Anytime" - in the prototype. Access to archived television programs demands large numbers of high-capacity media servers distributed throughout the telecommunication network close to the user, but emerging intelligent network structures - possibly including peer-to-peer solutions - together with cheaper computer storage makes this increasingly feasible.

Telecommunication networks are converging into 4G networks, where cellular mobile networks are interworking seamlessly with wireless Local Area Networks (WLAN) at so-called “hot-spot” areas. We wanted to investigate whether digital television broadcasts could be included in these future 4G networks. This would make new kinds of interoperation between broadcast (one-to-many) and cellular (one-to-one) communication possible. For example, Aaltonen (2003) shows how such a hybrid network raises the transmission capacity for mass media content several times compared to a one-to-one network.

More and more transmission capacity is available in the terrestrial television network for mobile use. In Finland, a fourth multiplex – in addition to the existing three – is allocated for this purpose[2] with the aim of starting commercial broadcast to mobiles in 2005. It is also technically possible to enlarge the existing multiplexes to include mobile users in addition to the current fixed users.

[2] http://www.mintc.fi/www/sivut/dokumentit/julkaisu/julkaisusarja/2003/a252003k_eng.pdf

Mobile television is becoming standardised. The international DVB-H(andheld) standard [3] that is under preparation is based on the well-established DVB-T standard and contains some modifications for fully supporting small battery-driven terminals. The technology for encapsulation of Internet Protcols (IP) into the DVB broadcast is also in existence (IP-datacast=IPDC) [4]. This makes it possible to use the same streaming video protocols (e.g. MPEG4-based) used on the Internet for DVB broadcasts.

However, there are still problems with the technology. Hardware and battery problems have to be solved before a DVB receiver can be neatly integrated with a handheld device (Aaltonen 2003). In addition, correct broadcast parameters have to be used to allow the receptionin moving vehicles and inside buildings with small antennas.E.g. the 64-QAM modulation of current Finnish terrestrial broadcasts is too accurate for mobile use.

One solution is - like what is planned in Finland - to build a separate transmission network that uses transmission parameters suited to mobile reception, such as 16-QAM or QPSK. In Finland, the RTT (Radio ja Televisiotekniikan Tutkimus) organisation is building such a network, using the IP-datacast technology [6]. VTT has also built an experimental television station that can use mobile transmission parameters [7]. Another solution is to a receive the TV broadcast from the air, transcode it and transmit it further through the Internet to a Wireless Local Area Network that delivers it to mobile terminals in a hot-spot area. This hybrid was the method used in this project, because it allowed us to simulate future services using the current DVB terrestrial network [8].

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[3] See http://www.dvb.org/

[4] http://ipdc-forum.org/

[6] It is also technically possible to change the transmission parameters of existing multiplexes, but the compatibility with current receivers must then be granted.

[7] See http://www.otadigi.tv/

[8] We also developed a solution whereby the trancoded tv program is delivered over a cellular GPRS connection with a lower "mobile" quality. This solution was not used in the trials.

As a summary, the goal of the work reported here was to *study, develop and test in user trials mobile television applications that use multiple delivery networks.* The user trials should show which user interface, content and service suit mobile television in various user situations.

This report is structured as follows. Chapter 2 reviews television usage patterns, as well as experiences of digital television, and provides an overview of mobile televisions trials around the world. Chapter 3 places mobile television in the broader media landscape and social context on the basis of observations in public places and interviews with users and experts. Chapter 4 describes the user-centered design process of the prototype, including consumer and expert interviews about the device, content, user needs and business models, as well as user interface visualizations and tests. Based on this iterative design the prototype is implemented (Chapter 5) and used in the field trial (Chapter 6). The conclusions are drawn in Chapter 7.

This report builds on extensive empirical material. In addition to observations in public places, 97 people were interviewed for the media environment investigation (Chapter 3), 65 people were interviewed as a part of the design process (Chapter 4) and 81 people participated in the field trial (Chapter 6). As an additional 46 people used the system at an exhibition, a total of 289 people were consulted in the research.

2. Analog, digital and mobile television

To understand mobile television, it is enlightening to study its predecessors - normal television viewing and early experiences of digital television. There are also some early international and Finnish attempts at realising mobile television, which are reviewed in this Chapter.

2.1 Use and users of television in Finland

Television has strongly shaped the lives of Finns for decades. From the black-and-white television of the fifties it has changed to colour; the latest stage in television's evolution is digital television.

Although digital television has not advanced as rapidly as was originally expected (first predictions figured that there would be enough equipment on the market in the autumn of 2001 for the digital channels to begin with a full agenda), digitalization is going forward anyway. In the spring of 2003 there were approximately 80, 000-100, 000 digi-boxes in Finnish households.

Almost every Finnish household has a conventional television. Only five per cent are without TV. Many families (43 %) have several television sets. Television's strong presence in the everyday life of Finland makes it a challenging research subject.

Television has become a device for all people; although earlier it was viewed with contempt by the elite. It has a cradle to grave presence. According to various studies, a child notices television at home as early as the age of six months. Nowadays viewing of television is the most common spare-time activity in Finnish families, for all age groups except small children (Central Statistical Office of Finland, 2002).

The amount of time people spend watching television in Finland has increased annually since the beginning of the 1990s. According to Finnpanel's television-barometer, the average time Finnish people spent watching TV was 2 hours 41 minutes a day (not including video viewing) - an increase of seven per cent on the previous year, which was estimated as considerable (Finnpanel Oy, 2003).

The increased in television viewing is ascribed to the growing program supply as well as better recognition of diverse target groups. Various demographic factors, such as age, sex, social class and education, affect the viewing figures. Among the different age groups, the most active viewers are elderly people over 65 years; the young have also increased their television viewing. The extension of broadcasting time into the early hours of the day has meant that the importance of so-called breakfast television and other daytime programs may be significant for elderly people who are no longer working (Finnpanel Oy, 2003).

However, when reading the statistics one must remember that not all television viewing is busy activity. Television is often browsed passively, or even just listened to while doing other tasks at home. Television is a part of the sound and image environment in the home, like wallpaper, which frames people's everyday lives and routines. Even when watching the news the content may be secondary. Empirical results of television news research indicate that people remember disappointingly little of the broadcast. An important factor may be the way in which television schedules and rhythms the day (Pantzar, 1996, 10, Konig et al., 2001).

When interviewing viewers after a period spent without television, the functions of TV in order of importance were:

1. producing information
2. relaxation and entertainment
3. awakening of discussion
4. communality
5. scheduling the day
6. spending time together.

(Winick, 1988, 223).

This study was made in the United States, but it is also understandable in the Finnish context. Television's role as a social device that produces communality has traditionally been strong. Earlier, when television sets were rare, people got together with their neighbors to watch TV. These days, social aspects appear among the nuclear families. In certain cases new social viewing situations are generated in public spaces, where people get together as a large audience to watch, for example, sports.

However, progress towards an individual watching culture is also perceived. As the standard of living has risen, people have bought several television sets and family members may watch television in their own rooms. According to estimations, the future services of digital television are also changing viewing behavior towards a more individual way of use. When audiences become more fragmented, television does not set just one common agenda, but it is still a significant connective element among different target groups.

Despite the development towards individuality, the character of television has not changed. Annetertaining flow of programs that flame passive transference is crucial for the success of television, not the activity of the viewers. Television is watched from the couch and the cultural ways of use change slowly. Innovations and changes happen both in the television content and the technology, but usually these changes happen inconspicuously in the long run (e.g. Näränen, 2003, Leppänen & Marttila, 2000).

Entertainment is an important characteristic of television. Often, the rationality of user interviews affects the way in which people say they mainly watch news or documentaries and diminish the importance of entertainment. However, the TVbarometers articulate the popularity of the entertainment content.

According to the Finnpanel barometer, different age groups differ slightly when it comes to their favorites, but entertainment is still durably represented;young people (10 to 24 years) in particular favor the entertainment content and mainly watch foreign television series and movies. In this age group the top-ten list of 2002 contained news (7th) and the Finnish Independence Day celebration in the Presidential Residence (10th) - other programs being TV series like Sex in the City, Friends, Austin Power, etc. (Finnpanel Oy, 2003).

The adult group (25 to 44 years) also preferred entertainment, although the ranking of news (4th) and Independence Day (1st) in the top-ten list arises; other programs were also foreign television series and movies. The favorites of the middle-aged and elderly (44 years and over) are different. The number of news, documents, sports and domestic entertainment programs in the top ten was higher.

Although an entertaining flow of programs is typical for television and can be considered a more passive than active way of using TV, the growing popularity of different TV chat shows over the past couple of years has shown that there could also be a call for television containing interactive elements. Nowadays every main channel has a chat-program, which is broadcast outside other program times - for example, Subtv considers chat services to be one its future focuses (Sihvonen & Suominen, 2002).

People have aspirations for interaction with television and TV viewing will continue to evolve, but, in general, the core functions of television are quite simple: to entertain, to inform and to provide relaxation with the help of a passive program flow. These functions are not likely to change and this is important to remember as new contents are created (cf. Carey, 2002).

The "Media in young peoples' lives" survey gives some interesting results on how young people use conventional television today and what programs they watch - 698 young Finns (age 13–19 years) took part in this survey by the University of Jyväskylä 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 for at least three hours per day and at weekends two-thirds of them watched TV for at least three hours per day.

The young people watched foreign and Finnish TV shows and movies, the most popular TV shows being Salatut Elämät (a Finnish soap opera), South Park and The X-files. Young people were also interested in the 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 section in Jyrki was music videos: the young people took part in the making of Jyrki by voting on music for the countdown chart and taking part in events that were shown later. A fifth of the young viewers sent feedback to the producers. Girls voted, chatted and took part in competitions on the Jyrki website more often than boys. Some young people said they had found new friends through the Jyrki chat line (Luukka et al., 2001).

The young people used television for entertainment. Boys were more fascinated by moving pictures and special effects, while girls were more interested in texts and stories. This can been seen, for example, in their opinions of commercials

and websites. 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 of using 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).

2.2 Digital television viewing habits

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 to 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), in her Masters thesis, surveyed the views of digital television producers. The views were also compared with an earlier study done on the public. According to the interviews, the producers felt that the starting time of digital television was too soon, there not being enough equipment yet on the market. The thesis stated that the interaction was not going well. The main services available include the Electronic Programme Guide (EPG), supertext-TV and games. The producers considered interaction the most important thing for the success of digital television; both viewers and producers regarded the EPG, the recording of TV programs and the supertext-TV as the most interesting interactive services. There were differences of opinion on the choice of camera and on the importance of viewing www pages and wide-screen. The viewers thought that choosing the camera would be a good idea but the producers did not think the idea was so suitable for digital television (Hannula-Stenqvist, 2001).

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 they are not interested in extra channels or they feel 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; younger age groups in particular are interested in digital television, and the interactive services are mostly used by young people. According to Oftel's survey, 13% of households without digital television were planning to get one in the next 12 months (Oftel, 2000).

Oftel conducted a new study in 2001. This study showed that the reasons 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. People learn new features from their friends and younger family members. In the EPG, people tend to browse the "all programs" menu most often. The interviewees said it only takes a short time and they can see the whole range of programs they are paying for. The results of this study suggest that channel identity and branding are 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 program list because people tended 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 a program. 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 favored genres more than to terrestrial scheduled television (Oftel, 2001).

In the study of O'Brien et al. (1999) the test users were able to order movies, music or radio channels, play games, do shopping, read local ads, check timetables, reserve tickets, etc., via the set-top box in their homes. All of the

participants reacted favorably to the set-top box. One difficulty was that the users did not know exactly how much everything cost. There was also confusion as to where all the information lay at any given time: 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 to prevent children from watching certain things (O'Brien et al., 1999).

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. It is very important 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 of whether (s)he is currently using the Internet or the television. The user interface comprises several components that need to be connected together as well as possible. The move from passive to active television watching 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).

Campbell (2000) has studied the usability of interactive television in the UK. In his dissertation he claims that the reason interactive television has been studied so little has to do with the fact that very little hardware was available. At that time he forecast that the set-top boxes would develop a lot in the future, but the television and the remote would mainly stay the same. According to Campbell, current usability research methods are suitable for designing the interactive television. Campbell did not release his results to the public when this study was done. 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 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).

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 was not interested 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).

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 a telebanking application. On top of the usability evaluation they also made a telephone survey of TV viewing habits and people's opinions about advances in TV technology. 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, the users considered them to be very useful. 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 under 30 years of age were very interested but people over 30 years thought that 10 years later they would still be using the same TV system as now (Concejero et al., 1999).

2.4 State-of-the-art of mobile television

2.4.1 International experiences

The Terrestrial Broadcasting Tokyo Pilot Project, which is co-ordinated by the Japanese Broadcasting Corporation and Nippon Hoso Kyokai (NHK), began in 1998 and was in its second phase[9] at the time of this survey. The Tokyo Pilot is carrying out experimental digital broadcasting and studying fixed, mobile and portable reception of digital broadcasting[10]. 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 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 spectacles.

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 Organization of Japan (TAO) in Hokkaido[11]. One experiment has

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

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

[11] 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

already been conducted on the Bullet trains. The aim was to examine the characteristics of digital terrestrial broadcasting in high-speed mobile reception[12].

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 programs 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 programs is wide: entertainment, fashion, travelogues, documentaries, movie previews, sports and up-to-date news. The criteria for choosing the programs are based on viewers' traveling time (about 20 minutes). Other requirements for programs are that they must be entertaining, fast-paced and visually captivating. TVMobile was first launched on 1, 500 buses. In the future TVMobile will keep people occupied with information and entertainment in queues at supermarkets, clinics, taxis, ferries, private vehicles, etc. 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 that time the Japanese were gaining familiarity with the new third-generation mobile phones. They could, for example, send music, pictures or video clips to one another. The new phones could also act as videophones (DoCoMo, 2001).

2.4.2 Finnish experiences

People in Finland started to visualise mobile television in 2001, after the release of the first short film that was made with a handheld computer and small camera. The news report stated that more applications were 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 with portable mobile devices. The competition was held at the Tampere 32nd International Short Film Festival in March 2002[13].

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

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

There is also a great deal of interest in the future use of mobile devices and, in particular, the possibilities offered by 3G phones. In 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 menus. The end-users' experience of the pilot was very positive: over 60% 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 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, the users tested a user interface control based on movement of the mobile device. Mstation applications will cover areas such as wireless games, messaging, on-line betting and lottery services. At the time of the survey the results of this pilot had not been published (Sonera, 2001).

The RTT (Radio ja Televisiotekniikan Tutkimus) organisation is building a mobile experimental network in the Helsinki region using the IP-datacast technology. VTT has also built an experimental television station that can use mobile transmission parameters.

3. Shaping the space of mobile television

3.1 Introduction

Media development can be characterised as a socio-technical phenomenon bringing together different engineering specifications and media production values in the changing social context of the user's everyday reception and use. People, technologies and institutions can all be seen as octants, which have equal potential for influencing development. (Media) technology can thus be understood as socially shaped (Lievrouw, 2000, 184).

Technology or marketing are not the only limiting or promoting factors behind the media development. On the contrary, the social and human elements are important. The relevance of a technical innovation is considered in the actual user environment and this social nature of devices and user views must be taken into account when developing new products. Taking possession of a new device is often a long process, reminiscent of evolution, where the importance of social interaction is great (Herkman, 2001). People do not use media just for the sake of using it (functionalism/ instrumentalism), but always in a social context composed of the surrounding world and other people (Falk, 1992).

When producing a new service or device, it is essential to pay attention to the social context in which the device may actually be placed. The context affects the way people perceive the device and how it is used.

When deliberating the possible user context of mobile television, the idea of a mobile device that could be used anywhere and anytime, and probably with the same motives as other mobile devices, came about. Mobile devices are particularly used in the public sphere, which is characterised on the one hand by mobility and on the other by waiting and so-called idle moments. In both situations mobile communication is common and the context could be also typical for mobile television.

In post-modern urban societies life and action is increasingly concentrated in public spaces. Urban space is becoming a common living room. In the urban environment

mobile media has contributed much to the reorganization of public and private spheres. The concepts of time and space have became more flexible as it is possible to be connected almost everywhere with mobile phones. Mobile media have changed the way people behave; working hours and leisure time intermingle and much private activity takes place in public places (Kopomaa, 2002).

This chapter introduces three different perspectives, all aiming to perceive the social context and media environment in which mobile television could possibly be placed. These are the public space observer's, the group interviewees' and the media experts' perspectives. The goal has been to examine existing, customary ways of using media to depict the different functions of media use in different situations and consider the changes in the media environment. By doing this it is possible to outline the expectations that mobile television is about to confront.

The study began with the idea of public space as a communication environment. The researchers visited different public and semi-public spaces and observed people's communication behavior in certain situations. The observations are described in Chapter 3.2.

Because observation always raises the question of interpretation, the next stage was to interview people about their opinions on public space as a communication setting, the role media plays in their everyday lives and the functions it has. The purpose of the interviews was to confirm or question the observations made earlier. Discussion about people's everyday media use broadened the perspective; not only the public sphere but also the private sphere as communication environment was discussed. It was a matter of the changing communication environment in the context of everyday media use. Broadening the perspective was quite natural because the border between the public and private spheres is not unambiguous and media itself contributes to this. The group interviews are presented in Chapter 3.3.

Third, the changing communication environment was considered by various media experts. They were asked to discuss different future scenarios: what is the field of media facing right now, what is probably about to come and what should be avoided if possible. They also reflected on the group interviewees' opinions. The expert interviews are reported in Chapter 3.4.The concept of mobile television as a future innovation was carried along all the way. During the

observation period mobile television was imaginarily located to the real media scenery and its possible functions were outlined and compared with the existing forms of media use.

Both the group interviewees and media experts were asked direct questions about mobile television. They deliberated the possible use, users and content of mobile television, images associated with mobile television, etc.

Visualising a device that does not actually exist is always somewhat difficult (cf. Leppänen & Marttila, 2000, 18). To make mobile television more concrete, a mobile television demo from the computer was shown to the interviewees. Mobile television and its possible place in the context of changing media environment is reported in Chapter 3.5.

3.2 Public space as a communication environment

In urban societies life is often concentrated in public places and urban space is becoming a common living room. In this process of urbanization the traditional division of space between public and private has become rather complex.

Media has contributed to this reorganization of public and private spheres. Much of private activity takes place in public places as it is possible to be connected almost everywhere with mobile phones. However, it is not only the media that complicates the concepts of public and private spaces. Traditionally, public space can be defined as publicly owned, where everyone has access. In the urban environment these spaces are becoming fewer: for example, many restaurants and cafeterias have private owners and can thus be called semi-public. The diversity of the concept has motivated some researchers to use terms like collective space or socially central space instead of traditional public space (Haarni, 1997, Nielsen, 2001).

In this study the concept of public is used quite simply to refer those concrete communication environments outside the home. The aim has been to gain an impression of peoples' communication behavior in the public environment.

There are specific ways of use typical of each medium. These are adapted to certain practical circumstances. People always use media in a certain context. Not only the device and the user but also the environment and the context affects the communication process (Nieminen, 1999, Lundby, 1993). Therefore, it can be expected that there are some aspects especially typical of public space communication. Being aware of those may be useful when developing mobile television.

3.2.1 Method - non-participant observation

Non-participant observation was the method at the beginning of the study. Researchers visited different public spaces and observed people's communication behavior. The approach can thus be defined as media-ethnographic, where contrived research arrangements are avoided and people are studied in their natural environment (e.g. Ridell, 1998, 114).

Observation as a method is not as random as it may sound. The course of the study was planned in advance and a research questionnaire with specific themes was drawn up for use in observation situations (Bodgewic, 1992, 58):

Table 1. The factors observed in the research.

Themes	**Features**	**Observations**
Space	Open-close, soundscape, articles, items, atmosphere	
Octants	Number, age, sex, special characteristics	
Media	Devices, duration of communication, possible functions	
Action	Connections between different activities	

Observations were made in 24 public spaces, such as public transportation, restaurants, shopping malls, sports events, streets, cafeterias, etc. Three different

cities were included: Helsinki and Tampere being the bigger ones and Huittinen representing a small town.

Observation is heavily dependent on the observer, and the question of subjectivity always emerges. For example, casting around for possible functions of media use is quite naturally interpretation based on situation analysis and common cultural knowledge. Yet such interpretations were included because they might offer some additional value in assessing the situation.

Imperceptible observation was easier on some occasions than on others. It was easy for a researcher to become part of the mass in a crowded waiting hall. In small places a researcher constantly looking over her shoulder attracted attention more easily and this may have sometimes affected people's behavior. However, the effect of observation on the studied situation is more likely to be stronger in the private sphere, where the method is quite traditionally used (Ridell, 1998, 114).

In addition to observation some brief interviews were made, in which cafeteria employees were asked their opinions on people's media use.

3.2.2 Media-laden public space

When observing the public sphere the image of medialization became evident: public space is very much media-laden, communication and media are everywhere. Media is accumulated in layers, one medium on top of the other: background music, papers, television, advertising, mobile phones - all compete with each other for people's attention.

Media and communication could be seen as public wallpaper. It borders people's life in the public sphere and is more often passively received than actively used (cf. Kivikuru, 2000). Sometimes the active use of media in the public sphere is that of blocking out noise or distractions with the help of the media. For example, the use of a Walkman was quite common in the Internet cafeterias. This gave the net user more privacy in the restless environment.

Seeking privacy seems to be one reason why people use media in public space. With newspapers or mobile phones one can create an invisible territory that tells

the other not to come too near or interrupt. Hence the reasons for peoples' media use are not necessarily very rational. The media is not always used to fulfill the need for information. Quite the opposite, the media may help people to cope with stressful public situations and fulfill emotional needs. In general, the role media plays in a person's everyday life, how it schedules and sets rhythms for it, may be more important than the actual content of the media (Nieminen, 1999, 36–37, Kiuru, 2000, 91, Pantzar, 1996, 10).

Seeking privacy was quite understandable in the observation situations, especially as the researchers considered the amount of noise in the public sphere to be surprisingly high. Obviously, in the normal everyday situations one does not pay so much attention to it. People are probably very indolent and take certain features like noise for granted. However, the environment affects the communication process and the restlessness nature of communication in the public sphere seemed not to be intense but *brief* and *momentary*; people read afternoon papers and free papers, which are easy to browse and can be left behind when leaving.

Figure 1. Europe House clothing store & web cafe, Tampere, 29.11.2001.

In so-called semi-public places, where the environment was more conducive to communication, different media services were often available. Media is one important service that makes public living rooms more alive. Television sets, Internet access, magazines, afternoon papers and background music can be found in ladies' gyms, restaurants, clothing stores and cafeterias. Enterprises can

complete their image with specific media services. For example, in the museum of modern art one does not find afternoon papers but art magazines, and in the youngsters' clothing store quite naturally the Music Television is on.

Mediatization is especially prominent in the urban environment. The trend can also be found in smaller towns like Huittinen, but it is not so obvious. One of the reasons could be the insignificance of the public meeting places and the lack of public transportation and waiting rooms in small towns. People are able to move from one place to another directly, in fewer stages, and the time spent hanging around is less.

3.2.3 Mobile nature of the public sphere

Observation took place mainly in November, and the cold season quite naturally affects the street scene and the way people behave. In summer mobile phones, as well as other media, might have been more noticeable on the streets.

Despite the season, it became very clear that public space is the greatest area of mobile communication. One could see people with mobile phones everywhere. Mobile phone sounds were typical of the public soundscape. During the last few years the use of mobile phones has become so common that the one person who used a traditional phone box during the observation period attracted more attention than those talking on their mobiles. In the Finnish media environment it has become a rarity if a person does not have a mobile phone, as people are used to making connections to each other easily.

Public mobile etiquette seems to allow the use of mobiles almost everywhere. Although there has been public discussion about irritating situations where mobile phones have caused disruption, very few seemed to pay any attention to other people's use of mobiles - at least in the negative way. People may be more used to mobiles, and some features, like keeping the phone on silent, are also being used more capably, which decreases the disruption. Sometimes it seemed that people with mobiles gained positive attention and the phone call was like a radio play for the benefit of those around the speaker. Mobiles seemed to create the illusion of a private phone box; people talked quite uninhibitedly about their personal matters on the phone and did not seem to care about the listeners.

Figure 2. Koskikeskus shopping mall 14.11.2001.

Most of the calls seemed to be fairly short, possibly updating on a user's location, which is one of the typical functions for mobiles (cf. Peteri, 2000, Kopomaa, 2000). People sent at least as many sms messages as they talked, which is quite natural in noisy public situations.

Besides mobile phones, other media suitable for short and temporary use were popular. Newspapers and magazines were read in the train and in places that were meant for reading and waiting around. Elsewhere, people mainly read afternoon and free papers, which do not demand so much concentration.

With regarding to television, it appeared in the public area more as a living painting than a watched medium. With certain exceptions, television in the public space is not watched very much. Very often, the device is located in a place that makes watching difficult and the programs are shown with the sound turned down. According to the employees, customers very rarely ask to have the channel changed or the volume turned up.

The exceptions are the wide screens in the pubs, where people get together to watch sports as a large audience. Besides the sports, some major news events, like September 11th, might make people stop to watch TV. One group of users who were actively watching television were children. Televisions showing children's channels or cartoons were typical of hamburger restaurants and department stores; television keeps children entertained and quiet while their parents do their shopping.

The function of the radio appeared to be that of a sound background, which merges with other noise. It is the basis for building other communication. Very often, radio or background music was played so quietly that active listening would have been impossible. As a medium, public space radio is beyond the customers' control. Mobile radios and Walkmans were used by young people in particular, and very often in a situation where the listener was also using some other media – such as the Internet.

During the observation period public Internet services were very intensively used and the employees in the Internet cafeterias reported that they had to limit the time and control teenagers' net playing. Young people and young adults seemed to be active users of the public net services.

Face-to-face communication in coincidental situations is not very common in the (Finnish) urban culture. People do not talk to strangers in real situations, although they are quite eager to talk anonymously in the Internet discussion forums. In the public sphere there are various chat services shown on wide screens in the restaurants. This made the researchers wonder if other anonymous discussion forums could be created for the public sphere. Could there be a call for chat screens in trains for example, would that generate discussion among passengers and what would that discussion be like?

A note should be made about the distinctive role of young people as octants in public space communication. Young people figured prominently in the Internet cafeterias. A collective use of devices was also typical of young people. They gathered together around the net and also used quite private devices as mobile phones in a collective way. The mobile etiquette appeared to be more loose among them. They used their mobiles freely and did not apologise if the phone disrupted the conversation.

3.3 Views on everyday media use

The observations made in the public space were beneficial at the next stage of the study, where the aim was to talk with people about how they feel about public space as a communication environment. People were asked how they use media in their everyday lives, what routines they have and what the functions of media are for them. Interviewees were also asked about their observations of other people's media behavior.

3.3.1 Method - group interviews

The study material was collected through

- group interviews (35 persons)
- enquiries in the authentic public environment (30 persons)
- the method of empathy-based stories (27 persons)

With three different methods the sample became quite large - a total of 92 people were involved. The age distribution was 12 to 78 years. The groups represented both sexes and different socio-economic classes.

The main method was group interviews, which were conducted in Tampere and Huittinen. Five different groups were convened and they had some common denominators.

The groups were

- Young people (16 to 17 years old) from Messukylä upper secondary school.
- People whose work calls for frequent traveling
- People living in a small town (Huittinen)
- Activity group at the night school
- Group consisting of families.

Group interviews have some advantages over normal theme interviews. The aim is to benefit from the group dynamics and create free, sometimes rambling, discussion about the subject of interest. Within the given themes, the conversationalists decide how different matters are stressed; it is also easier to

overcome the formality between the researcher and the interviewee (Sulkunen, 1990, 264).

In addition to interviews, the method of empathy-based stories was used. The idea is to provide writers with alternative frames for stories and ask them to use their imaginations and write an essay about the given theme (Eskola, 1997).

The exercises were done by the university students on the course called Sociological User Analysis, and the course leader, Virve Peteri, provided the material to be used in this study. The frame stories in this case considered mobile television and described two visions where the mobile television was either successful or unsuccessful. The students were asked to imagine the reasons behind the possible success or failure. Because the writing exercises only considered mobile television the results are discussed under mobile television, Chapter 3.5.

The italicised quotations in the text are translated comments from the interviewees. The original comments are in the footnotes.

3.3.2 Communication as a rational project

Most of the observations of public space were confirmed in the interviews. The idea of a mediatised public sphere that people more or less take for granted became evident. Although public space, with its various communication content, was expected to be noisy and restless, some of the interviewees criticised it and saw themselves as targets for ongoing communication, even comparing it to brainwashing.

> *"I used to take a bus to work and there were those bus drivers who played the radio. It was very annoying. It is like someone takes possession of my consciousness and it is no longer under my control. It pisses me off, anything may come from the radio, it is like violence.*

I think that the maintenance of autonomy is important when the environment sends so many messages one must receive." (man, 50+) [14]

Despite this quotation, interviewees usually considered the media services in the public sphere to be important. They stated the charitable perspectives and pointed out that the unemployed, students and displaced persons have communicational needs they cannot otherwise afford to fulfill. Although this idea of equality is true to some extent, it is also part of the larger rational discourse, which was quite typical of the interviewees when they talked about communication.

The meta-level talk about communication emphasised rationality, although the interviewees mentioned various not-so-rational reasons for their media use more or less straight away. In this rational context even the 16-year-olds supposed that they are "*those short ones*" who are playing with their mobiles, not they themselves.

It seems that the common moral code for right or wrong ways of communication is well known (cf. Alasuutari, 1991). It is appropriate to consume media actively. The whole capacity of the urban community rests on the assumption that people use media for updating information (Nieminen, 1999, 24–25). People should be information-intensive individuals. However, the active media user is also supposed to control his media use; addiction is not desirable. It may be because of this code that people also liked to estimate that their personal media use is below the average.

3.3.3 Different functions of media use

In the group interviews the public space media environment clearly took the form of mobile phones. The ordinary and intimate mobile brought about

[14] "Mä aikanaan kuljin bussilla työhön, niin siellä oli näitä radioita huudattavat kuljettajat. Musta se oli hirveen kiusallista. Joku muu ottaa mun tajuntani haltuunsa, että se ei olekaan mun hallussa. Se kyllä ottaa päähän, kun sieltä tulee mitä tahansa, se on mun mielestä väkivaltaa ihan. Mun mielestä sellanen autonomian säilyttäminen on tärkeetä, kun ympäristöstä tulee valtavasti viestejä, jotka on niinku otettava vastaan." (Mies, 50+)

discussion to such an extent that it was sometimes hard to steer the conversation to other themes. Although people mentioned the rational use of mobiles, it is evidently a device that arouses emotions. Television was a medium that also provoked conversation. This time the interviewees did not find other media, like the Internet, radio or papers, so interesting.

Previous assumptions on the functions of media use were pretty much confirmed in the group interviews. In the public sphere media are used as buffers of privacy. Despite the rational discourse, people's media use is not always quite rational. With mobile devices, private territories, so-called phone spaces, are created in the middle of the public sphere. They function as a filler of empty moments and, at least partly, help to cope with embarrassing situations. A mobile device is an important link between the public and private sectors, and is used quite often when moving between these spheres (cf. Kopomaa, 2002, 3–5).

> *"We were sitting at the same table as usual and he started to lay out his things closer to me. So the first thing I did was put my mobile there between us, as a sign not to come too close." (woman, 20+)*[15]

> *"Usually I use my mobile to tell someone where I am and when I'm coming, so it is rational. But I can't deny that sometimes you just call someone to chat for a while and after that you can keep on doing what you were doing. During the call you can have a private moment and then continue your work." (woman, 30+)*[16]

Certainly people also have many so-called rational functions for their mobiles. With mobiles they organise their schedules and update their location. In the era of mobile phones people do not make appointments for a precise time but check

[15] Me istuttiin tapamme mukaan saman pöydän ääressä ja se rupes levittelemään tavaroitaan lähemmäs mua. Niin eka mitä mä tein oli se, että mä siirsin kännykän siihen väliin ikäänkuin merkiks, että älä nyt tuu liian lähelle. (nainen, 20+)

[16] Useimmiten mä käytän kännykkää siksi, että kerron esimerkiksi missä oon ja millon tuun eli rationaalista se on etupäässä se käyttö. Mutta kieltämättä on semmosiakin tilanteita, jollon vaan soittaa jollekin tutulle, että voi hetken löpistä niitä näitä ja sitten taas voi jatkaa mitä oli tekemässä. Sillon saa vähän aikaa olla omissa jutuissa ja sitten taas jatkaa töitä. (nainen, 30+)

one another's locations with the mobile when the meeting approaches. Waiting without interim information is considered unnerving. Many of interviewees mentioned that the mobile phone is also a security factor for them.

Mobile media have changed people's expectations regarding attainability of information and people. Demand for real-time services and connections is growing.

> *"This here-and-now culture has affected me at least. I have to get information or make contact just when I want it or need it. I can't wait for a long time. If you have considered yourself as a pretty calm type, this characteristic is quite surprising. Technology has made me like this." (laughing) (woman, 30+)*[17]

Although the researchers in the observation situations did not notice that the use of mobiles irritated anyone, there was a lot of discussion about mobile etiquette in the group interviews and almost everyone had a story to tell about when the use of a mobile had been annoying. It is obvious that the threshold to show one's irritation in the public area is quite high. It seems that according to the general media etiquette everyone should know how and when to use different devices, but even so it is not desirable to control the others.

In the public space people also use media to enhance their own public image and identity. For example, Kopomaa compares the logos and sounds of a mobile to the tattoos on the skin, which brand their user (Kopomaa, 2002) People are aware of this identity-building when choosing which media they use in the public area (cf. Herkman, 2001, 69).

> *"Well, I would not buy 7-päivää magazine to read on the train, because I don't want to read it in public. If I buy it, I automatically look over my shoulder at the cash desk and hope*

[17] Kyllä tää kaikki tänne heti -kulttuuri vaikuttaa muhun ainakin, että mun pitää saada joku tieto tai yhteys heti kun mä haluan. Mä en jaksa odottaa sitä kauheen kauan. Kun on kokenut itsensä suhteellisen rauhalliseks tyypiks, niin huomaa tällasia hämmästyttäviä piirteitä itsessään. Ainakin joskus. Teknologia on tehnyt minusta tällaisen. (naurua) (nainen, 30+)

that there is no one sensible behind me. I wouldn't like them to think me an idiot."[18] *(woman, 20+)*

In the group interviews the private sphere as a communication environment was also discussed. Private space came about especially when people talked about their relation to television. Some of interviewees mentioned that they had watched television in public places because of the social aspect and beer, but primarily television was associated with domestic routine. It is part of the sound and picture environment of homes. People do not always watch television actively, but it is glanced at or listened to fleetingly in the everyday hustle and bustle at home.

"You are so used to it, you always turn it on at some point of the day. I always watch breakfast television. Actually, I doze on the couch at the same time and listen to it. It is so mind-numbing and familiar." (woman, 30+)[19]

That people discussed communication in the research interviews may create a biased picture of the importance of communication in people's everyday lives. In the end, communication is very much a matter of habit, not the focus of people's lives. Media schedules and regulates people's lives and people spend many hours consuming media. Still, a major part of this media use is passive.

"I used to have radio on all day, and Pertti, a journalist at the local radio station, says that it is a waste of effort for both of us. I don't listen to him, although I keep the radio on and he's trying to work for me. " (woman, 50+)[20]

[18] No en välttämättä ostas 7-päivää lehteä junalukemiseks. Koska en sitä viitsis julkisesti lukea. Joskus jos kaupan kassalla sen ostaa tulee sellanen olo, että toivottavasti ei oo järkeviä ihmisiä takana jonossa. Ettei anna ihan idiootti-kuvaa itsestään. (nainen, 20+)

[19] Siihen on niin tottunut, että sä aukaset aina jossain vaiheessa päivää telkkarin. Mäkin katson aina aamu-tv:tä ja oikeestaan torkun sohvalla samaan aikaan eli oikeemmin kuuntelen telkkaria. Se on niin tuttua ja turruttavaa. (nainen, 30+)

[20] Mulla on yleensä radio auki koko päivän ja Pertti (paikallisradion toimittaja) sanookin, että menee meidän molempien työ hukkaan, että kun sitä et kuuntele häntä, vaikka pidät radioo auki ja hän yrittää tehdä sulle töitä. (nainen 50+)

Recent statistics show that the amount of time people use media has increased annually. However, very few of the interviewees estimated that they could or would like to add to the time or money they spend on media at the moment. On the contrary, the interviewees expressed some opposite intentions: to limit or cut down on media use. In the changing media environment people considered the attainability enabled by mobile media as a demand and saw the real-time news flow as wearisome.

> *"You just have to make a choice and cruelly choose what to watch and when you want to be reachable, because you could fill the whole 24 hours with the media. I want to back away to silence from time to time."(woman, 40+)*[21]

3.4 Perspectives on the changing communication environment

Besides the public, the private sphere as a communication environment was also discussed in the group interviews. It was a question about people's experiences of the changing communication environment. This broader context was also typical in the third stage of the study. The aim was to contemplate the topical parts of the changing media field and the possible future scenarios with media experts.

At the moment there are several elements in the field of media that cause change and adjustment. Radio and television reception is being digitalised, development towards multiple media is going forward and the new economy euphoria is decreasing. It seems that future planning needs also tend to be based on a re-analysis of past and former predictions.

[21] "Sitä täytyy vaan tehdä valintoja ja valita raa'asti mitä seuraa ja mitä katsoo ja millon haluaa olla tavotettavissa. Koska kyllähän sillä sais täytettyä sen vuorokauden kokonaan. Mä haluan ainakin välillä vetäytyä ihan hiljasuuteen. " (nainen, 40+)

3.4.1 Method – Delphi

The material was collected by interviewing seven different media experts, who had various standpoints on the field of media.

The interviewees were
- a representative of a Finnish teleoperator company,
- an editor-in-chief of a news agency
- an editor-in-chief of an Internet newspaper and news agency
- an editor-in-chief of a newspaper
- a representative of a radio station
- a researcher in television user surveys.

The italicised quotations in the text are the views of the experts.

When organizing the interviews the delphi method was adapted. In the delphi method several experts are asked their views on the chosen matter and its possible future scenarios. Experts have so-called silent knowledge and this enables them to visualise the future better than laymen.

In the delphi method
- The expert group is built up
- The experts' opinions are elicited either in an interview or, for example, via email and they form their opinions individually.
- Surveys or interviews are carried out anonymously and the interviewees are given an opportunity to comment on the opinions of the others and also reconsider their own views.
- The experts may change their opinions several times.
- A summary or report is written.

(Turoff & Hiltz, 1996, www.metodix.com/metodi/delfoi)

Earlier, the aim of the delphi method was to produce unanimous opinion on the matter of interest, but this objective was more or less abandoned as defective. Nowadays the goal is to produce many argued opinions.

Although the expert interviewees in this study brought out many interesting points about the changing communication scenery, they were characterised by

a certain deliberation and wariness. The interviewees' visualization of the future was quite levelheaded. The hype around ITC and some earlier unsuccessful predictions may have affected the experts' willingness to prophesy. Some of them openly expressed their uncertainty:

> *"I can't guess anything.… You just have to see how it goes, because there are several courses available. Some of them are going to edge out the others … Usually the history does not go as it is planned, but quite the opposite or at least in a very unexpected way."* [22]

Some main themes from the interviews are presented in the following chapters.

3.4.2 Rediscovering the audience

When talking about important elements in the future media environment, the interviewees stressed the importance of the audience. The success of future media services and innovations depends on their ability to meet the actual needs of the audience. The interviewees harshly criticised the technology-oriented media development.

> *"Now we have to have some breathing space … the engineers and marketing men wisely created this schedule, which I also followed. But people did not live according to that schedule. So the changes have to be carried out according to the peoples' time. Anyhow, technology is secondary. It may limit the development, but it does not necessarily advance it. It does not matter how great a device you develop if it has no content."*[23]

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[22] "En mä osaa arvata mitään.--Pitää vaan katsoa miten tää menee, koska koko ajan on monta suuntaa tarjolla ja jotkut syrjäyttävät toiset.-- Yleensä historia ei mene niinku sitä suunnitellaan, vaan se menee joko täysin päinvastoin tai jollain odottamattomalla tavalla."

[23] "Nyt on paikallaan pitää hengähdystauko kun insinöörit ja markkinatmiehet olivat luoneet viisaasti ja minäkin niitä toistin tämmösen aikataulun millä toimitaan. Mutta ihminen ei elänyt sillä aikataululla. Täytyy olla ihmisten aikataulu millä näitä viedään läpi. --Tää tekniikka on aika toisarvoista kuitenkin. Se voi rajoittaa kehitystä, mutta se ei vie sitä välttämättä eteenpäin. Jos kehitetään vaikka kuinka hieno laite, mutta jos siinä ei oo sisältöjä, mitä merkitystä sillä laitteella on?"

This rediscovering the audience is also familiar from other countries. For example, the BBC has declared that the audience is nothing less than the reason for a company's existence. Besides quality content, future media enterprises must create a new, two-way relationship with their audience. The audience should not be considered an end-user but brought to the center of the creative production process (Tarkka, 2002, 2).

The concept of audience is not necessarily very clear. First of all, the audience is not a monolithic entity but a fragmented group of people with some common denominators and different needs. To identify those needs, the importance of the audience research in media production should be re-assessed. Audience experts should be included in the production groups and new, light methods for audience research should be developed.

Building up a new audience relationship also means changes for the journalistic culture and will challenge the familiar ways of journalistic work. The interviewees demanded a radical change, where the producers must take greater responsibility for the communication processes and the actual usability of their products.

> *"The old-fashioned mass communication means that you own the newspaper or television, or both, and you bundle all you have into them without caring if it is really reaching anyone. The radical change is that you care about the message reaching people and you care that the people are getting what they want. It is a greater responsibility for the whole communication process rather than just creating some excellent writing and dashing it into the paper."* [24]

[24] Vanhan mallinen joukkoviestintä on just sitä, että omistetaan lehti tai televisio tai näitä kaikkia ja tungetaan se kaikki mitä on, välittämättä juurikaan meneekö se perille jollekulle ihmiselle. Se on aika radikaali muutos välittäminen siitä, että meneekö tää oikeasti perille niille ihmisille ja saako ne ihmiset tästä kaiken mitä ne haluaa. Se on hirveen paljon suurempaa vastuunottamista siitä viestinnällisestä prosessista kuin vaan se, että mä oon tehnyt hienon kirjoitelman ja paiskannut sen tohon lehteen.

In practice, this greater responsibility means progress from a supply orientation towards demand-based production. As an example of this supply orientation, interviewees mentioned an enterprise with multiple media publishing aspirations and its goals of easily producing different versions of the same content for different platforms. In this sense the experts did not quite believe in a massive boosting of the general news content.

> *"… there is no news freak who would like to order national news. We cannot push news at them if they do not want it or are not interested in it. … but almost everyone is interested in something. And almost everyone will become interested if it is offered easily and cleverly."*[25]

The experts recommended a study of people's actual needs for information and preferred the customised combinations of mass and personal communication. The idea of the news chains was mentioned. People could choose subjects - for example, a certain court event - order news on that subject and thus follow the news process from the beginning to the end via different devices.

Although consideration for the audience was presented as a condition for successful future operations, one could also hear some indications of doubt associated with the audience-oriented approach. Because the success of the media innovation is hard to predict, possible demand is to be found in the product's context of use (cf. Pantzar, 2001, 99); some of the interviewees commented that people cannot need something if they are unaware of its existence.

> *"If you talk about new content, the old truth is that an audience cannot want something that they do not even know exists. So,*

[25] "Ei missään oo sellasta uutisfriikkiä, joka haluaisi tilata kotimaan uutiset. --Ei me voida väkisin tunkea niille kaikenmaailman uutisia, jota ne ei halua tai josta ne ei kiinnostuneita. Mutta kyllä lähes jokainen on kiinnostunut jostain. Ja lähes jokainen kiinnostuu jostain, jos se tarjotaan sille helposti ja fiksusti."

when developing new products you also have to forget about what the audience wants."[26]

The quotation is partly true, but it may also reflect the media producer's way of considering the audience rather as a block to the creative process than an asset to it (cf. Tarkka, 2002). A doubtful attitude towards audiences could also be heard when some of the interviewees associated the audience-oriented approach with the burgeoning entertainment content.

This controversy over the meaning of the audience suggests that building up a new audience relationship requires cognizant work. Traditionally, the audience has been very much an economic issue for the media industry; audience has been defined through consuming and receiving (e.g. Ridell, 1999). The interviewees also said that

"No longer can we afford to produce content ...without caring how needed or wanted the audience think they are."[27]

A broader perspective is required in order to achieve the future vision of the audience as an interlocutor. In general, media producers should learn to trust that the audience, as a discussant, could have relevant opinions.

3.4.3 Other future scenarios

The importance of the audience was a specific, dominant theme in the expert interviews.

The material for those interviews was quite large. In this chapter it is presented briefly through three possible future scenarios. These are

- the scenario of threats - avoidable future
- the scenario of desired future
- the scenario of anticipated future

[26] "Jos puhutaan uusista sisällöistä, niin se vanha totuus pitää paikkansa, että yleisö ei voi haluta jotain sellaista mitä se ei tiedä olemassa. Joten uusia tuotteita kehitettäessä täytyy myös unohtaa se mitä yleisö haluaa."

[27] "Meillä ei oo enää varaa tuottaa sisältöjä välittämättä siitä kuinka tarvittuina tai haluttuina yleisö niitä pitää."

The scenario of threats

Talk about the undesirable future media environment was more a far-reaching vision of a **privatised society** where people are no longer interested in common things.

> *"The real threat is the fact that there are people who do not care who is in the Finnish government or the city council - what is it? It is the horror scenario for society and communication is one part of it. People no longer care about common things, but have become tremendously private and are only interested in their own business. And those who are not able to look after themselves fall by the wayside."*[28]

Regarding communication in this scenario, the interviewees saw similarity of content as a threat. The significant trend towards entertainment content and the one-sidedness of the communication routes were seen as undesirable. The interviewees were concerned about the future of the Finnish Broadcasting Company YLE in the throes of its digitalization process. Maintaining YLE was considered equally important in order to ensure the variety of views.

> *"There's going to be a fight over information vs. entertainment and I'm afraid that entertainment is going to have even more space, especially among those who do not have such a firm contact with life. There are people who just rely on 7päivää magazine because it has TV news."* [29]

[28] "Oikeesti on uhka on se, että on ihmisiä, joille ei oo mitään merkitystä ketä Suomessa on hallituksessa tai niinku kaupunginvaltuusto - mikä se on. Se on yhteiskunnallinen kauhuskenaario, jossa viestintä on yhtenä osana, että yhteisillä asioilla ei oo ihmisille merkitystä, vaan ne muuttuu hirveän privaateiksi ja ovat kiinnostuneita vain omista asioistaan. Ja ne joista ei oo huolehtimaan omista asioistaan putoaa synkeästi kelkasta."

[29] "Siinä käydään tieto kontra viihde aikamoinen tappelu ja mä pahasti pelkään, että viihde saa sieltä enemmän osuutta, varsinkin niille ihmisille, joilla ei oo kiinteetä kontaktia elämään. On varmasti väestönosia, jotka sitten on 7-päivää lehden varassa. Että se on ainoo lehti joka tilataan, koska siinä on ne telkkaohjelmat."

In the scenario of threats, media development is still carried out from the technology and market perspectives. The digital gap between different people is becoming wider. The audience is not considered an interlocutor but is treated as an end-user; thus simplifying the concept of audience as an empty mantra to be used, in appropriate situations, in the mission statements of media enterprises.

The interviewees thought that there is a risk of underestimating people's actual needs, and this causes similarity of contents.

> *"We do not believe that people would read long stories. We imagine that everyone wants short pieces, and then we cry because they only want 160-character-long stories for their mobiles. Someone may only want this and that is ok. But how about those who would like to have well-thought-out essays and significant writing about important matters as well? Very few newspapers would consider those worth producing. I think people are underestimated."*[30]

The changing media environment itself was not seen as a threat to journalism or media content. New devices, working methods and information routes do not necessarily cause bad journalism. The question is what choices are made in the changing field of media.

> *"This choir, which is always afraid that the quality of journalism is about to collapse. Well, that collapsing does not have anything to do with devices, it depends on doers, those who do the journalism. I don't see any reason to be part of a choir that*

[30] "Ei esimerkiksi uskota, että ihmiset jaksaisivat lukea pitkiä juttuja. Että kuvitellaan että kaikki haluais lyhyitä silppuja ja voidaan sitten parkua, että ne haluaa vain 160 merkin juttuja kännykästä. Joku saattaa haluta pelkästään sellasia ja se on ihan okei. Mutta entäs sitten ne, jotka haluais oikeesti näitten täydennykseksi hyvin ajateltuja esseitä, merkittäviä kirjotuksia tärkeistä aiheista. Hirveen harva lehti katsoo tarpeelliseksi sellasta tuottaa. Musta ihmisiä myös aliarvioidaan."

assumes that the distribution channel itself would degrade the quality of journalism."[31]

The scenario of desired future

According to the experts, the vision of a desirable future was pretty much the opposite of the former vision of threats. A society in which communal values would flourish was considered the ideal. The interviewees wanted to believe in the revival of communality.

> *"It galls me that the environment people live in has became so commercial. Every good moment you have is associated with commercial events. Every channel is marketing this to you.… but I want to quote Niiniluoto (a renown Finnish philosopher), who talks about changing values in long cycles. Communal values like solidarity, equality or justice, and individual values like self-interest, selfishness and profit, take turns. According to Niiniluoto, the collective values of the sixties are coming back around 2010, when the egoistic world has sufficiently shown the bad sides of it."*[32]

The interviewees believed that media services that could promote communities and social capital would be successful in the future. They argued for the peer-to-peer sharing of content and thought that this would fundamentally change many sectors of media's structure.

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[31] "Tää kuoro, joka aina pelkää, että journalismin tai mediasisältöjen laatu heikkenee. Ei se välineistä johdu mitenkään se heikkeneminen, vaan niistä tekijöistä, jotka tekee sitä journalismia. Ei minusta ole mitään syytä lähteä siihen kuoroon, joka olettaa, että jakelutie sinänsä heikentäisi journalismin laatua."

[32] "Mua nyppii, että tää ihmisten elämänpiiri on tullut niin kaupalliseksi, että kaikki elämän hyvät hetket pyritään liittämään kaupallisiin tapahtumiin. Tätähän sulle työnnetään joka päivä joka helvetin tuutista. Mutta mä haluan siteerata Niiniluotoa, joka puhuu arvojen muutoksesta pitkinä sykleinä. Yhteisyyttä korostavat arvot; oikeudenmukaisuus, tasa-arvo, solidaarisuus ja yksilökeskeiset arvot: omaetu, itsekkyys ja voitto vuorottelevat. Niiniluodon mukaan 60-luvun kollektiivisten arvojen vuoro olisi tulla muotiin 2010-luvulla kun itsekkään kilpailun maailma on riittävästi päässyt osoittamaan huonoja puoliaan."

> *"If you think about how fast mobiles and sms messages have conquered the world, it is because they strengthen social relationships and are easy to use. Services that can feed peoples' social relations in an easy way are certain. There is a call for social capital in this country. I would like to see peer-to-peer kinds of pieces in the media. Stuff made for small audiences. Small-group communication."*[33]

In the scenario of desired future the role of the Finnish public service broadcasting company would be strong. Together with smaller media production companies, YLE could ensure the versatility of communication.

Many of the interviewees stressed the importance of media education among young people. In this scenario of hope people have learned to read the media critically, and have thus become subjects in the field of media.

> *"It would be valuable for everyone to be a subject, not just an object in this media environment. They would understand the routes of communication and could distinguish between facts and truths. A well-built world of communication supports this development."*[34]

The scenario of anticipated future

Somewhere in the middle of the desired and feared future visions is the scenario of anticipated future. The experts visualised this scenario at length. Some of the main characteristics are presented here.

[33] Jos ajatellaan kuinka nopeasti kännykkä ja tekstiviesti valtas maailman, niin sehän vahvistaa ihmisten sosiaalisia suhteita ja on yksinkertainen. Ne palvelut, jotka vahvistaa sosiaalisia suhteita ja yksinkertaisia on varmoja. Sosiaalisen pääoman tarve tässä yhteiskunnassa -- mielelläni näkisin tämmösiä tuttujen tekemiä juttuja tutuille. Pienelle piirille. Pienryhmäviestintää.

[34] Arvokasta on, että jokainen olisi mukana subjektina, ei vaan objektina tässä viestinnän kentässä. Ja ymmärtäisi nää viestintäverkot ja tiedon ja totuuden erot. Hyvin rakennettu viestintämaailma tukee tätä kehitystä.

The interviewees believed that in the short run the change in the media field would affect the way in which different media articulate their roles and functions. The new tempo of communication presumes a re-defining of news criteria. It is not only the newspapers who have to internalise their role as a source of background information; the same re-thinking of the concept of news is more or less necessary in television news production in this era of real-time communication. The interviewees thought that old news is still published amazingly often; the media should re-consider their roles in order to fare better in the future media environment.

> *"Earlier, people heard news on the radio during the daytime, watched it on television in the evening and then read some deeper information in the next morning's newspaper. Now this process is about to change. People get first-hand information from the Internet at their workplaces and then they want a more in-depth examination on the television in the evening. And the next morning they expect to get more from the newspaper. I think you still see this attitude, that news is what a person has done or said, nothing more."*[35]

Steps towards **multiple media operations** are being taken and services in which many media types and distribution channels are put to use are under development. The process takes time, but the experts forecast that in five years the so-called spaded Internet papers will be history. These adjustments will affect the way journalism is performed and change people's job descriptions.

A concentration of media production was assumed to continue. Besides the two large concerns in Finland, Alma Media and Sanoma WSOY, small and medium-size enterprises could flourish. Their strength is in their local perspectives.

[35] "Aikaisemmin ihmiset on kuullut uutisen ehkä radiosta päivällä, katsoneet sen illalla tv:n iltauutisista ja sitten vielä lukeneet siitä seuraavana päivänä lehdestä syvempää tietoa. Nyt prosessi on kääntymässä, että ihmiset kuulee ekat tiedot tässä netistä omassa työpaikassaan ja sillon televisiolta vaaditaan illalla jo syvempää paneutumista ja näkökulmia tähän asiaan.-- Ja varsinkaan se ei enää riitä huomisaamun sanomalehdelle. Musta kummallisen usein näkee sitä asennetta, että uutinen on yhä se mitä joku sano tai teki, ei muuta."

The interviewees stated the importance of **synergy** of the media concerns and pointed out that it has not been exploited as well as it could have been.

Although the interviewees were against technological determinism, some overtones of it could be heard when they talked about the future visions. For example, the **digitalization** of radio and television reception was considered a natural conclusion to the technical development.

> *”I think there is a unanimous opinion that it is going to happen, because, technologically, digital television is a natural corollary to all that has happened so far. It is an indisputable technological conclusion.”*[36]

The only uncertain thing in digitalization seemed to be the timetable. Although earlier predictions over-estimated the rate of digital television success, the interviewees considered its breakthrough to be coming in a few years’ time. They commented that short-term predictions usually fail because they tend to over-estimate the change, while long-term change is often under-estimated.

According to the interviewees, the characteristics of different media devices will not change radically in the short run. For example, the motives for television viewing will remain the same and the couch potato will flourish for a long time, despite possible future programs that support interaction. Cultural ways of using devices change slowly (cf. Näränen, 2003). In the long run changes do come about, as one can see when studying the history of radio and television: at first television edged out radio and captured its place as the social centre of the home, but nowadays television is assuming the position of radio as a device to be listened to.

The experts believed that different mobile services and the Internet are going to be successful and their magnitude will grow in the future media environment. Media **convergence** was seen to be part of the anticipated long-term development. However, the idea of one meta-media did not get support.

[36] Tästä ollaan yksimielisiä, että se tulee joskus, koska teknologisesti ajatelleen digi-tv on luonteva jatko kaikelle sille mitä on tapahtunut. Se on vääjäämätön teknologinen loppupäätelmä tähän.

Nowadays media convergence in people's everyday lives is more of a growing **divergence**: user interfaces, devices and services are diverging rather than converging (cf. Herkman, 2003). Some of the interviewees preferred the idea of divergence to convergence in the future too.

> *I hope that terminal diversity will endure. People could search for information as sound, data, moving image, etc. And I take the view that the development is supporting this vision. I do not see television as a multi terminal in homes. I think the PC can be television, but the television in the PC is subordinate to the use of computer. But I don't believe in a television with a small Netscape page in one corner of the screen.*[37]

The diversity of the devices and services will make communication routes more complex and audiences more fragmented. The interviewees believed that the trend of the **fragmentation** or segmentation of mass audiences and mass communication is going to continue (cf. Dominick, 2002, 25). In this less mass-oriented field of media so-called special interest news or content will probably be more popular than traditional general interest news or content. The interviewees also subscribed to the importance of personalised or customised content by which people are engaged to certain services.

Despite the present trend of individuality, experts found the services that could support social capital appealing for the future. Possible success stories will more probably be found among the services targeted at different small audiences or groups. This presupposes better identification of audiences and the development of new, light methods of user study.

[37] Mä toivoisin että meillä säilyisi päätelaitediversiteetti. Että ihmiset voisivat etsiä tietoa äänenä, datana, liikkuvana kuvana jne. Ja musta tähän suuntaan kehitys on menossakin. En näe televisiota minään kodin multipäätteenä. Musta pc voi olla televisio, mutta tv pc:ssä on alisteinen pc:n käytölle. Mutta en usko siihen, että televisiossa olis pieni netscapen sivu kulmassa.

3.5 Placing mobile television in the context

What could all this mean for mobile television? The concept of mobile television as a future innovation was a central theme and carried along all the way. The changing media environment, with all its features, is the context in which mobile television would have to position itself.

During the observation period mobile television was imaginarily placed in the public media scene. As mentioned earlier, public space as a communication environment was full of communication and media services, it was noisy and restless, and communication was momentary and not sustained. In observing this environment it was quite hard to localise any vacant *media hole* that mobile television could automatically fill. However, it has to be remembered that as an existent hole in the media field does not necessarily mean useful potential, the lack of such a hole does not necessarily mean that there could not be potential in certain social situations. At least mobile television could be used with the same motives as other public space media are used: as a time-killer, filler of the empty moments, as a buffer for privacy, etc.

In the public space mobile television would compete with the afternoon papers and other mobile devices. Public space television is not a very intensively used medium, so in this sense mobile television could find its place as a supplier of television content, especially when some major news events occur. Public space, with all its features, sets a requirement for mobile television. As the environment of use is not ideal, the device should be adjustable with regard to its features (screen, contrasts, volume, etc.).

The public communication environment can be illustrated with the following figure. Mobile television is located in different sectors defined by space and mode of use.

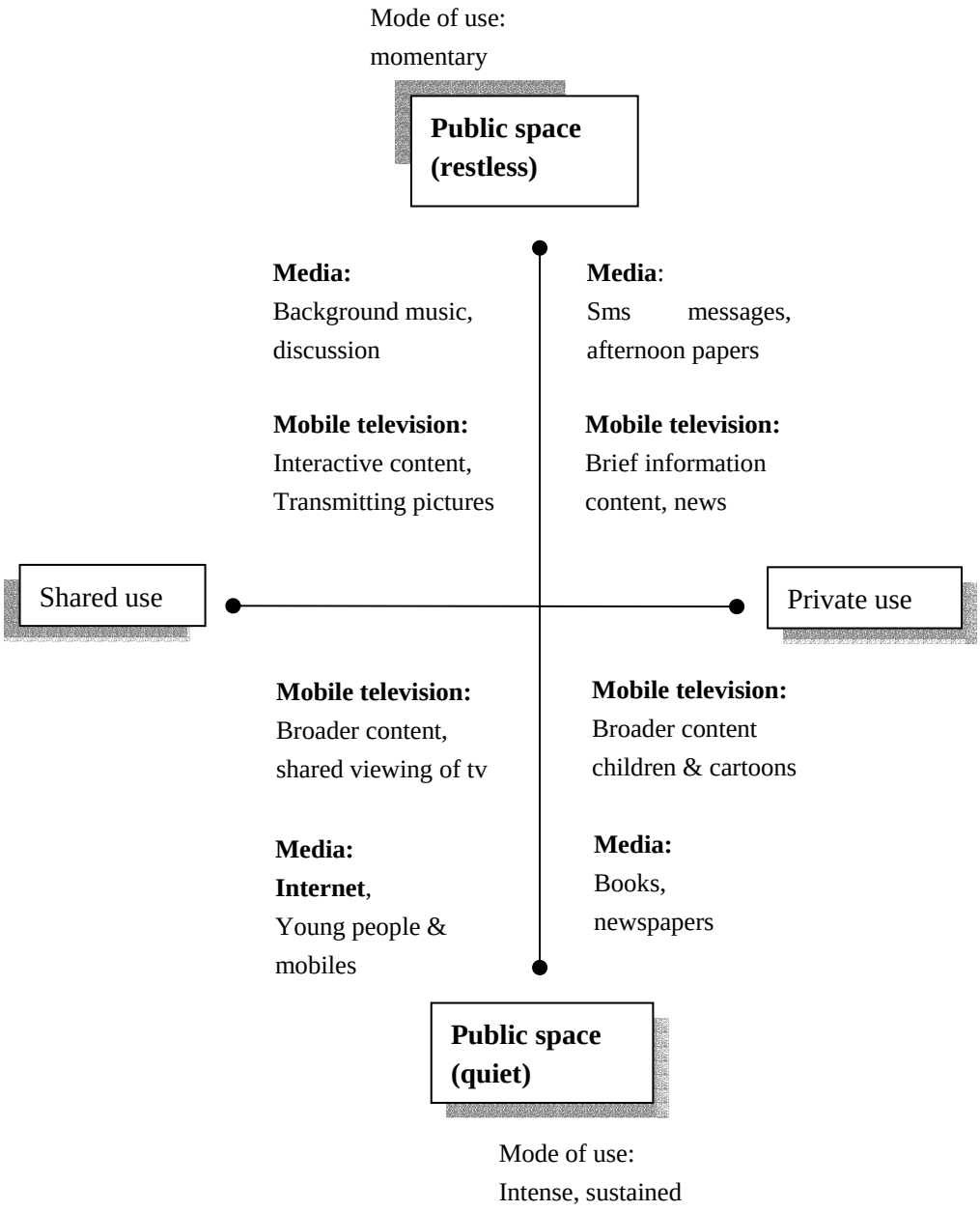

Figure 3. Mobile television and the public space communication environment.

3.5.1 Image of the device: evolution of television?

Both the group interviewees and the experts deliberated on how mobile television could blend in with the present communication scene and how it could be used in everyday situations. The opinions of all groups were quite cautious.

In the *group interviews* the common discourse centered on rationality. Part of that rationality seemed to be a critical stance on technical media innovations. Mobile television was visualised by comparing it with other technical innovations; in this context, disappointments with wap phones and other mobile communication devices affected the way mobile television was considered. Above all, its technical functionality was questioned. People are not necessarily eager to visualise the future if they find the present communication services unsatisfactory.(cf. Peteri, 2000, 75).

During the interviews in the spring of 2002, peoples' attitudes towards digital television were still quite skeptical, which also shaped their opinions of digital mobile television. People were suspicious and they felt that they were being urged to buy something they did not actually need (cf. Leppänen & Marttila, 2000, 18). As has by now emerged, launching digital television by stating interaction and new services has not been the best possible marketing strategy. The greater the change or discontinuity a new device is about to bring, the more likely it is to be opposed. This was also pointed out in the experts' interviews.

> *"The essence of this launch was that it was stressed to people how marvelous a device digital television was going to be. In people's minds this means 'bloody complex and horrible to use'. And naturally people are against it. Of course. The secret of television's triumphal march is the fact that it may be the easiest medium on earth. And now it's marketed as a medium that requires activity. I think it was the absolutely wrong way to market it."*[38]

[38] Koko tän lanseerauksen ydin oli se, että ihmisille korostettiin, että kuinka hieno ja monipuolinen laite digi-tv on ja mitä kaikkea se tulee tarjoamaan. Kansan kielellä tää tarkottaa saatanan monimutkainen, vitunmoinen härdelli ja kauhee opettelu. Ja ihmiset ovat näin luontaisesti vastaan. Totta kai. Television voittokulun salaisuus on ollut se, että se on ehkä maailman helpoin media. Ja nyt yritetään markkinoida sitä mediana, joka vaatii aktiivisuutta. Se on mun mielestä täysin väärää markkinointia.

The interviewees visualised mobile television quite realistically by deliberating on the price of a device and how much actually using it would cost them. Operating expenses were among the first subjects discussed concerning mobile TV. In these interviews people figured that a steady price per month might be better than a pay-per-view system.

Young peoples' attitudes towards mobile television were somewhat more open and positive than adults' opinions. In the group consisting of families, the parents criticised mediatisation and this brought about ideas where mobile television was also seen as a threat to authentic existence. New devices are very easily seen as unreal experiences and their use as being beyond control.

> *"I think not in a million years. When I'm outside I read a magazine or a book or something. Or curse the neighbors or spy on them. I wouldn't buy it even to make my neighbors envious. Watching it would be like activity for restless people and escaping from reality. If people don't want to hear their own thoughts for a second …." (woman, 30+)*[39]

Despite this critical attitude, interviewees were also realistic. Many of them thought it quite possible that they could still have mobile televisions in the future. They mentioned the breakthrough of sms messages, which was not predicted, and the service is now part of people's everyday lives. It has to be noted that people's intentions do not always correspond to their actual behavior.

In the discussion groups mobile television was compared with conventional television. However, in the *empathy-based stories* the students wrote about mobile television as being more like a meta-media than ordinary television. Sometimes this visualization was quite self-ironic:

[39] Mä ajattelen, että ei missään nimessä. Kun mä oon ulkona, niin mä luen lehtee tai kirjaa. Tai kiroan naapureita tai kyttään niitä. En hankkis edes siksi, että naapurit näkis. Toi olis vaan, oisko se jotenkin levottomien ihmisten puuhastelua ja pakenemista todellisuudesta. Ei haluta hetkeekään kuulla omia ajatuksia." (nainen, 30+)

> *"You don't want to carry both the television and the mobile with you. If I had that kind of device with me all the time, I would like it to contain television, the Internet, phone, calendar, iron, you could toast bread with it." (boy, 20-)*[40]

In the *expert interviews* attitudes towards mobile television were also slightly dubious. Interviewees found it hard to define the role or significance of mobile television in the present media environment. Still, mobile television was considered a natural part of the evolution of television. The expert interviewees visualised mobile television as part of the future integrated media environment. In that context mobile television would also be more than television.

> *"Mobile devices are an essential part of the media chain. Neither entertainment nor the moving image are fundamental, though they are commercial. I do not think this device would be just television, but something more diverse. Ultimately, television is quite a silly device."* [41]

3.5.2 Use and users of mobile television

The interviewees' ideas of who could be the possible users of mobile television and in what situations it could be used were quite similar to those of the researcher group on this project. Mobile television was expected to be used in public places and the first notion of its possible user was a person whose work calls for traveling.

Thus possible environments of use were airports, vehicles, hotels, places of work, waiting halls, etc. With mobile television these places could gain a more

[40] Ei sitä halua kantaa sekä televisiota että kännykkää mukanaan. Siinä vaiheessa jos minulla olisi mukanani tuon kokoinen laite koko ajan, toivoisin, että siinä olisi telkkari, internet, puhelin, kalenteri, silitysrauta, sillä voisi paahtaa leipää.(poika,20-)

[41] Paikasta toiseen liikuteltava pääte on välttämätön osa mediaketjua. Laitteen viihteellisyys ja edes liikkuva kuva ei ole välttämätöntä, joskin kaupallista. En usko, että laite on tv, vaan jotain muuta moninaisempaa. Tv on loppujen lopuksi aika tyhmä päätelaite.

functional meaning. The interviewees hoped that the device would also be usable abroad.

Although many public places offer television services, freedom of choice, private viewing time and independence from the set tv schedules were considered the benefits of mobile television. Interaction and communication with communities elsewhere are the key factors for mobile communication in the public sphere. The interviewees hoped that mobile television would also contain interactive elements.

In the group interviews the private sphere was also brought out as a possible environment of use for mobile television. Watching television has changed towards a more individual way of use and households have bought several small screens. Besides the main television in the living room, there may be TVs in children's rooms, garages, bedrooms, utility rooms, etc. In the private sphere mobile television could be placed in all of those places. Mobile television could even be carried to bathrooms, which was mentioned with delight.

> *"I always read newspapers in the toilet, so why couldn't I watch television. Even I wouldn't dare to fix up a solid television there." (man, 30+)*[42]

Besides the places inside the home, other free-time spaces like gardens, summer cottages, boats, caravans, etc., were also mentioned. Families with children were tempted by the idea of a peaceful journey to the summer cottage.

> *"I didn't think that, well in that case I would even have an advertisement slogan ready: would you like to change a hellish four-hour-long trip to your summer cottage in a way that your children could remember it with warmth." (woman, 30+)*[43]

[42] Mä luen aina vessassa lehtiä, joten miksen mä siellä voisi telkkariakin katsoa. Vaikkakaan en varmaan kiinteetä telkkaria kehtais vessaan hommata. (mies, 30+)

[43] Tota en ajatellutkaan, no siinä tapauksesa. Mullahan olis mainoslausekin jo valmiina: haluatko tehdä neljän tunnin helvetillisestä mökkimatkasta sellaisen, jota lapsesi muistavat lämmöllä." (nainen, 30+)

In the expert interviews mobile television was not envisaged for use in private areas.

They believed that the use of mobile television could be localised when examining the present mobile culture of the public sphere. Thus mobile television was considered to be part of the future mobile communication culture.

Although the expert interviewees did not make a direct association between mobile television and private environment of use, they raised some aspects that brought about the idea of mobile television as a device working together with the main television in homes. The experts said that there is a certain collision between the interactive services of new digital television and social ways of using TV:

> *"Television is an easy way to be together and experience things together. If I were watching Champion League together with my daughter, all hell would break loose if I suddenly took the menu of Veikkaus and started to bet on whether the striker is going to score. Just using text television causes the same. Because if you watch TV, you watch it, you don't play with it."*[44]

The former quotation raises the idea of a call for a mobile television-type of user terminal to practice the supplementary services of digital television without interrupting the television viewing. In addition, people in the group interviews hoped that mobile television could function as a decoder to order programs to be watched later on the bigger screen.

3.5.3 The possible content of mobile television

Both in the empathy-based story writing and in the group interviews people discussed mobile television as a technical innovation and deliberated its

[44] Televisio on luonteva tapa olla yhdessä ja kokea yhdessä asioita. Jos mä katson mestareiden liigan ottelua tyttäreni kanssa ja yht'äkkiä ottaisin Veikkauksen valikon ja lähtisin veikkaan tekeekö hyökkääjä maalin, niin tytär nostas helvetin möykän. Pelkästään jos sä käyt tekstitv:ssä, se saa täydellisen möykän aikaiseksi, koska sitä katsotaan tv:tä eikä pelleillä sen kanssa.

technical functionality more than they talked about its possible content. It was partly expected because the writing students were particularly technically oriented.

When discussing the content, people usually compared mobile television with conventional television. They believed that it could have an advantageous role if some major news events, like September 11th, the sinking of the Estonia or the Lahti sports doping scandal, occurred and peoples' need for real-time news exploded. In addition to news, the interviewees mentioned sports and entertainment content like TV series to be watched on mobile TV. A mobile television demo shown on the computer may have affected this a little as there were South Park and Ally McBeal icons on the screen.

However, the interviewees were quite skeptical and wondered how convenient watching the small screen would be. The small screen is not very inviting if the content has plenty of special effects or small details. The expert interviewees stated that specific forms of visual narration should be developed for mobile devices.

> *"It depends on what services are brought to that television, television programs or something else. Specific services designed for this device could have better markets. Mobile television should have its own visual expression or some supertext television kind of service. One practical view is that most of the Finnish television programs are foreign and subtitled, and the text may be difficult to read on the small screen. In this sense talking heads and news could come on better. That is, those programs where the picture is not so important."*[45]

[45] Se riippuu mitä palveluita siihen telkkariin tuotaisiin. Olisko ne televisio-ohjelmia vai jotakin muuta. Sellasilla palveluilla, jotka on kehitetty just tätä laitetta varten voi olla paremmat markkinat. --Mobiilitelevisioon tulisi kehittää ihan oma kuvailmaisunsa tai jokin superteksti-tv -hässäkkä. Yksi käytännöllinen kuvakulma: suurin osa suomalaisesta tv-ohjelmistosta on ulkomaista tekstitettyä ohjelmistoa - tekstiä voi olla hankala lukea pienestä ruudusta. Puhuvat päät ja uutiset toimisivat näin ajatellen parhaiten. Eli ohjelmisto, jossa jo nyt on kuvalla pieni rooli.

The visual genre for mobile devices is under development. It may have some common features like non-narration, simplicity and parody. The contents could be reminiscent of narrow-cast productions on the Internet (e.g. videos of car-crashing) or those grotesque films from the beginning of the 20th century depicting isolated events (Järvinen, 2002).

Very few of the interviewees evidenced new content types. Those who did, suggested some simple forms of reality TV, such as filming people in the restaurant line or some extreme exercises. In their opinion mobile television could offer communally produced narrow-cast content. Those ideas included the features of the digital age, like new communality, participation, experience and variation. In the empathy-based writing mobile television was envisaged as follows:

> *"Tampere has participated in the mobile television project by putting monitoring cameras into public places. On television you can easily see the whole of Tampere, Hämeenkatu, at the railway station, etc. The original plan for mobile television was to offer information about traffic jams and different happenings in the city."*[46] *(woman, 20+)*

The on-demand and TV-Anytime principles were seen as appealing. It may be that in the future tv schedules are going to go away, except for live events (cf. Carey, 2002) Despite this important on-demand feature, mobile television was considered more as a device that could offer special and extra content than conventional television with normal programs. As an example of these extra services one interviewee visualised a situation in which a viewer could be at a sports event, watch a football match on the field and then, at the same time, zoom in on a certain player who could be seen on the mobile television.

The interviewees regarded different games as the possible high-fliers at the beginning of mobile television production. They argued that people who are

[46] Tampere on osallistunut mobiilitelevisio hankkeeseen laittamalla valvontakamerat julkisille paikoille. Televisiosta näkee helposti tampereen kokoisen kaupungin; keskustorin, rautatieaseman. Alkuperäisenä ajatuksenahan mobiili-tv:llä oli tuoda tietoa mahdollisista ruuhkista ja paikkojen tapahtumista. (nainen 20+)

used to playing are also used to paying, thus chargeable content might be most easily accepted by this group. The interviewees stated that games should be developed carefully together with the programs. When talking about games, the idea of a consolidated user terminal for digital television emerged again.

When developing new television content it is important to consider the ways in which services are used and the contexts in which they are used. A television viewer can adopt different levels of activity when watching television. Future television programs should be made so that they could be approached from various perspectives, both participatory and less actively. To support individual and social ways of using television, some content could be decentralised to different terminal equipment (Ermi & Sotamaa, 2002).

3.6 Conclusions

The aim of this chapter was to outline the changes in the media environment that would be the context of use for mobile television. Multiple media production, digitalization, convergence vs. divergence of devices, concentration of media enterprises, privatization of society - all these change the field of media and the job descriptions of journalists and other professionals. Economic life greatly affects this development, which can be seen especially in cash-strapped content production at the moment. The experts interviewed were cautious in their calculations, because the future of the media environment is the sum of many elements and hard to predict.

Changes in the field of media are not as dramatic in people's everyday lives. The characteristics of different media change fairly slowly and the use of media is quite routine. Thus the importance of media for people is exaggerated. Adopting new devices is a long process. It is a social process where people self-reflectively observe other peoples' media use and then change their behavior in relation to that of others. Rapid changes may happen, but only if people are offered a service which answers an evident need.

According to the group interviewees, deliberation is considered a healthy way to react when it comes to new technical innovations. After the hype of new media, peoples' attitudes are circumspect and careful. This should be remembered when marketing new devices. Expectations that are not met may have long-term effects.

A big gap between vision and reality discourages advertisers, audiences and product developers. When launching new devices it may be wise to use the interfaces of the old services rather than question the old ways of using media all at once.

Knowing the audience is important in product development. To understand the audience one must take account of the whole social context, which gives an inkling of the shared cultural interests and peoples' needs for media. Information about peoples' media environments, models of their schedules, lifestyles and routines is needed. People should be taken into the product development and new, light methods of user surveys should be developed (cf. McQuail, 1997).

Outlining this context of a changing media field generated various ideas that could be useful for mobile television. Many of the researchers' original ideas were affirmed in the interviews regarding the use and users of mobile TV. The interviewees considered mobile television a natural part of the public space media environment - although the restless public sphere is not ideal and imposes requirements for the adaptability of mobile television. Mobile television was thus seen to be part of the future mobile media environment.

However, when observing public space it was quite hard to find a vacant media hole that mobile television could fill. It would compete with the other public space media to kill time. Interaction is an important element of public sphere communication. Interviewees expected mobile television to contain interactive features. Thus it would be more than conventional television.

In the group interviews mobile television was also placed in the private area. In the home environment it could replace the so-called second televisions in different locations. As digital television becomes more common, mobile television could also be some sort of a terminal device and be used compatibly with the home's main television.

The interviewees pointed out that there is a call for special content to be developed for mobile media, where the features of devices and visual narration match. The interviewees believed that the social narrow-cast content and special interest news would be successful in the future media environment. They also regarded mobile television as a device that could offer extra content and archive material, rather than a device that would show mainstream television programs.

4. Design of the prototype

4.1 The human centered-process

Human-Centered Design was applied in designing the prototype used in the trials. It is a design approach where the product development process focuses on users from the very beginning, and throughout the development process. Examples of such a design approach are use-case scenarios, paper prototypes and computer-based prototypes. By adopting the Human-Centered Design approach we can ensure that we will develop useful and easy-to-use products.

Usability is a measure of the quality of a system from the user's point of view. Usability defines whether the system solves the right problems from the user's point of view (i.e. includes the right functions) and whether the system solves the problems in the right way (i.e. is easy to use). Usability design includes learning to know the users and understanding their needs so that the user's point of view is properly taken into account in the design (Kaasinen et al. 2000).

Usability has multiple components (Nielsen, 1993) and is defined by the International Organization for Standardization (ISO) in ISO 9241-11:1998 as "The effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in particular environments".

effectiveness	defines whether the system includes the right features from the user’s point of view
efficiency	defines how quick and easy the system is from the user’s point of view
satisfaction	defines that the system should be pleasant to use, so that the users are subjectively satisfied when using it - i.e. they like it.

It is important that the Human-Centered Design approach is adopted from the very beginning of the design process. The earlier a new or refined user requirement is identified in the design process, the easier it is to take it into account in the design.

According to the International Organization for Standardization (ISO) standard, ISO 13407:1999 (Human-Centered Design Processes for Interactive Systems), the incorporation of a human-centered approach is characterised by:

the active involvement of users and a clear understanding of user and task requirements
an appropriate allocation of functions between users and technology
the iteration of design solutions in multidisciplinary design

ISO standard ISO 13407:1999, Human-Centered Design processes for interactive systems, provides guidance on Human-Centered Design activities throughout the life-cycle of computer-based interactive systems. The standard is targeted at people who manage design processes. According to ISO 13407:1999, Human-Centered Design consists of four different types of design activities:

understanding and specifying the context of use
specifying the user and organisational requirements
producing design solutions
evaluating design against requirements.

These design activities are carried out iteratively - i.e. there is likely to be more than one pass through the cycle as the design develops. This is because the process of producing design solutions and evaluating them with users tends to identify new requirements or reveal the need for more information to be collected about the context of use.

The Human-Centered Design activities in the design process included:

1. Mobile television state of the art
2. Analysis of the current products
3. Consumer interviews
4. Expert interviews
5. Brainstorming sessions
6. Definition of the initial user requirements
7. Scenarios/User stories
8. Visualisations
9. Mobile television mock-up

10. User specifications
11. Prototype implementation
12. Field trials

The results of the process can be found in this chapter, although not all of the results are reported here. User requirements were not fixed at the beginning of the project; rather, the project was prepared to refine user requirements throughout the design process. New ideas during the development were registered even if the project could not implement them at that moment.

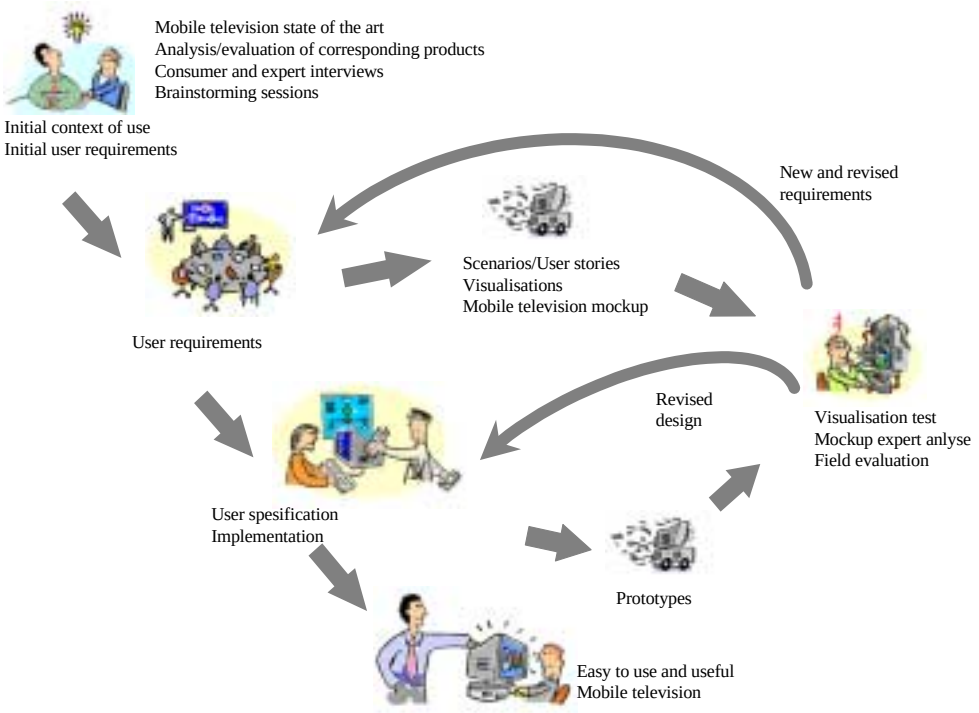

Figure 4. The Human-Centered design process used in the project.

4.2 Consumer interviews

The purpose of the consumer interviews was to ascertain people's attitudes and first impressions towards mobile digital television: how they would use it and the kind of content they would be interested in. Interviewees were also asked what kind of mobile device would be most appropriate for mobile television. Hints were also collected about how to conduct interviews in the field, e.g. at the railway station, on the train, etc.

Methods

The interview method was chosen because the interviewees were not previously familiar with mobile digital television. During the interviews the interviewees were able to ask questions and gain familiarity with the equipment. The interview themes were:

1. device
2. content of mobile digital television
3. operating situations and users' needs and expectations

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


Figures 5 and 6. Using the portable computer and PDA on the train and at the railway station.

First, all interviewees filled in a background information form (Appendix A). After that the interviewee gained familiarity with the devices (computer and PDA) and was interviewed. The interviews were recorded. Each interview took about 15 minutes. After the interviews the recorded material was transcribed onto paper in order to analyse the material.

The equipment and the software

The interviewees used two devices to look at television programs during the interviews. One was a PDA, the Compaq iPAQ pocket, and the other was a portable computer, Fujitsu Siemens Lifebook B-2175/128 MB.

TV programs were digitised from the air and stored on the portable computer's hard disc and the memory of the PDA. Windows Media Player was used to watch the programs. On-the-air TV broadcast was not used.

The interviewees

A total of 29 interviews were held. Of the interviewed people, 16 were women and 13 were men. Most of the interviewed people reported having several

different hobbies. The most popular hobby was sports (23/29 exercised). Music and reading were the second most popular hobbies. A couple mentioned that studying is their hobby and a couple had a special interest in technology. The age distribution was 10–72 years (See appendix B, Pictures 1 and 2). The people interviewed were selected in the places the interviews were held. The interviewers just went up and asked people to participate in the interview.

Results

First impressions and opinions on the devices

First impressions

After becoming 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. Among the seven who reacted negatively were people from all ages (10–72 years). Two of them said that the equipment was unnecessary, two said that they could not see anything on the screen (these people were interviewed in a train where there were a lot 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 needed to be more like normal television. By this he meant that changing channels and adjusting the sound and color should be as easy as it is in traditional television.

> *"I would take to 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 had some spare time I could check the results and so on."* [47]
>
> Woman age 38

[47] "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."

Weight and size of the device

Most of the interviewees thought the equipment 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 shouldn't be more lightweight because then it might easily get lost. A recommendation for putting non-slip material on the bottom of the device also came up.

> *"If I would use this (PC) I would like to be sitting down, e.g. in a train. I would also like to have headphones. The smaller one (PDA) I could use anywhere."* [48]
>
> Woman age 26

Of the interviewed people, 18 said they would carry a mobile television the size of the portable computer around with them. The main reason for this was that they felt they could use the portable computer for other purposes too. 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 wouldn't carry either of the two devices around - these interviewees were the two oldest ones, a man and a woman.

> *"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."* [49]
>
> Man age 28

Finally, 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. In the train, six people (6/7) chose the smaller device. In the secondary school, five people (5/6) chose the bigger device, and all the interviewees (3) in the adult education center chose the bigger device (See appendix C).

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[48] "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."

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

Should the mobile phone and the television be integrated together?

The interviewees were asked if the mobile phone should be integrated with the television device. Of the interviewed people, 14 said it should be integrated and 13 said it shouldn't; two interviewees had no opinion on this.

> *"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."* [50]
>
> Woman age 16

> *"I don't want to carry many different devices around."*[51]
>
> Woman age 27

Content of mobile digital television

The interviewees were asked to compare the watching of mobile television with normal television. The quality of the picture was experienced as poor, and this was the main difference (besides the size of the screen) between the mobile television and the normal television; the youngest four interviewees (10 years old) particularly commented on the difference in the quality of the picture.

The interviewed people said that the most suitable programs for a **small screen** (PDA) are news and weather, as they are both programs that you mainly listen to and don't necessarily need to see in detail. The interviewees described programs suitable for a small mobile device as follows:

> *" Things other than visual feedback is important."* [52]
>
> Woman age 27

> *"The programs need to be the kind that you just quickly check some facts".* [53]
>
> Woman age 47

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

[51] "Yes, ei liikaa eri vehkeitä."

[52] "Sellaset, joissa painottuu muut tekijät kuin visuaalisuus."

[53] "Tilapäisiä, esimerkiksi säätila. Semmonen minkä sä vaan katsot ja toteat."

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

> *"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."* [54]
>
> Woman age 38

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

> *"It would be boring to watch movies alone from the card deck sized screen."* [55]
>
> Man age 16

Operating situation and users' needs and expectations

The shortness and plenitude of information was typical of programs people would watch on mobile television. The most common choice of program in every interview was news, although other programs related to current affairs were also mentioned; people interviewed on trains in particular mentioned news.

Some interviewees also gave examples of possible operating situations:

> *"I usually wait for my children a lot. They study in the conservatoire and I spend hours and hours in the cafeteria waiting for them. I could really use some kind of portable computer in that spare time."* [56]
>
> Woman age 38

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[54] "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."

[55] "Elokuvat ainakin isommalle. Niitä on tylsä katsoa yksikseen jostain tollatteesta korttipakan kokosesta laitteesta."

[56] "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."

"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." [57]

Man age 25

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 within channels, better quality of picture and sound, long-lasting battery, and other services integrated with the same device - e.g., e-mail, Internet, phone and computer programs like "word". Pupils and teachers in secondary schools particularly stressed the importance of other services besides the television.

Mobile digital television in school

Pupils in elementary schools did not mention any definite learning situation mobile television would be suitable for. For them, mobile television would enable them to stay in their own classroom when watching programs – at present they have to change classroom. Students in secondary schools and adult education centers thought mobile television could be used during breaks, on field trips, for teamwork and in tasks that require searching for information, writing and printing. So they wanted mobile television to have other features in addition to the television feature. If schools could have mobile digital television in portable computers, pupils wouldn't need to use the computer class so often and maybe in the future the schools wouldn't need computer classes at all.

"It would be practical if everybody could have this equipment. Then we wouldn't need computer classes any more." [58]

Man age 17

Two of the 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 a program.

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[57] "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."

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

"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 onto a screen. If the pupils had those smaller devices, the program could be sent to them and they could watch it later when they have the time." [59]

Woman age 27

Mobile digital television on the train

The most interesting program when on the train was the news. When people interviewed on the train were asked to select between the two devices, six (6/7) chose the smaller device, although it was very difficult to see the picture on the screen of the PDA because of the strong reflections from the windows. Headphones were thought to be necessary for the train so that watching television doesn't disturb others. One thing that came up while observing people on the train and at the stations is that people seem to immerse themselves in the television programs easily - e.g., you might not hear what a person next to you asks if you are concentrating on watching a movie. This means that while you are watching mobile television - e.g., on a train - you might miss your station if you don't get some kind of message on the screen saying "we will shortly arrive at Tampere".

4.3 Expert interviews

The purpose of the expert interviews was to get a clearer picture of the business model that is evolving in the field of mobile digital television; the experts' opinions on suitable content for mobile digital television were also sought. Since the concept of mobile digital television is new, the actors in the field haven't had

[59] "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."

much time to think about their role in the value chain. Many organisations feel that the changes in the TV medium are about to bring major changes in the business markets.

During the interview round attention was paid to who the actual players in the field are and what kind of new knowledge is required when starting to use digital television in a **mobile** context. The business model has been defined as: "Business model is an architecture for the product, service and information flows, including a description of the actors and their roles. Business model also includes the description of the potential benefits for the actors and sources of revenues." (Timmers, 1998, 4). Since mobile digital televisions don't yet exist, it is not clear what the business model will be like. At the moment it is only possible to speculate and try to define it as accurately as possible.

One thing that is likely to affect the business model of mobile digital television will be the Communications Marketing Act ("viestintämarkkinalaki"), the first phase of which came into force in July 2002.

All communications networks will be subjected to the same law. The aim is to enhance fair competition in the field of communications and establish rules that don't favor or punish any actors in this field (Pursiainen, 2000; Heikkinen & Karhusaari, 2001).

4.3.1 Achievement of the expert interviews

Method

The structured interview was used as a method. The interview questions were sent to the interviewees in advance. There were two different sets of questions: one addressed the business model and the other addressed the content of mobile digital television. The background information and some general issues were asked of all interviewees (Appendix D).

During the interviews the interviewees were asked to draw a picture of the value chain if they thought it would help them to see all the different actors and their roles better. They were also asked to rank services (e.g., search, program ratings,

links, etc.) according to how suitable they thought the services were for mobile digital television besides traditional TV programs (Appendix E).

There were two interviewers in every situation, one asked the questions and the other one took notes. In one interview situation two people from the same company were interviewed at the same time. The interviews were recorded. Each interview lasted about one hour.

Interviewees

A total of 15 interviews were held. Most interviewees came from companies involved with the Mobile TV project. Besides this, two interviewees came from companies that are currently working with digital television technology.

Experts on the business model

Seven people (6 men and one woman) were interviewed about the business model. Of the people interviewed, 5 had an academic background in technology and 2 had an academic background in economics. One of the interviewees was working as a technology specialist and the rest were working in various professions at a managerial level. Five interviewees had a relatively long history with digital television and 2 were more specialised in mobile devices. The age range was from 25 to 53 years.

Experts on content

Nine people were interviewed about content issues. These interviewees were all men - 3 had an academic background in technology, 3 had an academic background in science (e.g., computer science), 2 had an academic background in media studies and one had an academic background in economics. The interviewees worked in various different professions. Only two of the interviewees had little or no history with digital television and the others had been working with issues related to digital television for a longer time. The age range was from 29 to 54 years.

4.3.2 Results

Content

Mobile context changes program format

The interviewees said that the content of the current TV programs was suitable for the mobile context, but the mobile use required a change in program format. For mobile digital television to be interesting for consumers it needs to offer more than regular TV programs. Just watching TV shows on the bus does not bring enough added value.

The programs need to be shorter. The current TV program format is suitable for watching television in the traditional manner. The new content could be, e.g., news flashes or short reports on sport events, local or context-related advertisements, music videos, chat, content that consumers make themselves (pictures, short movies, etc.), reports on weather or traffic, etc.

Context-aware services could be, e.g., short infomercials, reports on local weather or traffic, or betting on a hockey game. The interviewees mentioned that push services can be annoying at times and there needs to be a way to shut them off. Maybe context-aware services need to be more of a pull type, so the consumers could decide when to use them.

The interviewees did not have strong opinions on how theme channels would fit with mobile television, but the theme channels were seen as a good idea in general. The question of having enough viewers in Finland for these special channels came up.

All the interviewees agreed that the same actors who are currently providing the content for digital television would continue to make content for mobile use too; 3 mentioned the possibility of the people themselves and telecommunications operators making content for mobile television. The question of who owns the content also came up. Special attention needs to be paid to copyright issues.

User has control over the content in interactive TV programs

The interviewees weren't sure what kind of interactive TV programs are suitable for mobile use, but again the idea itself was acceptable. One interviewee mentioned that maybe the interactive TV programs are more acceptable in the mobile context because the mobile devices are more personal in nature. An interactive TV program was defined in many ways, but the most important thing was that the user has some kind of control over the content or the flow of the program.

Most interviewees described a continuum when they defined interactive TV programs. At one end the interactiveness is local - e.g., watching text television. The software comes to the user through the TV program stream and the change is made locally. At the other end of the continuum the user affects the program flow - e.g., changes the ending of a movie. The user can affect the TV program through the return path. If interactiveness is defined as a way of affecting the program flow, there are no real interactive programs at the moment. But, if interactiveness is defined more loosely, we already have many interactive TV programs - e.g., chat, game shows, talk shows (it is possible to send an SMS (Short Message Service) to the host or the guests and see it on the screen), etc. One other way of categorising interactive TV programs was also mentioned: is the decision to change something in the TV program made by one person or by a group.

Advertising and services

The interviewees thought that advertising on mobile television will differ from traditional television by being more personalised and more related to the context. Several interviewees suggested that commercials could be used to lower the price of programs: "Watch this commercial and you can see the rest of the quiz show for free."

The rating of the services from 1–12 was experienced as too difficult, so the interviewees were asked to choose the five most suitable alternatives from the list. Some interviewees chose less than five services because they felt that there were no more suitable alternatives available. All 16 interviewees completed this task.

The results show that 13 interviewees chose "search" to be among top five most suitable services; "links" was chosen by 12 interviewees and "chat" and "games" were both chosen by 9 interviewees. Other results can be seen in Appendix F.

General issues

Mobile digital television as an accessory and part of spare time

According to the interviewees, mobile television should be integrated with some other device. It should be marketed as an accessory. The interviewees stressed that the name "television" should be completely forgotten. Only one interviewee said it should be marketed as mobile television. The marketing should focus on the content rather than the technology.

The penetration would happen faster if mobile television was integrated with the equipment that people are familiar with - e.g., mobile phones. It could also help if mobile television was made familiar by initially introducing it in public transportation vehicles. Digital television programs could be shown on television screens in local trains or buses and later move into more personal use and offer services directly to commuters' mobile devices (value-added network service).

The interviewees couldn't think of one suitable name to replace the name mobile television. The most often mentioned suggestions referred to "multimedia-device". Some other suggestions were: "UMTS (Universal Mobile Telecommunications System) phone", "Multikka", "Multimedia TV", "Mediascreen" and "UMTS TV".

The mobile digital television would most likely be used in situations where people have extra time. It could be watched on a bus or a train, in a queue at the supermarket or in a boring meeting. It could also come in handy for sailors and campers. One interviewee mentioned that as mobile phones are now used in social situations (e.g., writing SMS while talking to your friend at the same time) there is no reason why mobile television couldn't be used in the same way.

Usability engineering key to successful product

The interviewees stressed that the first thing that needs to be considered in the development process is that the new device needs to be easy to use. Integrating

many appliances and services brings about many challenges. Another thing that needs to be addressed during the development is try to find out if there is a real need for this product. The developers should be able to state the added value that this product brings. This means that the development process shouldn't start from the technology but from the user's needs.

Integration with other devices makes mobile digital television interesting

What makes mobile digital television interesting for the users is a difficult question. The interviewees stressed that television needs to be integrated with some other device. The interviewees also desired other services besides traditional TV programs - e.g., map, local weather reports, supertext TV, personalised push services, on-demand services, etc. The answers can be seen in Appendix G. .The four main groups of potential users mentioned were: young people, people who can combine the usage with their work, wealthy people and the “gadget freaks" who will buy any new technology device.

Business model

The value chain of digital television and analog television is almost identical at the moment

According to the interviews, the value chain of digital television is almost identical with traditional analog television at present. The main parties to digital television broadcasting are the television companies who control the three multiplexes (YLE, MTV3, Nelonen) and the network provider Digita, which is responsible for broadcasting the television and radio programs to the consumers. Consumers can also watch digital channels via a cable or satellite connection. So, besides Digita there are also cable and satellite companies in this value chain. Television companies make some content themselves but most of the content is made by production companies - e.g., Filmiteollisuus. Commercials are made by advertising agencies. There are also companies specialising in digital television technology - e.g., Sofia Digital, which has made the EPG (Electronic Program Guide). They also have their place in the value chain. Besides all this there are companies who make equipment (set-top boxes and television sets) and companies that import equipment and retail it. At the end of the value chain are the consumers.

YLE gets most of its income (80%) from TV fees (TV maksuhallinto 2002). MTV3 and Nelonen are commercial television companies. The business for all other actors in the value chain comes from selling their products, which can be a network, a TV show, a commercial, an MHP service, a television set, etc.

Mobile digital television business model is evolving

According to the people interviewed, the main edge condition is the markets. The companies will come along if it can be shown that this service is needed and people are willing to pay for the devices and the services. Another edge condition mentioned was that suitable equipment has to be available. A few interviewees were also concerned about the size of the Finnish market and stressed that the start of mobile digital television needs to be international.

The interviewees couldn't say what the mobile digital television value chain will look like. There were still many unresolved issues in this area. The biggest questions were: do we need a separate mobile DVB network and do we need a separate mobile multiplex? These questions weren't asked of the interviewees but the topics came up in several interviews. If there will be a mobile multiplex and a mobile DVB network, then there will be many new actors in the value chain - e.g., the multiplex controller and the network provider. The multiplex controller and the network provider can also be one and the same company.

Besides these issues the new actors in the value chain will possibly be Internet service providers, telecommunications companies, parties that have a lot of digital content to provide, consumers as content providers, content aggregates and equipment manufactures.

MHP services had not started when the interviews were conducted. The interviewees remarked that the Internet service provider is needed as soon as the use of MHP services starts. The Internet is one option for the return path for interactive services. Internet access can be provided by, e.g., a telecommunications company. Mobile phone operators will also become a part of the value chain. Content will also be provided through their mobile networks, and mobile networks will also be used as a return path (SMS, GPRS (General Packet Radio Service), UMTS).

Consumers will possibly have a bigger role in this value chain. One interviewee stated that the most interesting content for mobile television would be the content that consumers make themselves. Another interviewee pointed out that attention should be paid to how i-mode is functioning in Japan. In the i-mode value chain consumers make the content (e.g., www pages) and the content can be accessed through mobile phones. The content can include text, photos, videos, etc.

On top of all this, "content aggregates" - people who make the content suitable for mobile use – are needed. Equipment manufactures to make the new devices are also needed.

The question of mobile digital television's business model is quite delicate. The actor who is first to figure out how to make the business model work will probably have a competitive advantage over the others. One important point brought up by one interviewee was that the longer the value chain gets the more money it costs.

The frequencies and the different networks cause the main conflicts of interests

The experts thought that if there are to be conflicts between the actors in the value chain, they will most likely concern frequencies and networks: Who is controlling the networks? Who gets to use the existing networks? Which of the existing networks are used? Do we need new networks? The Communications Marketing Act will probably have some influence on this topic.

The interviews brought up some concerns about the use of the networks. A lot of money has been invested in UMTS networks and for some companies it is essential that they are able to get some money in return for their investments. So the success of UMTS is very critical. The mobile operators and mobile content developers wanted to use just the UMTS network. Then again, other companies who have not invested their money in the new UMTS networks see them as an expensive (maybe too expensive) way of sending content to the customers. These companies (e.g., television companies, network providers, digital television service and technology experts, and equipment manufactures) would like to use and develop the existing DVB networks, which would mean no new actors and "money takers" in the value chain. The different networks were sometimes seen as being in competition with each another.

The value chain comprises many actors and all of them want to make a good profit. This might mean that all the actors will try to make their "piece of the cake" bigger than it is at the moment. This means that companies might try to broaden their field of expertise from their traditional core functions. The actors in the value chain might take on other actors' roles. For example, a mobile phone operator could buy content and distribute it through the UMTS networks, or a television company could rent a mobile network and use it to distribute content to the customers. In any event, the broadcasters, the cable companies and the telecommunications companies and operators will continue to compete for customers.

The founder will be one with lots of content to offer or the one who controls the networks

The founder of the mobile digital television channel should be either a broadcaster who has lots of content to offer or a mobile operator who controls the networks. Two interviewees pointed out that perhaps we should forget the traditional television channels in the mobile context. It would be more suitable to talk about different services.

Monthly payment or pay-per-view are both necessary options

According to all the interviewees, a consumer should be offered several different ways to pay. The main options should be monthly payment and pay-per-view. One interviewee suggested that mobile television could be viewed as a value-added network service - for example, when you have purchased a train ticket and enter a train some services could be offered on your mobile television automatically.

4.4 Mobile television user interface – Visualisation tests

A brainstorming session was held to ideate different interface solutions. Five different user interface metaphors came about. These were visualised with paper mock-ups to find the most suitable interface for mobile digital television. It was

important to define possible usability problems and the best possible interface before the implementation of the actual interface. By doing this it was possible to minimise the problems users encountered.

4.4.1 Achievement of the visualisation tests

Methods

Paper mock-ups were drawn or realised on an image-processing program. Visualisations were carried out on two different terminals: the iPaq pocket PC (Compaq) served as the smaller and the Pen Tablet (Fujitsu) as the bigger terminal. In the interviews the users became familiar with the interfaces by completing various tasks. In every interview the beginning metaphor and the beginning terminal changed. Two different rounds of interviews were held. They were held in the usability laboratory with one interviewer and one observer in the room. The observer took notes during interviews. The interviews were also recorded.

The interview rounds and the interviewees

The first round of interviews was held to define usability problems in the interface metaphors and to find the best interface. Each interview lasted 1-2 hours. After the first interview it became clear that the length of the interview had to be shortened. the following changes took place: opinions about metaphors 1 (WWW), 2 (file) and 4 (menu) were only asked with the first terminal because the interface looked and functioned in the same way in both the bigger and the smaller terminal. The fifth task was only performed with metaphors 3 (TV) and 5 (desktop) because the correct answer was revealed during earlier tasks with the other metaphors. The interviewees completed five different tasks. These included navigation and carrying out some activities that were considered most important. The questions covered the first impressions of the metaphors, and there were some extra questions about the usability and comparisons with different interfaces. The questions and tasks are described in more detail in Appendix H. Six people were interviewed in the first round; 2 men and 4 women. The age range was from 20 to 50 years.

None of metaphors proved to be superior in the first round. The purpose of the additional interviews was to find the most popular metaphor to serve as the basis for the interface to be implemented later on. The interviews lasted less than an hour. Some of the tasks and questions used in the first round were chosen for the second round: task 1, part of task 2 and some extra questions about the usability and comparison with different metaphors (Appendix I). In addition, the interviewees were asked to grade the metaphors from 4 to 10. Eleven people were interviewed in the second round; 5 men and 6 women. The age range was from 9 to 54 years.

Analysis

The interviews from the first round were analysed to find both the most significant usability problems and the advantages of each metaphor. These results were summarised. The interviews from the second round were analysed by summing up the given grades and checking the comparisons. The usability results from the first round were supplemented according to the latter results.

4.4.2 Visualisations

Different metaphors were chosen according to the results of the brainstorming session. Several different options were offered to the users to get the best possible picture of their opinions and expectations of the interface. Visualisations were implemented so that it was possible to follow through all the tasks that had been decided earlier. The metaphor's logic of operation was decided partly by a group of designers and partly by each user interface designer. Both terminals had a touch screen but it was also possible to control the smaller device with hardware buttons.

Interface metaphors

WWW metaphor

This metaphor was made to resemble WWW pages (Appendix J). Different functions were situated in the menu as links. When a link was chosen a certain function opened. There were also longer paths. In these cases choosing a link

opened a new menu over the preceding one. At the top of the menu were three icons: voice adjustment, a search function and an e-mail sending icon. The icons served as shortcuts to the functions. Buttons for adjusting the video functions were at the bottom of the menu.

File metaphor

The logic of the file metaphor was much the same as the menu metaphor. The only difference was that the functions were visible horizontally, not vertically as in the menu metaphor. Shortcut icons for the favorite programs on the screen were beside the files (Appendix K).

TV metaphor

The use of the metaphor was reminiscent of traditional TV. The use of the smaller terminal was similar to a remote control:(Appendix L). it was possible to surf through different channels and programs with the 5-way navigator button. Channel and program choice was determined by pressing OK on the 5-way navigator button. Search and other functions could be used with other hardware buttons. The bigger terminal could only be controlled by touching the screen. Most functions were available on the screen instantly.

Menu metaphor

The metaphor was suggestive of the interfaces used in, e.g., the *Word* text editing program. The different functions were located in menus (Appendix M). Opening the menu showed all possible functions. An arrow pointing to right showed the user additional functions to be reached through the main menu. A new menu opened to the right side of the preceding menu.

Desktop metaphor

The main idea of this metaphor was quick access to favorite programs. Icons of the favorite programs were placed on the desktop so that the users could see them instantly. Touching the icon started a program. Access to other channels and functions was from the tree structure on the left side of the bigger terminal and the bottom part of the screen on the smaller terminal. (Appendix N).

4.4.3 Results and recommendations

All the interfaces had some advantages and some usability problems. Table 2 shows the things that were identified in the first round. Although none of the metaphors was superior to the others after the first round, the menu interface seemed to be the one to choose, but with moderate changes. In addition to the menus there should be shortcuts to favorite programs and/or channels visible on the screen, as in the desktop metaphor. Some extra tests were made to confirm the selection of the interface metaphor the users liked best.

After the second round the selection of the best interface was easy. The menu metaphor was the easiest to use and most often selected as the best alternative. The desktop metaphor on the bigger terminal was selected as the quickest to use. Considering the grades the users gave to each interface, the best interfaces were menu and desktop on the bigger terminal. Both got an average grade of 9 on a scale from 4 to 10. The most difficult interface was the TV metaphor on the bigger terminal. It was also the one the users pointed out when asked to choose the most undesirable interface. From the given grades it can be stated that the male interviewees liked the TV metaphor more than female interviewees. The average grade for the smaller terminal was 8 from the men and 7+ from the women. For the bigger terminal, men gave an average grade of 7.5 and women 6.5.

Table 2. Usability of the tested interface metaphors.

WWW metaphor	File metaphor	TV metaphor
Advantages: - logical and clear - quick to use - the users had no problems with the tasks **Problems:** - some terms were not clear (*lisätoiminnot*, *lisätiedot*) - search icon (magnifying glass) was not clear - video function buttons were not necessary in the main menu - how to get the main menu off the screen The interface metaphor didn't function very well on paper. The functioning might have been more clear if the visualisation had been on the computer screen.	**Advantages:** - the three menus in the upper part of the screen were clear and easy to use - the users had no problems with the tasks **Problems :** - on the small screen the arrows pointing to left and right were not clear, the users immediately wanted to know how many functions there were behind the arrows - on the small screen there was too much information (e.g., buttons: *katso* and *poista*) - the view on the screen was not consistent throughout the interface (e.g., the placing of the menus changed)	**Small screen, advantages:** - easy and quick to use after the user had learned it - channel-hopping was familiar from normal TV **Small screen, problems:** - not intuitive - users had big problems getting started with the first task, it was not clear that you have to first select the channel with the OK button to be able to see what programs are on the channel - too much use of the OK button - many users would have used the up and down arrows to go through the programs on a channel **Big screen, advantages:** - good idea to have the most often used buttons on the screen easily available - you don't have to go through multiple files **Big screen, problems:** - the round buttons (*kanava*, *ohjelma*) were confusing - the users expected to get a visible list of channels when pressing the round button (*kanava*) - the grouping of the items in the lower part of the screen was not clear - the difference between the buttons *lisä* and *info* was not clear
Menu metaphor	Desktop metaphor	Some remarks about the search function
Advantages: - clear - easy to use - requires no learning - user can easily see all the available functions **Problems:** - some confusion with the terms: *suosikit*, *omat*, *oma juttu*, *lisätoiminnot* (e.g., the users connected the term *lisätoiminnot* with the functioning of the computer)	**Small screen, advantages:** - quick to use through program icons **Small screen, problems:** - users had problems with terms *ohjelmavalikko* - desktop is not a suitable term for the television environment - there was too much information on the small screen - the view on the screen is not consistent throughout the interface **Big screen, advantages:** - quick to use through program icons - visual **Big screen, problems:** - too much information in the tree structure - users had problems noticing the program-specific tree structure *ohjelmavalikko* in the lower left part of the screen	The search function was experienced as unfamiliar in the TV environment. It wasn't clear exactly what the search function did. The users connected it with finding channels and programs. This is why they said it would be more logical if it were placed under the *kanavat* menu. In some metaphors the user could define where he wanted the information to be found. This function was new to the users and was experienced as confusing. There where also some comments about the search results in general.

4.4.4 Conclusion

The best possible choice for the prototype interface seemed to be a combination of the menu metaphor and the desktop metaphor on the bigger terminal. The www metaphor also had some effect on the interface. When combining the different metaphors it is important that the functioning logic stays coherent throughout the system.

Constantly visible menu names were considered important. On the other hand, menus can easily become too heavy. Attention was paid to making the grouping of the items and functions as logical as possible. There was some confusion with the terms *suosikit, omat, oma juttu* and *lisätoiminnot* (see Table 2) in the menu interface, so some changes were made.

According to these interviews, searching for favorite programs and channels would have been faster via icons on the screen, as in the desktop interface. The icons should have appeared on the screen when the mobile TV was turned on. If the user had wanted to see programs other than the favorites, he could have used the menus. The possibilities and use of the desktop metaphor and icons need to be explored in more detail in further research – perhaps access to channels would be better through icons and extra functions could be placed in menus.

5. Implementation of the prototype

5.1 Architecture and networks

The prototype system of mobile television is based on multiple data transfer methods for delivering A/V content. At best, the terminal can get broadcast-quality DVB-T MPEG-2 bit stream. In this case the received MPEG-2 bit stream is not further compressed. For lower bandwidth connections two additional bit rates are generated, “mid” and “mobile” quality, as described in chapter 5.5. The designed system is presented in Figure 7.

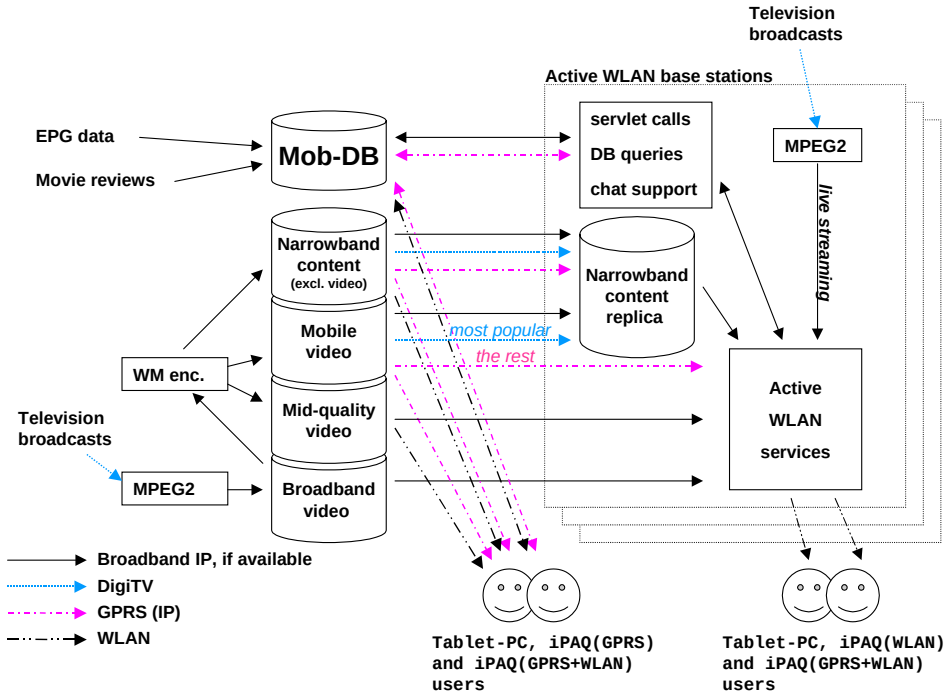


Figure 7. Designed mobile television architecture.

Mobile users are able to access the content directly over a GPRS connection, which typically provides 30...50 kb/s data transfer rates, thus viewing the mobile quality video clips.

When the user is within range of a WLAN base station, mid-quality videos become available as well. This was the configuration in the field trial.

Technical tests were also made with broadcast quality. In this case, 11 Mbps WLAN, the required speed was just within the limits of IEEE 802.11b technology. As higher-speed WLANs were yet to come, we used the Cisco Aironet 350 Access Point with an external antenna. The external antenna was a diversity patch antenna with an 80 degrees horizontal and 55 degrees vertical radiation pattern. By thus limiting the radiation angles we reduced multipath distortion and got 6 dBi gain at the same time.

By connecting a laptop with DVB tuner and GPRS phone to the WLAN system we were able to deliver broadcast-quality videos to WLAN users and mobile quality videos from the central system. In this case a Plain Digital DTV-A1 PCMCIA receiver was used. With the software development kit provided by the manufacturer, DVB-T transmitter frequency can be selected and PAT, PMT, video and audio PID's filtered in order to generate a valid MPEG-2 stream. The re-transmission takes place by writing the MPEG-2 data into a file without any file sharing restrictions and sending it to the client over an HTTP connection by using an Apache server in the laptop. For playback, the Elecard decoder together with Windows Media Player 6.4 was chosen because of the compatibility, stability and HTTP support.

The laptop refers to "Active base station" in the Figure 7 above. The GPRS traffic is routed through the laptop to the client terminals, and the laptop generates a cache copy for every video clip and jpeg image transferred. The cache can also be filled with DVB-T data broadcast. Making it simple, a separate PID is inserted into the DVB-T bit stream with the most popular mobile quality clips as the payload. These PIDs are then filtered with the DTV-A1 SDK and the original data restored from the payload. The Otaniemi area DVB-T test transmitter facility, OtaDigi, was used for the data broadcasting tests.

Several alternatives were discussed during the development period. It should be noted that DTV-A1 (as well as some USB tuners) could have been installed in the PC-based terminal directly. The main reason for using an intermediate WLAN was the fact that the national DVB-T modulation was not optimised for indoor reception. Additionally, concrete reinforcements and tinted window

glasses turn the rooms into Faraday cages and, last but not least, the antenna would have made the unit too cumbersome for the users. For these reasons it was considered feasible to have a fixed antenna with guaranteed reception and to forward the bit stream to the terminals with WLAN.

5.2 Incremental development of the prototype software

Software process models depict the phases of a software project. They give rules and instructions to be followed in the software development process. The main goal of the process models is to advance the quality of the process by adding measurability, repeatability and manageability. That should lead to more efficient working and better software. The most common, or at least the most widely known, process model is the waterfall model[60].

In our project no process model was followed strictly. The detail level of the different process models varies, and it is not an absolute goal to follow any model strictly, but to adapt the model to fit the needs of the project.

For the design and implementation phases, Tom Gilb introduced the incremental, or iterative, development process (Gilb, 1988). Unlike the waterfall model, the incremental development process executes at least desi more than once, and in each phase more features are added to the software. Incremental development was best suited to the mobile television project. Using incremental development, new features can easily be added during the field testing periods. Delays in development do not delay the start of the field test period if it is acceptable to leave some parts out of the release. Instead of waiting for the new version, the previous working version can be used without modifying code. If the increments have been kept small, the previous version contains all the features except the one that is currently under way.

Iterative and incremental development are not always considered to be the same. In iterative development the project is analysed in every phase, thus the system is refined at each iteration. This is best suited to situations where the

[60] http://wombat.doc.ic.ac.uk/foldoc/foldoc.cgi?Waterfall+Model

requirements are not precisely known in advance. In our project the system requirements were clearly specified at the very beginning; hence the software development was not iterative.

Extreme programming[61] was also studied. Some of its ideas are too radical, but some were utilised in the project. One was the fact that code was often integrated. All the new added features were integrated with the system and tested immediately.

The idea of an extreme programming planning game was adopted when the features for each field trial were decided. In an early phase of the project, before any requirements specification was written, all the features and ideas were gathered together. Then the developers estimated each feature's risk and time (development cost) to implement, and the designers estimated each feature's value to the project. According to these estimations, features with high risk and development costs but low value could be left out of the system. Those with high value but low risk or development costs were prioritised. If a feature was critical to the whole system, it had the highest priority, even if its risk or development cost were high. A release plan was then written, in which these features and some necessary components were defined as modules. These modules were the increments added to the software. The implementation order of these modules was based on the risk, development cost and value to the project estimations of the "planning game".

Altogether, there were nearly 40 modules in the release plan, each one targeted for one of the three field trial periods. Most of the modules could be integrated with the system without affecting the rest of the system, though a few modules relied on other modules and could not be implemented before those other modules were ready. The release plan was updated frequently during the project development.

[61] http://www.extremeprogramming.org/

5.3 User interface and terminals

This chapter is about the implementation of the user interface. The user interface design is reported in Chapter 4.4.

5.3.1 Same user interface for two terminal types

There were two kinds of terminals, or clients, used in the project. First, there were the bigger devices, which, in the project, were Fujitsu tablet PCs. They had the Windows 2000 operating system and were technically very similar to normal laptop PCs, only lacking a fixed keyboard. In addition, there were smaller devices, PDAs. Compaq Ipaqs and HP Jornadas were used. They had a Pocket PC operating system, and their screen resolution was 320 x 240 pixels. The client devices are described in more detail in Chapter 6.4.

The absolute requirement for the user interface implementation was that the user interface was available for both of the chosen terminal types. Of course, separate applications could have been developed, but it is clear that they should use the same software components as much as possible.

Originally, a rich client was considered appropriate for use in the mobile TV. Video playback is the essential feature of the client, which, by itself, prohibits very thin clients. Rich clients could also keep the network traffic as low as possible, which can be an important feature in the wireless networks.

Rich clients' drawback, when compared with thin clients (typically, web services accessed with browsers), is that they require either installation of the client software beforehand or the downloading of a large file each time the application is started. In this case software installation was not a major problem, because the project delivered all the terminals to the users. The number of users was restricted and the installation problems could be handled by the project members instead of the end-users.

5.3.2 MHP compliancy

The Multimedia Home Platform, MHP, is a specification intended to ensure that applications are compatible with digital television terminals and gives the rules that digital television device manufacturers and application developers have to follow. The terminals are normally digital television sets or normal analog sets with a set-top-box. It is possible to build other kinds of terminals by following the MHP specification.

MHP tries to provide a way to move from the vertical digital television markets to the horizontal ones, as seen in the figure below (ETSI, 2001).

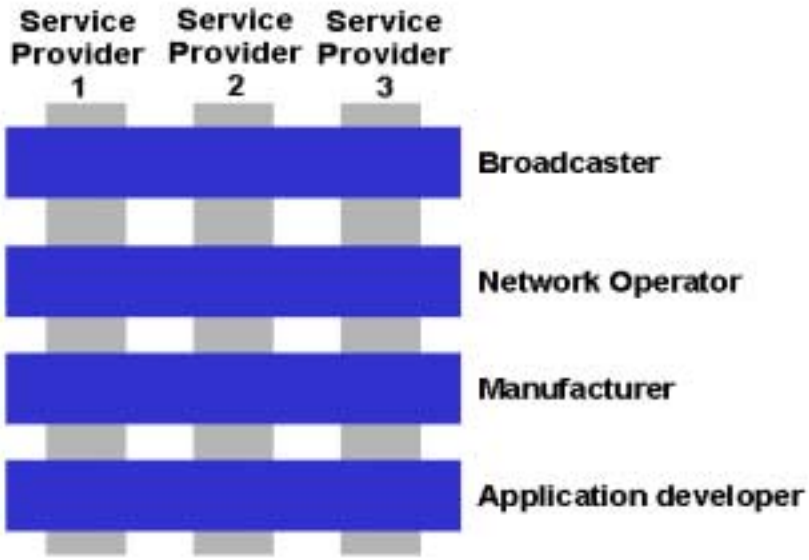


Figure 8. Transition from vertical digital television markets to horizontal markets.

In vertical digital television markets the service provider operates on all levels: application development, manufacturing, network operating and broadcasting. There are no uniform interfaces specified between the levels. It is not likely that the various systems are interoperable in the vertical markets, as the consumer needs a service provider-specific receiver to access the service provider's value-added services. The consumer cannot use a receiver meant for use with another service provider's system.

In the horizontal digital television markets each level has a well-defined interface. Implementations from different providers can work together. Companies can only target their products at one level and they need not operate on all the levels. MHP's key element is a generic API, which enables the MHP applications from the different providers to operate on all manufacturers' hardware and software implementations. Finnish broadcasters have mutually agreed to follow the NorDigII standard. NorDigII has since been renamed NorDig Enhanced profile. NorDig Enhanced profile-compliant receivers should support APIs and content formats defined for the Interactive Broadcast profile of MHP (NorDig, 2002). In addition to Finland, MHP has been chosen for use in Germany [62].

It should be noted that there is no requirement for DVB receiver manufacturers to support NorDigII. That means that DVB receivers sold in Finland might not support MHP at all. Consequently, the first set-top-boxes sold in Finland in August 2001 did not support MHP. As late as April 2003, over a year and a half after digital television broadcasts started in Finland, there are only couple of MHP-compliant set-top boxes or integrated receivers available[63]. The first MHP product in the Finnish markets was an integrated Sony receiver, which became available in May 2002.

MHP compliancy was seen as an important feature of the client software. We were particularly interested in the DVB-J part of the MHP specification. DVB-J is the MHP's Java platform. It was understood from the beginning that the MHP compliancy was making the implementation more complicated. The DVB-J platform is restricted when compared with the standard Java platform. DVB-J also contains several interfaces, which have no implementations yet available, for at least standard PC and PDA environments. If those interfaces were used in our applications, we would need to implement a partial DVB-J platform as well. It was clear that complete MHP compliancy was not possible. The target was set to keep the software as MHP compliant as possible without affecting the other goals of the project. Because there were no expectations that the developed

[62] http://www.dvb.org/graphics/internal/WAM-DVB-MHP.png

[63] http://www.digitv.fi/sivu.asp?path=1;2998;2626

applications would be used in the actual MHP set-top-boxes or receivers, MHP 1.1 specification was used instead of MHP version 1.0 (ETSI, 2001).

Actually very little of the DVB-J platform needed to be implemented in the mobile TV applicationas it was to be the only application to be executed on the terminal. Therefore, there was no need to implement a navigator that starts, pauses, or stops an application, or switches the control between running applications. And there was no need for us to deliver the application in broadcast, read and start it from it. For our purposes, it was enough that the class that implements the xlet (Java TV applications, including DVB-J applications, are called xlets) interface also had a main method - the main method initialises and starts the xlet as a navigator normally would.

Our user interface was not originally designed to be used by a remote controller but with a pen or similar pointing device. The MHP specification mentions a pointing device, but does not make it an obligatory feature. We still made the assumption that a pointing device was present, and our user interface did not have respond to a remote controller. Thus we did not have to create any remote controller mock-up in our system.

Video playback is the most important feature of the mobile TV system. MHP affected videos a lot, see Chapter 5.4. However, the DVB-J applications play all the media through JMF (Java Media Framework). Whatever is underneath the JMF interfaces is not seen in the application. From the application's perspective, video playback is clear as long as the JMF implementation is available. In MHP scaling only a quarter of the original full screen is required, but again we relied on more advanced scaling, which is naturally not prohibited in the specification.

In the normal Java environments there are several graphical components for the user interfaces. These standard components are not available in the DVB-J platform and were replaced by the HAVi components, which are designed for use in a television. An unfortunate fact is that implementations of the HAVi components were not available for our purposes. Because these ready-made user interface components were not available, we had to develop our own components. New components can be developed by extending `java.awt.Container` or `java.awt.Component`, and by writing a

painting code for the component. Complicated UI components require complicated painting, and this approach is laborious.

In addition to UI components, Java's standard windows and frames are not used in DVB-J and are replaced by `HScene`. Java's `java.awt.window` can simulate the `HScene`. If the window is used throughout the code, the whole code becomes non-MHP compliant. But if the code that uses the simulation class instead of the real thing is isolated, the rest of the code stays MHP compliant. This isolation is easily achieved by the factory design pattern (Gamma et al. 1995). When the code is moved from the simulation environment to the MHP platform, most of the code remains the same. By using interfaces and dynamic class loading, the code itself does not need any modification.

When all the things mentioned above are taken into account, it was possible to make the mobile TV application as MHP possible as is reasonable for this project, and still use the standard Java or Personal Java runtime environment. However, it should be noted that the MHP compliancy is only validated to the specification. The application was not tested on any MHP platform, especially as MHP 1.1 was used, but this should still guarantee fairly good MHP compliancy.

5.3.3 Implementation

Because rich client and MHP compliancy were targets, the client application was meant to be implemented as a Java application. A standard Java runtime environment was meant to be used in the Fujitsus; the Jeode Personal Java runtime environment was selected for the PDAs. Personal Java compliant applications can be used in the standard Java as well, so the idea was to use the same application in both terminals.

Because MHP was making the client part more complicated, the other parts were kept simple. The whole software architecture followed a standard 3-tier architecture. Java was already selected for the clients, and was used in other tiers as well. The database was accessed through the JDBC interface, and the middle-tier was run on top of the Tomcat[64] servlet platform. For communication

[64] http://jakarta.apache.org/tomcat/index.html

between the client and the server, the framework presented in (Moss, 1998) was used. This tunnels the Java objects and RMI calls over HTTP, which makes the transfer of complicated objects and data structures between the client and server easy. The drawback is that exactly the same compiled Java class has to be used in the server and in the client. Even a minor modification to a class that is used in the client-server communication requires an update to both the client and the server.

Unfortunately, the same application could not be used in both client types. Due to the MHP, the user interface components were self-made from scratch, extending `java.awt.Component` and `java.awt.Container`. In the PDAs, limited computing power, the Java environment and a pen as a pointing device made these components' usability quite poor. The user interface did not respond to the pen quickly enough and the components were very sensitive to pen movement on clicks. In the more powerful Fujitsu with a standard Java environment, these components functioned moderately well. It should be noted, though, that the bug in Java that makes components laid out on `java.awt.Window` instead of `java.awt.Frame` unaware of the current focus was quite frustrating. Therefore, text fields, for example, cannot notify the users that they are focused. The user has to type "blindly", without knowing for sure that the text field he/she has clicked is really now active. For example, the cursor in a currently focused text field cannot be shown to the user. If a component was registered to listen to the keyboard, it received the keyboard events, so the components really got the focus after the component was clicked with a pen or a mouse. But if a component asked if they had a focus, the answer was always no. As a matter of fact, JRE 1.4 could not be used because it didn't transfer the focus to a clicked component at all. Therefore, the older JRE 1.3.3 was used. This only affects components laid on `java.awt.Window`. We didn't want to use `java.awt.Frame` because the frames and header bars would have affected the user interface too much, and even made some features impossible (for example, opened menus, which are now windows on top of the main window).

The self-made user interface components were quite restricted. Therefore, an electronic program guide, which required a complicated user interface, was implemented in HTML. Java's in-built HTML renderer was used, and this part of the application clearly was not MHP compliant.

We did not want poor usability of the user interface to affect the whole research so the Java application was discarded in the PDAs. Poor usability in the PDAs was mainly the fault of Java and the self-made user interface components. The native Pocket PC applications responded to the user actions fairly well. Therefore, it was decided that the PDA user interface was to be implemented as a web application: the user would use a web browser built into the Pocket PC and browse HTML pages. This is clearly a thin client, but the usability has to be the most important factor and the increased delays caused by network traffic are more acceptable than the unresponsive user interface. In this new approach Java objects cannot be used in the communication between the client and the server. The user interface of the bigger device was still implemented as a Java application, and the two versions should share as much as components as possible. For the HTML user interface, new server-side adapters were implemented. One converted HTTP request parameters to the Java object, which could be delivered to the original server component. The other one converted a Java object to HTTP parameters that could be used as a link. HTML presentation was done with JSP.

The architecture is described in Figure 9. The MHP client sends and receives Java objects. The server component uses the database through the database API - the database does not reside on the same PC as the server software. The HTML client communicates with the so-called HTML access point. The HTML access point converts the HTTP calls and parameters to Java objects, and then uses the same server software as the MHP client. The JSP pages convert the Java objects to HTML forms and links.

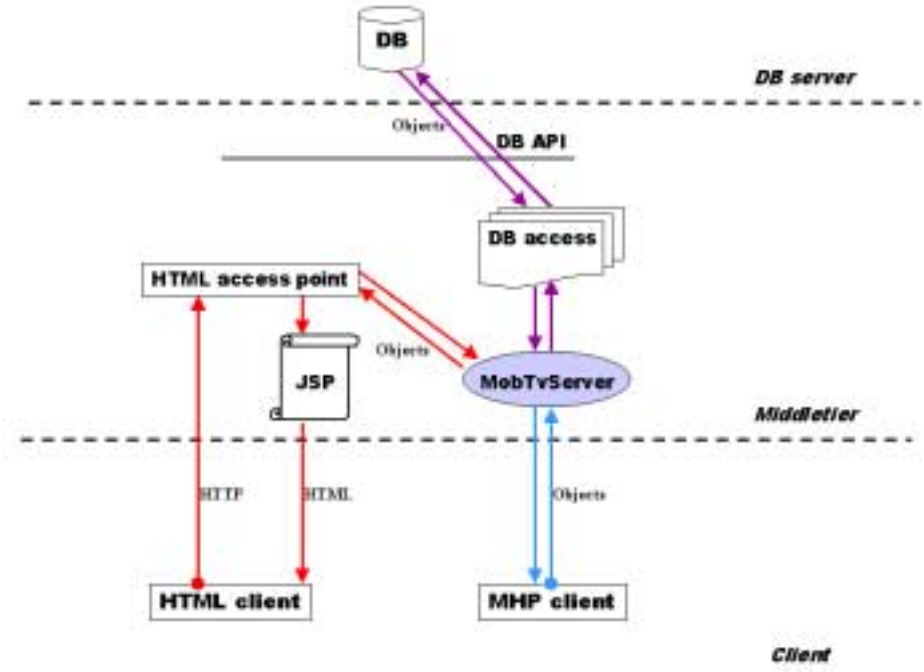


Figure 9. Mobile television client server architecture.

One challenging part of the client implementation was the video playback. In the HTML user interface this was fairly simple. When the user clicks a link that leads to a video file, the control goes to a video player, in our case Windows Media Player. Unfortunately, the Pocket PC's browser downloads the file first to the local memory, and after that transfers the control to the player, and the playback begins. This causes a delay, because the download occurs before the playback. This is not a particular problem if the file is small. And in this case it is. Instead of the actual video file, the link points to a playlist file. That file contains links to the actual video files. The playlist file is a small text file, and its download is very fast. ASX files are used as playlist files in mobile television. The Pocket PC's media player supports them, and when the ASX file is downloaded, Media Player uses streaming when it plays the video files. They are not downloaded to the client before playback but playback begins immediately after the download has started. One strange thing was noted in the Pocket PC's browser's behaviour: when the ASX file was returned from the server to the client, it was not enough to set the response's content type to video. The file extension of the ASX URL had to be .asx (perhaps some other extension registered to Media

Player could have been possible). The ASX file is not a static file but is created dynamically. We had to change the name of the servlet that generates the ASX file dynamically to asx. When the URL of the servlet that generates the ASX file is something like "http://www.server.com/servlet/fi.vtt.tte.mobile tv.asx?parameters", it is accepted as a valid Media Player file as the file extension looks like .asx.

The video playback was more problematic in the Java application. Videos were intended to be played through JMF. Encodings and file formats supported by JMF implementations are fairly restricted. Therefore, we ended up using Windows Media Player with the Java application as well. Media Player cannot be accessed directly from the Java, and an adapter was developed between them. This adapter is native code and was developed with both C++ and Visual Basic. The adapter has a JNI interface for the Java, and uses Windows Media Player for video playback. All this was hidden under JMF interfaces in the Java, so it didn't affect the rest of the Java application. However, we did not manage to make this work as reliably as it should. Delays in the network were especially fatal to this rather complicated system and the videos were not played at all. In the first two trial periods these two user interface versions were used concurrently. The users who had a PDA used the HTML version and the users who had Fujitsu used the Java client application. For the third trial period the HTML version was used in the Fujitsus as well. We had already tested the "as MHP compliant as possible" client, and found that the problems with the video playback were affecting its usability. It was trivial to make another HTML version with a different layout designed for a bigger screen for use in the Fujitsus while the PDAs used the existing HTML user interface. In the Fujitsu, the HTML user interface videos are embedded in the browser, which wasn't possible in the Pocket PC's browser. The same applied to the game, which was only available in the Fujitsu's version because it was implemented as a Flash animation. Almost everything that was possible in the Java application client was possible in the HTML user interface, but the menus, for example, were not as sophisticated in the HTML as in the Java version.

Figures 10, 11 and 12 show pictures of each user interface version: PDA version, Java application version, and an HTML version for the Fujitsu. Note that the PDA version is here depicted bigger than the other two user interface versions.

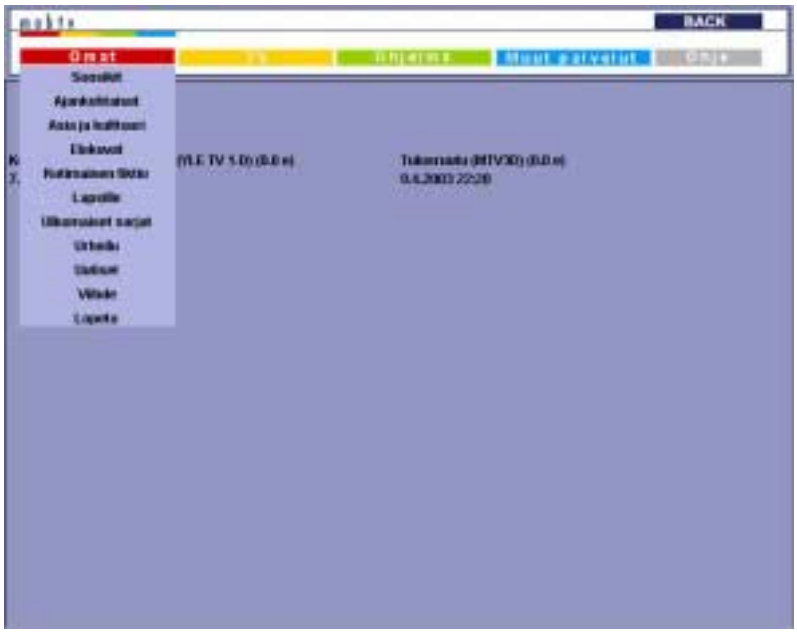


Figure 10. Menu in the Java application user interface.

Figure 11. HTML user interface for PDAs.

Figure 12. Menu in the Fujitsu's HTML user interface.

5.4 Available TV programs, channels, theme channels, and extra services

The user accesses TV programs in the mobile television system via the channels. Channel is a collection of TV programs. All the channels are gathered in the two menus in the user interface: My channels (Omat in Finnish in the user interface) and TV. In My channels the TV programs are divided into categories. The categories follow Finnpanel's categories[65]:

```
Ajankohtaisohjelmat
Asia-/kulttuuriohjelmat
Elokuvat
Kotimaiset fiktiot
Lastenohjelmat
Ulkomaiset sarjat
Urheiluohjelmat
```

[65] http://www.finnpanel.fi/

```
Uutislähetykset
Viihdeohjelmat
```

For example, the user can select the Sports channel and find all the sports programmes available in the system. In addition to these category channels there is a Favourites (Suosikit) channel, where the user can bookmark his favourite programs and access them easily. In the TV menu all the programs are divided traditionally: for example, programs from Yle TV1 are in the YLE TV1 channel.

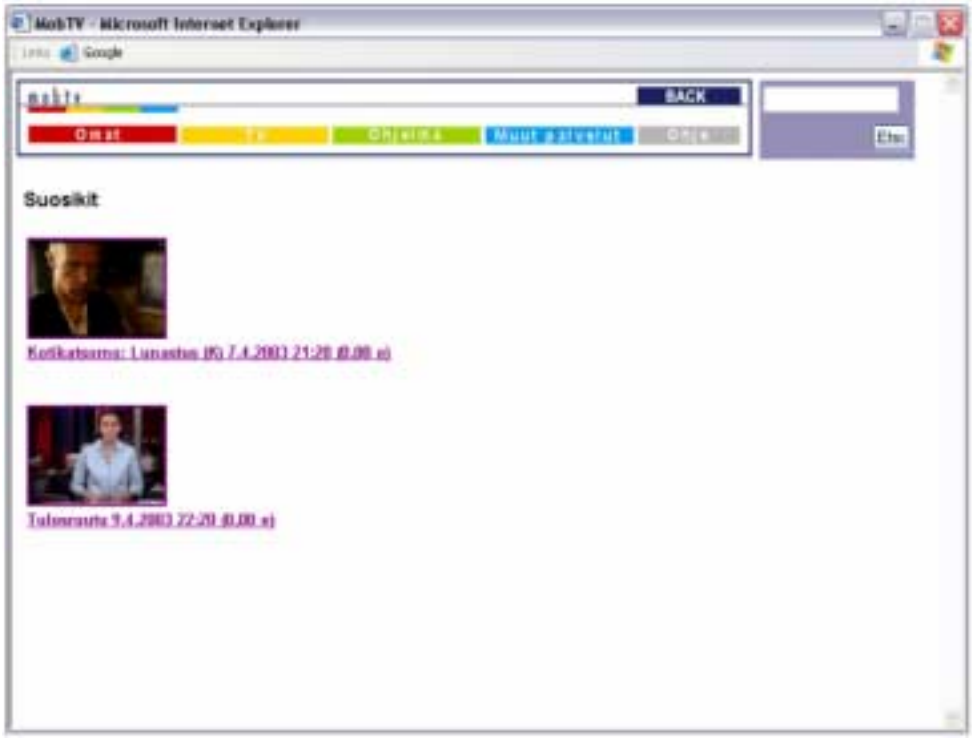


Figure 13. Users' favourites.

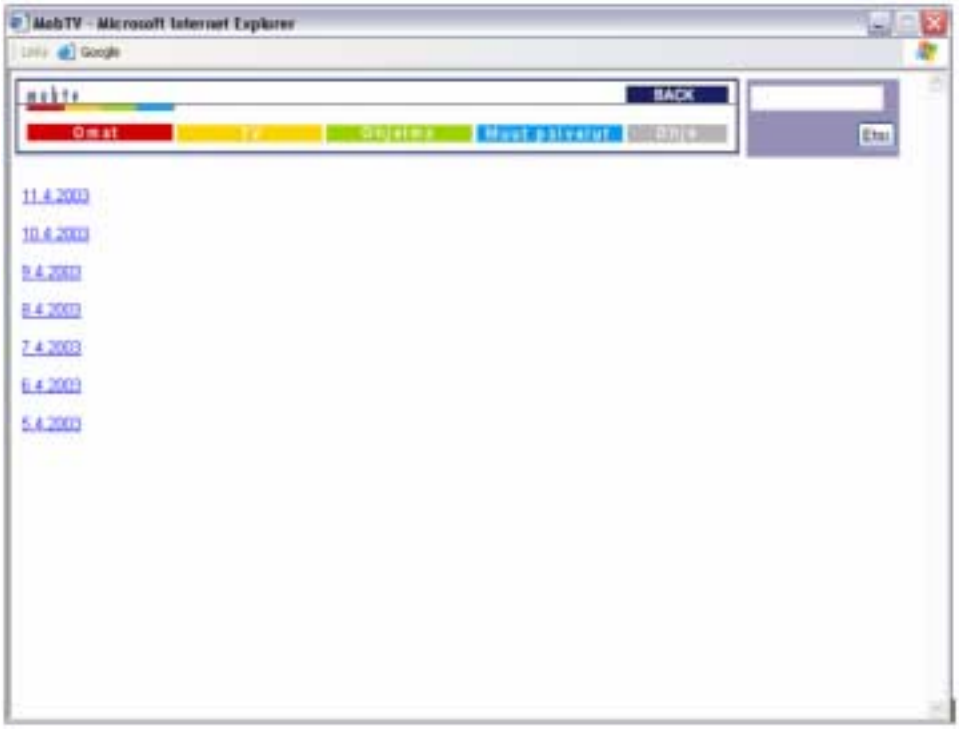


Figure 14. YLE TV1 chosen from the TV menu.

Figure 15. One day selected from the YLE TV1 channel.

Figure 16. The selected program is played embedded in the main user interface window.

Fetching a two-week program schedule

Every Friday, a two-week TV program schedule for the three TV channels (Yle TV1, Yle TV2 and MTV MTV3D) is fetched from the YLE website. A specific Java application was written to do this. It starts with today's programs and continues to fetch the 13 following dates using links

Channel TV1:	www.yle.fi/ohjelmaopas/data/t01today.htm
	www.yle.fi/ohjelmaopas/data/ddmm-t01.htm
Channel TV2:	www.yle.fi/ohjelmaopas/data/t02today.htm
	www.yle.fi/ohjelmaopas/data/ddmm-t02.htm
Channel MTV3D:	www.yle.fi/ohjelmaopas/data/t03today.htm
	www.yle.fi/ohjelmaopas/data/ddmm-t03.htm

where "ddmm" is date and month information generated automatically by the fetcher program.

Here is a small example fragment of program information from the YLE website:

20.00 Tosi tarina: Menopaluu Kostamukseen

Kostamuksen rakantaminen nosti Kuhmon kukoistukseen 25 vuotta sitten. Maanviljelijöistä tuli rakennustyöläisiä, muuttovirta kääntyi pohjoista kohti. Rakentamisen riemua kesti kuitenkin vain kahdeksan vuotta. Maanviljelijöistä tuli keikkatyöläisiä. Yhtään pysyvää työpaikkaa ei Kostamuksen avulla pystytty luomaan. Tosi tarina matkusti vielä kerran rakentajien kanssa rajan taakse. Suunnittelu ja ohjaus Pentti Väliahdet. Tuotanto TV1:lle Production House. Stereo. Tekstitys Teksti-tv:n s. 333.

20.30 Tv-uutiset ja sää

Stereo. Tekstitys Teksti-tv:n s. 335.

The fetcher extracts the following items for each program:

NAME	TYPE
tvChannel	fi.vtt.tte.mobile tv.basic.TvChannel
title	java.lang.String
titleInBasicForm	java.lang.String
description	java.lang.String
descriptionInBasicForm	java.lang.String
start	java.util.Date
end	java.util.Date
category	fi.vtt.tte.mobile tv.basic.Category
status	int (PASSIVE, ACTIVE or NOTALLOWED)

The items "titleInBasicForm" and "descriptionInBasicForm" are Strings that result when the original text is filtered through a keyword indexing application (Morfo by Kielikone); storing the basic form of words allows more flexible and efficient searching.

Manual Categorisation

Since the category information does not exist in the source, we must add it by hand. A specific XHTML category mapping file, "ohjelmat.xml", was created, where all currently known program titles are mapped to Finnpanel categories. Below is a small fragment of "ohjelmat.xml".

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"

    "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">

<html xmlns="http://www.w3.org/1999/xhtml">

<head></head>

<body>

<programmap>

<program>

  <name>Tosi tarina:</name>

  <channel>yle1</channel>

  <category>Asia-/kulttuuriohjelmat</category>

</program>

<program>

  <name>Tv-uutiset ja s&auml;&auml;</name>

  <channel>yle1</channel>

  <category>Uutisl&auml;hetykset</category>

</program>

</programmap>

</body>

</html>
```

This forced the fetching process into the following two phases: first fetch and only print out those titles that were not found from the category mapping file, then manually add those "uncategorised" titles to the category mapping file and

run the fetcher again, this time storing the result in the database. All titles should be correctly categorised in this second run.

Besides Finnpanel's categories there is also an additional 10th category, "Muut", which will contain all the programs for which the matching category is not found. This might be the case if manual categorisation was not properly done or not done at all. The fetcher also uses one extra category, the "Skip" category, which is used to skip some unwanted programs. Skipped program information is not stored in the database, so the user cannot access it through the mobile television user interface. Skipped programmes are typically those long chat programs during the night.

There is a need to enable some named programs and to disable all others. In the case of the YLE channels (TV1 and TV2), ALL programmes are enabled, but in the MTV3 case ONLY NAMED programmes are permitted to be stored and watched from the mobile television user interface. This feature is implemented in Programme status, which can be any of following three values: PASSIVE, ACTIVE or NOTALLOWED.

The search feature uses the title and description. The problem is that the descriptions are written many days in advance, and they do not contain up-to-date information. It is not known in advance what will be in the news next week. This limits the search feature, but it is a quick way of finding a program if the user knows the title of the program. The user can browse the old and coming programs, and their descriptions, in the EPG (Electronic Program Guide), which is presented in Figure 17.

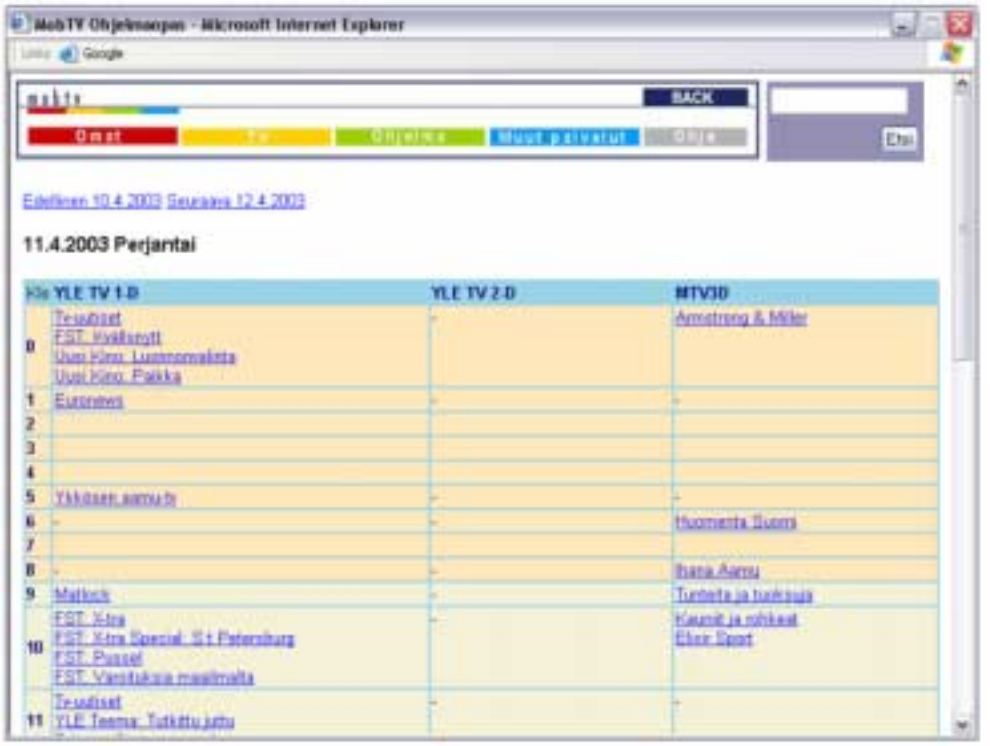


Figure 17. Electronic Program Guide.

When the user has selected one TV program, additional features related to that particular program can be selected from the Program (Ohjelma) menu. All the programs are divided into five-minute chapters, and by using the Chapters (Jaksot) feature the user can access these chapters directly. The user can view the description (from the YLE website), or sometimes a review, from the Programme menu. These reviews are gathered from Helsingin Sanomat's NYT website. Figures 18, 19 and 20 shows what these features look like in the system.

Figure 18. Contents of the program menu.

Figure 19. Program's five-minute-long chapters and their index images.

Figure 20. Additional information on the program.

Reviews for the movies shown in television

Every Friday the reviews of the TV movies are fetched from the NYT website:

http://www.nyt.fi/alaosasto.asp?path=790;90700&osio=Televisio&osno=790

The fetcher extracts following items for each review:

NAME	TYPE
publisher	fi.vtt.tte.mobile tv.basic.Publisher
tvChannel	fi.vtt.tte.mobile tv.basic.TvChannel
start	java.util.Date
title	java.lang.String
titleInBasicForm	java.lang.String
content	java.lang.String
contentInBasicForm	java.lang.String

The items "titleInBasicForm" and "contentInBasicForm" are Strings that result when the original text is filtered through the keyword indexing application (Morfo by Kielikone); storing the basic form of words allows more flexible and efficient searching.

Other features

The user can also give a rating to a program. The rating is given from the program's additional information page. All the user ratings are used when the overall rating is calculated. The user can add a program to his/her favourites from the Program menu.

In the Other features (Muut) menu the user can access the electronic program guide, EPG, modify his/her favourites, select a game and see his/her account. Favourites modification is restricted to removing. There is a price for each program in the Mobile television system. The price is based on the category the program belongs to. When the user selects a program, its price is added to the total money spent. When the user has paid for the program once, he/she can access it as many times as he/she wants without paying again. The total money spent can be seen in the account.

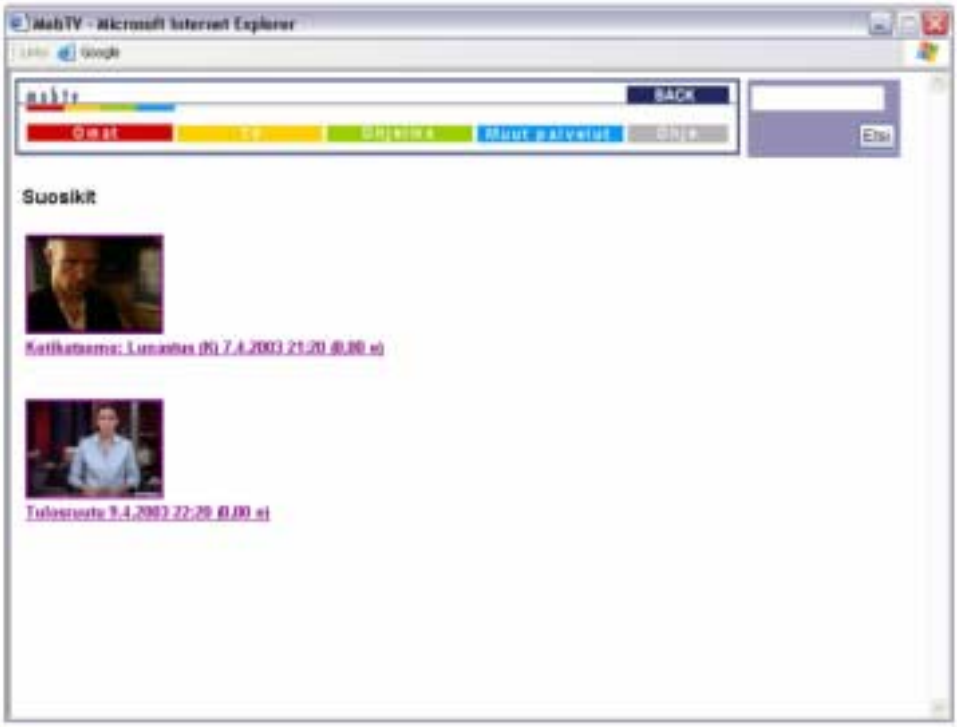


Figure 21. User's favourite programs.

5.5 TV programme capturing methods and video *quality*

There were three prequisities for the video encodings and formats in the mobile television:

1. MPEG-2 source material from the digital television broadcasts

2. MHP compliancy

3. PDAs have to be capable of playing the videos

MPEG-2 as a source means that whatever encoding and format is chosen there must be tools to do the conversion. MHP compatibility was the tricky part.

MPEG-2 can even be called native format for MHP, but there is no requirement for the MHP terminal to play videos anywhere other than the broadcast. So there is no totally MHP-compliant way of playing videos in this case. Our solution was to use JMF. The main advantage of JMF is that it is not restricted to any video encodings or formats. The applications that use JMF for media playback are not affected if the JMF implementation underneath changes. So, as long as JMF is used, the application can be seen to be fairly MHP compliant. A more detailed discussion on MHP-compliant video playback problems is in one of the project's earlier reports[66].

MPEG-2 could have been used in the Fujitsus, which have enough processing power. Windows Media Player 6.4 is capable of streaming MPEG-2 over HTTP, and a JMF interface to Media Player can be achieved as described in Chapter 5.3. Even the WLAN's bandwidth is enough for MPEG-2 (approx. 5Mb/s), but this would require optimal settings and no competition on bandwidth. The fixed connection to the WLAN base stations also has to have enough bandwidth. Still, it is clear that MPEG-2 is not a possible format for PDAs.

For PDAs, pure-Java MVQ video was tested. It would have been a great choice, but when it was decided that HTML was to be used, MVQ had to be discarded. In the PDAs the videos would have been played in a Java applet, but the MVQ version that worked as an applet with Jeode was not available. At this point video encoding and format were decided purely on the PDAs' terms. They have Pocket PC operating systems, so the choice was Microsoft's Windows Media, which is supported by the Pocket PC Media Player.

In the optimum setup there would be four different versions (different video quality) of each video clip:

1. Broadcast quality. The original MPEG-2, which can be used in Fujitsus.

2. High quality. About 1Mb/s, original resolution could have been used in the Fujitsu when there is not enough bandwidth for broadcast quality.

3. Mid quality. About 200Kb/s, optimum resolution and framerate for PDAs.

[66] http://www.vtt.fi/tte/mobtv/pub/kojo.pdf

4. Mobile quality. About 30Kb/s, used when there is only GPRS or HSCSD connection available.

The mid-quality version was considered to be the most important because it can be used in all the devices, and it would not require much bandwidth from the network. Different values were tested, and the best results on the Pocket PCs were found with the following values: mono audio, framerate 13fps, resolution 320 x 240 (resolution of the Pocket PC screen) and bitrate 225Kbps - including both the audio and the video. Before compression the original MPEG-2 video is first cropped to 640*480, so that the source material's resolution is the target resolution's multiple. This leads to better picture quality. The video encoding used was the Windows Media version 7, and the audio codec was Windows Media version 8. This mid-quality was used in the trials of both platforms. In the Fujitsus the video was zoomed to double. For the technical trials, mobile quality was also generated; the following table lists some of the parameters used with all three versions.

	MPEG-2	MidQuality WMV	MobileQuality WMV
effective bitrate	3-5 Mbps	225 Kbps	29 Kbps
video size (pixels, W x H)	720 x 576	320 x 240	160 x 120
frame rate (fps)	25	13	4

The only working streaming solution for MPEG-2 that we found was to use plain HTTP. Streaming here means that the playback begins immediately after the download has begun and the download continues in the background during the playback. HTTP is not a very sophisticated way of handling video streaming, but it proved to be adequate for the needs of the project. HTTP was also used with other video qualities, even though there wereother options as well. We used the Apache open source server[67] as an HTTP server. There seems to be a bug in the co-operation between Windows Media Player and Apache. It seems that the player is not capable of playing a video file before the previous one is entirely downloaded to the client. In normal situations this is not a problem. However, if there are delays in the network and the user wants to change the video file

[67] http://httpd.apache.org/

immediately after the playback has started, there might be a significant delay before the new file's playback begins. We are not sure what causes this behavior.

Recording and storage of television broadcasts

Three identical servers are used to record, store and serve the content. Each server handles one TV channel and has a TechnoTrend TT-PCline premium PCI card to receive the DVB-T broadcast. Large disk spaces are needed to store MPEG-2 files. An average size of a 5-minute clip is 200 MBytes; if 24 hours were to be stored in one day, it would take 57.6 GBytes of storage space. One week would then need as much as 403 GBytes of storage space. Fortunately, we do not store 24 hours of broadcast every day - the required storage capacity varies depending on the channel and how many programs are stored. The most demanding is the YLE TV1 server, since TV1 broadcasts almost around the clock. Next is YLE TV2; the least storage is needed for the MTV3D channel, where only selected programs are stored. Here are the hard disk sizes for the different servers:

TV1:	460 GB
TV2:	345 GB
MTV3D:	153 GB

Figure 22 illustrates the mobile television video server configuration and its most important tasks.

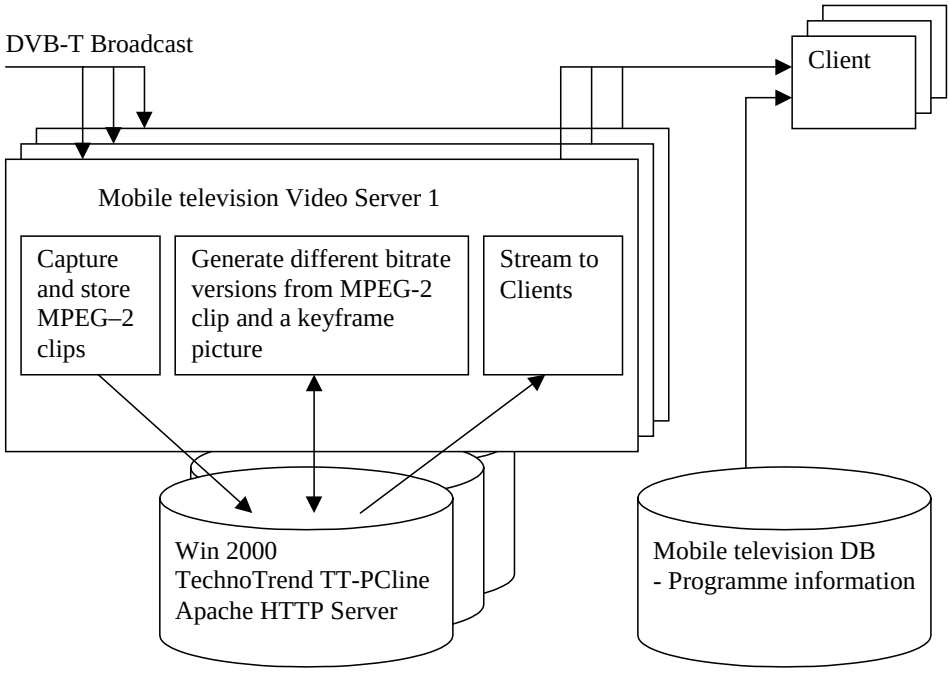


Figure 22. Mobile television Video Server Configuration.

TechnoTrend uses the PVA format when storing audio/video content, so we had to first convert PVA to MPEG-2 and then use Windows Media SDK to create different bitrate versions of the content. TV broadcasts are stored as 5-minute clips (chapters) in fixed subdirectories. Stored files use following naming convention:

d:\video\dd\mobile tv_cc_yyyymmdd_hhmm_q.ext

where

dd	= date subdirectory for this audio/video chapter (from "01" to "31")
cc	= channel number ("01", "02" or "03")
yyyymmdd	= year month date
hhmm	= hour minute
q	= quality constant
	1 = Broadcast Quality (MPEG-2 MP@ML)

3 = Mid Quality (Windows Media @ 256 kbps)
4 = Mobile Quality (Windows Media @ 56 kbps)
9 = Still Picture (JPEG thumbnail picture 112 x 80 pixels)

.ext = extension (".mpg", ".wmv" or ".jpg")

The archive is now limited to one week. A cleaning procedure runs every night at 05:00, deleting all files that are older than 7 days.There is always a capture and store program running on the video server. To capture just ”ON-AIR” chapters, this programme must know whether there is a broadcast on-air or not. For this need, one servlet call was specified: The ”is_broadcast_on_air” servlet, which returns a ”TRUE” or ”FALSE” answer to the calling C-program. The parameters to that servlet are ChannelNumber and TimeStamp.

Here are the steps of the process:

1. TechnoTrend stores PVA format	C:\upload\mobile tv_cc_yyyymmdd_hhmm_1.pva
2. When 5-minute clip is ready	C:\upload\mobile tv_cc_yyyymmdd_hhmm_1.~va
3. Check if this clip is "On-Air"	
4. PVAStrumento convert and move	D:\video\dd\mobile tv_cc_yyyymmdd_hhmm_1.mpg
5. WMEncoder generate MidQuality	D:\video\dd\mobile tv_cc_yyyymmdd_hhmm_3.wmv
6. Generate thumbnail picture	D:\video\dd\mobile tv_cc_yyyymmdd_hhmm_9.jpg
7. Empty file for MobileQuality params	C:\upload\dd~mobile tv_cc_yyyymmdd_hhmm_1.~pg
8. WMEncoder generate MobileQuality	D:\video\dd\mobile tv_cc_yyyymmdd_hhmm_4.wmv

Each step creates one new file in the video server. When step 1 is finished, a new 5-minute PVA clip is ready to be moved and converted. It takes very close to 5 minutes to produce MPEG-2, MidQuality and MobileQuality versions and a JPEG still picture. This means that **mobile television-recorded programs can be watched approximately 10 minutes later than live broadcast**. For example: a programme that starts at 13:00 can be viewed on mobile television at 13:10, regardless of how long the programme is - we can stream each 5-minute chapter to the client as soon as it is ready.

When Windows Media files are generated from MPEG-2 clips, the conversion makes new files that have reduced resolution and bandwidth demands.

De-interlacing problems can be avoided by cropping the original resolution of 720x576 to 640x480 before encoding to 320x240. Cropping values should be selected so that the safe zone area is not compromised, which means that we crop top and bottom 48 pixels, left 32 pixels and right 48 pixels.

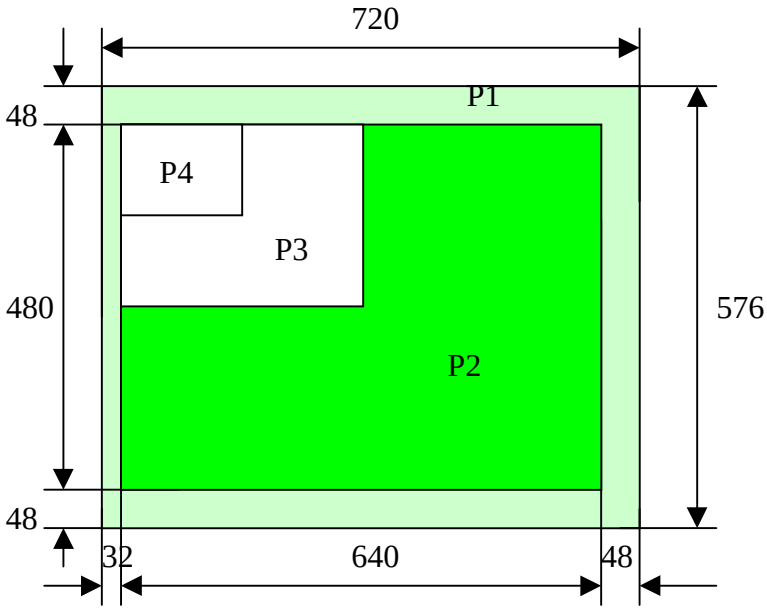


Figure 23. Cropping values and different Tv-picture sizes.

P1 = MPEG-2 Original Size 720 x 576 pixels
P2 = MPEG-2 Cropped Size 640 x 480 pixels
P3 = MidQuality WMV Size 320 x 240 pixels
P4 = MobileQuality WMV Size 160 x 120 pixels

5.6 Database

5.6.1 Introduction

The database of the mobile TV project runs in *IBM Informix Dynamic Server (IDS), Workgroup Edition, version 9.21*. The IDS (Informix Dynamic Server) Workgroup Edition delivers the performance, reliability and availability needed

for today's global, e-business enterprises It also provides scalability and simplified database configuration, maintainance and administration. IDS is a mature RDBMS (Relational Database Management System) that is able to handle the requirements of this project.

The mobile TV project's database name is **Mobtv**. Program metadata - i.e. the information related to the TV programs - are stored in the database.

The IBM Informix JDBC (Java Database Connectivity) driver provides a reliable and efficient way of accessing the Informix database in Java (Informix JDBC driver). The Java database access objects are built using the IBM Informix JDBC driver. They provide database access API (Application Program Interface) for the client modules to communicate with the database. Java classes are built for all mobile TV database objects.

5.6.2 Information storage

The EPG (Electronic Program Guide) data and movie reviews are stored in the mobile TV database. The content format is text. The metadata index is built for searching.

As this project deals with TV programs, the major goal of the database is to store the programs and user information. Ten database tables are created for data storage. Most application objects have their own table, such as the user table, the program table, the review table, and so on. Since this is a relational database, every table relates to others - some of them are one-to-many.

So far there are three TV channels providing programs for obile TV users. All the program metadata are stored in the table "program". Since the TV channels and program's categories are fixed, they are not stored in the database but in a class TVChannel and class Category. Thus getting the information from a constant class is much faster than retrieving it from the database. Mobile TV programs are stored as active for seven days. Instead of being deleted, the expired programs are marked as passive.

The table ”usr” stores user information, e.g. the user name, user password, user nickname, and so forth.

There is one important table named log_event, which stores every user's action log. With the log information, it is very easy to analysis a user's usage history and usage preferences.

The table "archive" stores the archive programs.

One program contains several chapters. The chapter's information is stored in the table "chapter".

Every user's favorites are stored in the table "favourite". The deleted favorites are not really removed from the database but are marked as 'passive'.

The tables ”rating” and ”rete_result” store information related to the users’ rating of programs.

The table ”review” stores program reviews. The resource of reviews is saved in the class Publisher. The reason is the same as the existence of the class TVChannel.

Mobile TV database objects have also respective classes in the fi.vtt.tte.mobile tv.basic package of the DB API (Database API). Because the DB API classes are implemented in an object-oriented manner, plenty of object-to-relational mapping is needed in the JDBC code.

5.6.3 Database API

The DB API is implemented in Java. The DB API provides client modules with a transparent interface so that they can just call the functions offered by DB API without having to know how the database works.

Package fi.vtt.tte.mobile tv.basic

This package contains the basic classes that represent the objects of the mobile TV application, e.g. Program for program objects, User for user objects, and so forth. The client side uses this package as an interface to get and set the objects' attributes.

Package fi.vtt.tte.mobile tv.dao

This package defines the database operations. The classes in this package are either abstract classes or interfaces. The abstract classes provide the default behaviors of the database operation. The interface DaoFactory defines the basic function of the DAO (Database Access Operation) Factory according to the Factory pattern (Factory Design Pattern). The abstract class ContentDao is the basis of DAO behaviors. The class UserDao defines the most important user actions.

Package fi.vtt.tte.mobile tv.dao.informix

This package contains the classes that implement database actions in package fi.vtt.tte.mobile tv.dao. They extend the abstract classes or implement the interface. The database connection is established by the class InformixGtonlineConnector. A single connection object is used for each database retrieval operation and for modification operations that require no transactions. A new conection object is created for each modification operation that requires a complete transaction.

5.7 Personalising the Electronic Program Guide

By personalising the TV services, the viewers get a more friendly interface, save time, and, if they wish, help the metadata providers to collect the viewing information for their business needs.

In our case the possibility of personalising the Electronic Program Guide (EPG) was added to the system (Ning, 2003). The system automatically generates program recommendations for a certain viewer based on his set priorities and his

viewing history. However, this feature was not ready at the time of the field trial so it could not be included.

The feature was implemented according to the recommendations of the global TV-Anytime Forum, which is an association of approximately 146 member organisations seeking to develop specifications to enable audio-visual and other services based on mass-market high-volume digital storage in consumer platforms (TV-Anytime Forum). The forum has published Metadata specifications to accompany its Content Referencing and System Description specifications based on an XML (Extensible Markup Language)/XML Schema framework, identical to that of MPEG-7 (Moving Picture Experts Group). TV-Anytime adopted the User Preferences Description Schemes and the Usage History

Description Schemes from the MPEG-7 Multimedia Description Schemes specification.

There are two parts to the personalisation system, Usage History and User Preferences. A user's actions performed over a period are recorded in Action Lists, which subsequently form Usage History (TV-Anytime Metadata Specification, 2002; ISO/IEC 15938–5). By tracking and monitoring an individual member's consuming habits, we can build a personalised TV guide for her/him.

Usage History Description Schemes describe the usage history information of a user or group of users over extended periods of time. When a customer requires the TV guide, instead of receiving all the available programs, his/her most preferred ones are shown. If there are no his/her programs in the 'Preferences list', s/he can require all hidden programs and choose what s/he wants.

User Preferences pertain to consumption of multimedia material (TV-Anytime Metadata Specification, 2002). Analysing the relationship between the user ‘s preferences and media descriptions facilitates the personalising of this project accurately and efficiently. The user can filter, search and select his/her desired content by setting the preferences. Users can keep their privacy. They can indicate whether external parties may access their preferences and whether their preference data may be updated automatically (Manjunath et al., 2002).

5.7.1 Overall System Description

The personalisation system implements the TV-Anytime metadata specification (Ollikainen, 2002). It is a server-side application. The upper side of Figure 24 shows a logical presentation of the personalisation application architecture. The EPG (Electronic Program Guide) data and movie reviews are stored in the mobile TV database. All of the user's actions, which form the Usage History at the end, are recorded in the server. Analysing the Usage History gets Usage Preferences.

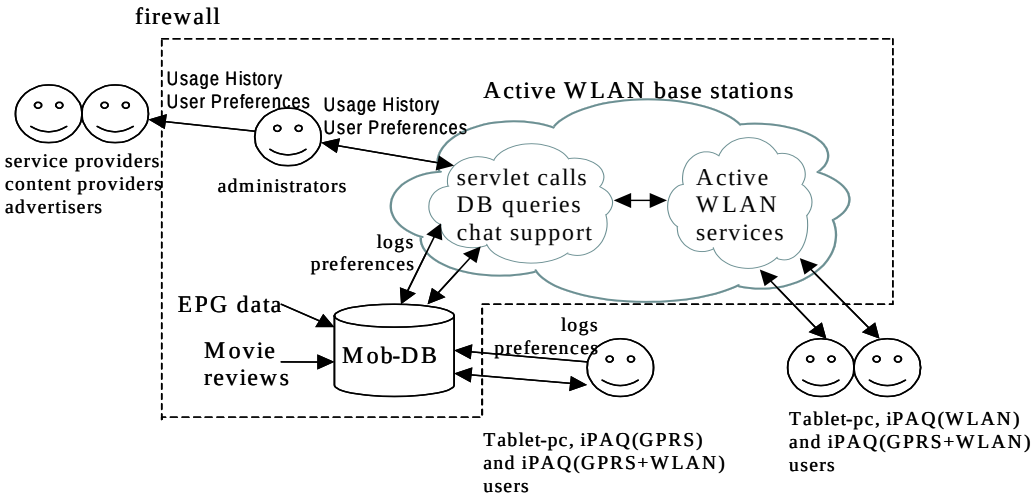


Figure 24. Personalisation System overall description.

When the user requires the program menu, the Usage Preferences are first checked on the server side. A list of programs that might be the user's most favorite ones are shown. In case this preference program list does not match the user's requirements, the original program list, which contains all available programs, will be shown to the user.

The content filter and search engine can be set in the local multimedia system (Manjunath et al., 2002). It is also possible to design the engine on the server side. The latter is adopted in this project. In this way users are able to use difference devices to get the same preference setting without having to configure

again. All the functionality is fulfilled on the server side. Every user's Usage Preferences are stored in the Mobile TV database.

5.7.2 Usage History

Before generating the UsageHistory, the user or group of users whose content consumption information is to be gathered, must be identified. The Usage History is specified by one or more UserActionHistory. The UserActionHistory description scheme contains multiple lists of actions performed by the user over an observation period. Each action list contains one action type, which is defined by the type of action and number of user actions of this certain type. As to one user action, the program identifier is attached if that action took place for it. The action time information associated with each user action is specified in terms of general time.

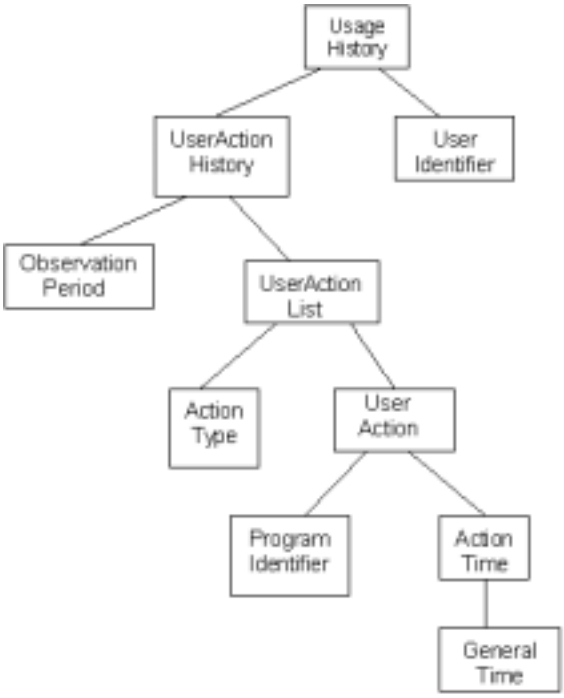


Figure 25. Usage History Description Scheme.

There are 15 types of actions. They are:

- Login
- Logout
- Modify user information
- Select automatically-generated chapter
- Modify user preference
- Check account
- Modify favourite
- Modify archive
- Select TV guide
- Select TV channel
- Search
- Select object (series, program, chapter, TV channel live broadcast or review)
- Select program-related operation
- Stop playing a chapter
- Select game

The first 8 types are not so tightly related to the content consumption, so they are left out. We are more interested in last 7 types of actions, which are listed in the Usage History.

Each user's actions are stored in a log file in the database for analysis. There are Web pages available for collecting the usage history information: Fill in the user's name, select the observation start time and period, and you will get the UsageHistory XML (Extensible Markup Language) file.

There is a small simplification of the usage history description definition. First, the user should be able to decide whether his/her usage information is allowed to be collected or not. The default setting is 'not_allowed' (TV-Anytime Metadata Specification, 2002). But, in this project, all we have are test users. We need their usage history information for further analysis. Thus we consider the value as 'allowed'. The UserActionHistory description scheme contains multiple lists of actions performed by the user over one or more non-overlapping observation periods (TV-Anytime Metadata Specification, 2002; Manjunath et al. 2002). Due to the Web page’s layout, we just ordered one observation period input at this stage.

User Preferences

There are two ways of getting the User Preferences description schemes: by analyzing the UsageHistory or being set by the user (TV-Anytime Metadata Specification, 2002). In the mobile TV project we used the second one. Web pages are offered to the user for setting their preferences. The result is stored in the database. When the user wants to change the setting, open that page and the next setting values are shown.

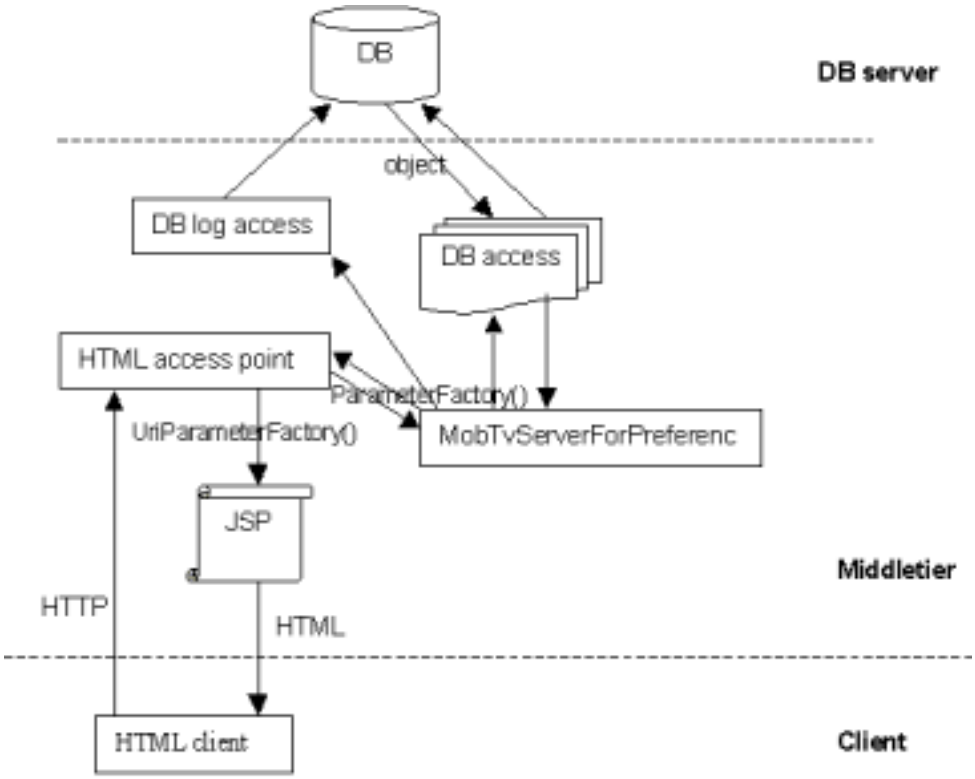


Figure 26. User Preferences structure.

After setting the preferences, the user can see a simplified TV guide with their favorite TV channels and favorite TV program categories. If the user has never set the preference setting, the preferred TV guide would be the same as the normal one, which already serves. This function is embedded in the Mobile Television User Interface.

The user sends HTML (Hypertext Makeup Language) requests using HTTP. The HTML access point handles the requests and calls the class Mobile tvServer, which automatically selects the correct subclass by the class of parameter generated by ParameterFactory. Then the class Mobile tvServerForPreference processes the request, handles the database operation and returns an object as a result to the HTML access point. According to the returned object and the parameter class, the HTML access point calls the class UriParameterFactory to convert the objects to URLs (Uniform Resource Locator). The desired JSP page is shown (see Figure 26).

17.4.2003 Torstai

Klo	YLE TV 1-D	YLE TV 2-D	MTV3D
0	Euronews	-	-
1			
2			
3			
4			
5	Ykkösen aamu-tv	-	-
6			
7			
8			
9	Matlock	-	-
10			
11	Tv-uutiset	-	-
12			
13	Tv-uutiset Prisma Studio Maailmannäyttämöllä	-	-
14			
15	Tv-uutiset	-	-
16			
17	Tv-uutiset ja Viiden talous Viittomakieliset uutiset FST: Kortnytt	-	-
18	FST: TV-nytt	-	-
19	Kotikatu	-	-

Figure 27. A Personal Programming Guide generated by the system.

5.8 Game

At the beginning of the Mobile Television in 4G Networks project we defined business-oriented and technical requirements for the mobile digital television system. We decided the content and interactive services that should be delivered to the mobile terminals and offered to users. We evaluated the alternatives on a scale of 0-2. Besides the evident television program-related content (EPG, etc.), we also discussed other interactive services - like peer-to-peer, entertainment, MHP games and communication - that should be considered. Games were chosen as a testing ground because of their wide range of use, accessibility and high level of interactivity.

The challenge was to consider the linkage to the actual broadcast content, the placement of the game in the mobile terminal's menus (whether to be connected to a certain program, located in the separate game menu, etc.), the technical demands of the digital television system, and the mobile game design and mobility. In other words, the game should be accessible anytime-anywhere, to be played alone or together with others, to enable peer-to-peer connection and pervasive computing or positioning systems (at least theoretically at this stage). It is important to notice that the mobile device is personal tool and, within the mobile digital television system, is connected to 1>N broadcast television programs. On basis of this, the production of local innovations and use of local information are just some possibilities a mobile digital television system can offer the user.

Within the project we produced a report entitled "Game Design for Mobile Digital Television" (Kangas, 2002b). The project includes discussions about game design for a new type of integrated mobile device. We collected the values of current mobile and digital television games, and listed the possibilities and restrictions for creating personalized entertainment for iPaq and TabletPC, the multi-user possibilities of the entertainment content, localization and ubiquitous-computing issues, and gaming connected to advertising, education and communication as well as to the idea of multiple media. On the basis of the report, we made a game design plan (Kangas, 2002b) and implemented some parts of it in the mobile digital television test system. The grounds for not producing the game as a whole were clear. The game was a prototype made with Macromedia Flash. It was impossible to simulate a real-life usage situation

because no television program was designed for the project. In the prototype the game was presented as a separate option, although in the game design plan the central idea is that the game is intensively interacting with the broadcast content.

Figure 28. At a Venture game.

Through the idea of educational multimedia for mobile digital television we were able to consider different usage situations and new user groups. Television can be found in over 90 per cent of homes, and are viewed by almost everyone in the western world. The audience of digital interactive television entertainment is not just the typical player demographic 13–30 year old males – it is everyone from preschoolers to pensioners (Lynch, 1998). We find it fruitful to study the young users because they are forerunners in mobile communication and quick to adapt to the new mobile services and applications (Coogan & Kangas 2001).

We designed an educational language game, "At a Venture", to be used together with a television program. As the program advances, different tasks are offered to the user. The tasks are tightly connected to the actual story and problems in the current series of the television program. The user chooses the level at which she/he wants to participate. An educational language game was applied because of experience in designing edutainment (education + entertainment) programs for studying foreign languages (e.g. Hewitt, 1998) and the role of the user is clear in programs in which homemade tasks are offered to the user. We designed the game mainly for children because we had a lot of knowledge of children's usage and

interests (e.g. Suoranta & Lehtimäki, 2003, Kangas, 2002a). The challenges of designing for children are notable. They do not necessarily see all the nuances or differences between fact and fiction, thus in an educational program the mix of entertainment and education has to be fluent and clear. The key issues when designing content for mobile digital television terminals are the entertainment needs and the limitations of the interface - e.g. slow-pace interaction, screen resolution, battery life and networking.

We discovered several aspects that affected the game design process and should be carefully considered in future projects. Those aspects were noticed in the At a Venture game as follows. Social communication between the users was pointed out as an important aspect. Mobile digital television allows the user to use broadcast, cellular and wireless local area networks. This allows the peer-to-peer services to be developed. The At a Venture game was designed for children playing with the mobile digital television terminal by themselves, sitting in the back seat of a car or at home. It can be used in a group, but at this stage it was mainly designed for a single user. There are certain challenges in connecting interactive entertainment to broadcast content. We found that a smooth and always-on connection between the broadcast television program and the add-on entertainment is important. The add-on game should be developed side-by-side with the actual program in order to get the greatest benefit out of it. In this way the add-on entertainment will not become too dominant or too separate but will support the informational content of the actual television program. It will also enable the user to practice the difficult parts in greater depth and/or skip or find challenges in the game if a lesson in the television program is too easy.

In our design we tried to meet the technical, usability, game design and pedagogical needs. We were not able to study the pedagogical needs that deeply in this project because we did not have a television program to be connected with. Also, due to the lack of a well-defined user group, we kept the pedagogical issues in mind on a theoretical level throughout the game design process. We studied the technical development of different (mobile) digital television systems and pointed out the possibilities of using educational entertainment for motivating the users to learn and to participate in a mobile situation as the immersed user is an active participant but also an external observer in the game world.

New possibilities of creating content for digital television arise in mobile digital television. One can consider entertainment and games as additional content for broadcast television programs, or even discuss the possibilities of mobility in this context. That would mean communicating with the everyday environment (ubiquitous computing) and with other users (positioning systems, multi-user playing) anywhere-anytime.

Due to the economic growth and increased importance, as well as the widening target groups for digital games, it is oir view that they will influence the future development of ICT. One development step for Information and Communication Technologies (ICT) is the development towards Quality of Life (QoL) technologies. These will contain the ICT abilities enhanced by e.g. entertaining experiences, environmental issues and locality. Local innovations and usage are one area of interest when implementing the interactive services of mobile digital television. Edutainment games, or, more widely, utility games, will offer possibilities for local user innovations because the application area is growing and will contain several aspects, like television program-related peer-to-peer material, local educational content delivery and local user-generated information as well as other regional usage opportunities.

5.9 Automatic indexing of television programs

Mobile television would gain from the ability to make searches based on program content. Therefore, we studied how automatic recognition of Finnish speech could be utilised for transcription and indexing TV news program content (Melin, 2001). The study showed that state-of-the-art recognition of Finnish speech only manages to correctly transcribe 40 % of the words spoken in the broadcast. As a conclusion, we decided not to include this feature in the prototype. However, automatic transcription remains an interesting topic for future study.

6. Field trial

6.1 The process

By adopting the Human-Centred Design approach we can assure the usability of the product to be developed. The key issue is to accept the fact that in most cases we cannot fix exact user requirements at the beginning of the design process. That is why we have to refine the initial user requirements throughout the design process by showing the planned design decisions to the users and actively gathering their feedback. We also wanted to discover people's attitudes and opinions on payment. Issues related to payment were also investigated in the Futuuri exhibition on 13 and 14.11.2002 (http://www.mindtrek.org/en/exhibition/) by asking exhibition visitors to fill in questionnaires (Appendix O). All of these research themes are related to how people will adopt the new service. See Table 3 for detailed information.

Table 3. Research questions in detail.

Ease of use	**Usefulness**	**Payment**
General research problems related to ease of use: - *Learnability:* How easy is it to learn to use the system? - *Memorability:* How well do users remember how to use the system? - *Absence of errors:* What kind errors exist in the system? - *Efficiency:* How quick and easy is the system from the user's point of view?	**General research problems related to usefulness:** - *Satisfaction:* Are the users happy with the way the mobile television functions? Is the system pleasant to use? - *Effectiveness:* Does mobile television include the correct features from the user's point of view?	- What is the general opinion of payment? - What would be a suitable way to pay from the user's point of view? - How much are the users willing to pay for the service? How much per month? How much per program?

Table 3. Continuing.

Specific mobile television-related research problems: - Size: What is a suitable size mobile television? What is a suitable size of screen for viewing television? - Quality of sound and picture: How important is the quality of the sound and picture in mobile contexts? - Other related issues: battery, screen reflections, use of stylus pen, etc.	**Specific mobile television-related research problems:** - Content: What kind of content are the users interested in? What kind of content is suitable for mobile use from the user's point of view? - TV-anywhere: In what kind of places and situations is the mobile television mostly used? How does TV-anywhere change viewing habits? Does the place or the situation have an effect on what programs are viewed? How does a public place and other people affect viewing habits? - TV-anytime: How does TV-anytime change viewing habits? - Additional services: How much are the additional services used and how useful are they from the user's point of view? - Other related issues: Is the mobile television viewed alone or in a group? How is it used compared to other media? Is it used for keeping up to date on current events? Etc.	

6.2 Before the trial: expert evaluation and technical pilot test

An expert evaluation of the system was made before the actual field trial. The goal was to find the main technical and usability problems in the system and correct them before the trial. The evaluation was made by three usability specialists and was based on Jacob Nielsen's usability guidelines (http://www.useit.com/papers/heuristic/heuristic_list.html). The usability of the system was evaluated with both the PDA and the Tablet-PC. The specialists first agreed on the tasks by which the usability of the system was to be tested and then evaluated the system individually and as a group

The functioning of the mobile devices in the WLAN was tested by three pilot test users. One of them used iPaq and two used Jornada. The testing period lasted for one week. The main idea was to see how reliably the WLAN

functioned in Tampere city center. The test users were instructed to access the Internet and view www pages in different physical locations and at various times of the day.

Different problems relating to implementation, networks and Media Player were found in the expert evaluation and technical pilot. Improvement suggestions were discussed in the project group after the evaluations the. The system was developed according to the discussion.

6.3 Set-up and method

A total of 81 people participated in the trial (45 male and 36 female, age range from 4 to 72 years). They were divided into five different groups: spare-time-users, workers, students, adult family members and child family members (see more details on user groups in Chapter 6.5). The spare-time users and the families were selected from a large pool of volunteers who enrolled through a newspaper advertisement. Users in the students group were asked to participate in the trial by emailing them through the university mailing list. The workers were asked to participate through email as we knew beforehand that this certain company had a WLAN at their office.

Every test user was supposed to use the system for four weeks. The actual usage time varied from 3–5 weeks. The field trial was divided into four periods (see Table 4). The first period started in October 2002 and the fourth period ended in February 2003. The division was necessary since the number of test users was bigger than the number of available devices and any technical problems were easier to correct as not all the test users were participating in the trial at the same time. Every user in the field trial was assigned one main place where they were supposed to use the mobile television. In addition, they were asked to use it in other places if possible. The testing environments in the trial were: Keskustori in Tampere city centre (eTampere relab network, Figure 29), the cafeteria in the main university building, a workplace, a cafe in the city centre and nine homes. It was possible to access a WLAN with a mobile device in all thse places. A WLAN was installed in the homes of those families participating in the trial (more details in Chapter 6.4).

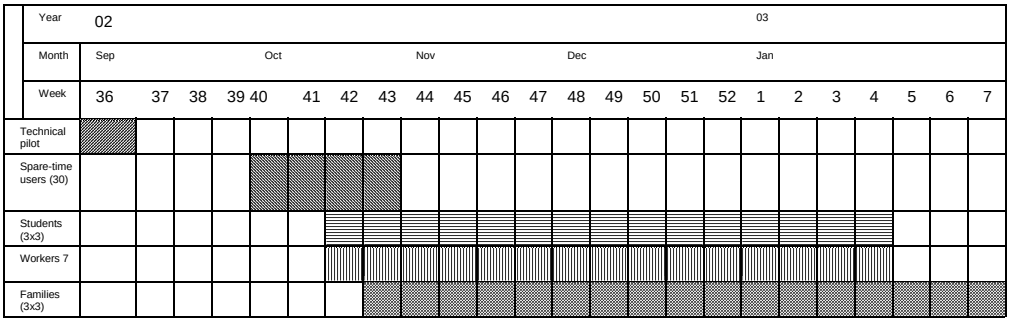
Figure 29. eTampere relab WLAN area.

Information was collected via interviews (see Appendix P) and questionnaires (see Appendices Q and R) throughout the trial. In addition, log information was gathered as all the users accessed the mobile television with a personal id-number and password.

At the beginning of the trial the users were taught to use the system, asked to fill in a background information form (see Appendix S) and sign a research permit. Younger children (11) were given a different background information form than teenagers and adults, as can be seen in the description of users in Chapter 6.5. The users were also given some written instructions and were asked to contact us as soon as possible if some technical difficulties or questions appeared. Near the end of the trial they were sent a questionnaire asking about issues related to the usability of the system. The questionnaire was given back in the final interview after the trial period. Most of final interviews were done individually. Younger children were not asked the same questions as adults in the interviews. Suitable questions were chosen according to their age. In the families group all the family members were interviewed at the same time, except for two families - In one

family the children were interviewed separately and one person from the other family answered by email. One of the spare time users wasn't interviewed and one family user had to leave before the interview was finished. The interviews focused on the themes referred to in Chapter 6.1. The interviews were recorded and pictures of the users and usage situations were taken.

Table 4. Field trial schedule.



Statistical information

The following log information was gathered: how much the system was used in total, when it was used (day of the week, time of the day), which channels and programs were watched and how much and which additional services were used (search, TV guide, TV guide's additional information, modify favorites, game, additional information on programs, add program to favorites, rate the program, view program chapters). The log data was evaluated statistically.

Some rules had to be made to manage the gathered log data. Login was counted as new (start of new watching session) if the time after the preceding log event was at least 30 minutes. If the time between the preceding event and login was shorter, login was considered an accident - e.g. the user had closed the service accidentally and logged in again. An exception was made if the preceding event was logout. Login following logout was counted as new even if there was less than 30 minutes between events.

> *Lengths of sessions were difficult to count since most users quitted watching sessions without logging out of the service. This made it cumbersome to specify the exact length of the session since the length of the last event was unknown.*
>
> Man, age 48 (Workers group)

The problem was solved by counting the average length of all known last events and giving that value to all unknown last events. The added value was 2 minutes 17 seconds. When the picture of the session length distribution (Picture 55) is studied the following should be taken into account. Sessions longer than 120 minutes (54 sessions) were excluded. The reason for exclusion was a possible mistake in the log information.

The number of watched programs was so calculated that if the same program was chosen twice or more during the same session, it was only counted once. It was thought that people would not have watched the same programs several times during one session and the log event was caused by some other reason. Still, when the distribution of program length (Picture 56) was counted every program choice was included except those programs whose length was unknown. The length of program was unknown if it happened to be the last event in a session that was quitted without logging out. To get a picture of how long users might have watched those programs, the average length of the last known program was counted. The average length of these programs was 3 minutes 45 seconds. Programs that exceeded 60 minutes were excluded (18) from the distribution. The reason for exclusion was a possible mistake in the log information.

Most of the log information in the study is reported with averages. It should be noted that when counting averages of small groups, each observation, even rare ones, can be significantly important. Thus these so-called outliers can have a bigger effect on the results than they would if the group was bigger.

6.4 Client devices used in the mobile TV field tests

The users in the student, free-time and workplace groups used the PDA devices. Most of the test people used HP Jornadas and a few were given HP (Compaq) iPAQs. Both PDAs had very similar specifications. Both had 64MB of memory and a 240 by 320 pixel active matrix 16-bit color screen capable of showing 64K colors. The Jornadas were equipped with Symbol Spectrum24 WLAN cards and the iPAQs with Compaq WL110 cards. The operating system in both devices was Windows CE 3.0-based Pocket PC 2002 and both devices had a speaker and an earphone jack.

Figure 30. HP Jornada 568 handheld computer with Pocket PC 2002 operating system and active matrix screen.

The users in these test groups watched mobile TV in places where there was already an existing WLAN available. Mobile TV was available in Tampere's central square, a cafe at the University of Tampere and another café in Tampere where a wireless connection to the Internet is provided for customers (Wayne's Coffee).

The only pieces of software needed to watch the mobile TV were Internet Explorer web browser and Microsoft MediaPlayer video viewer.

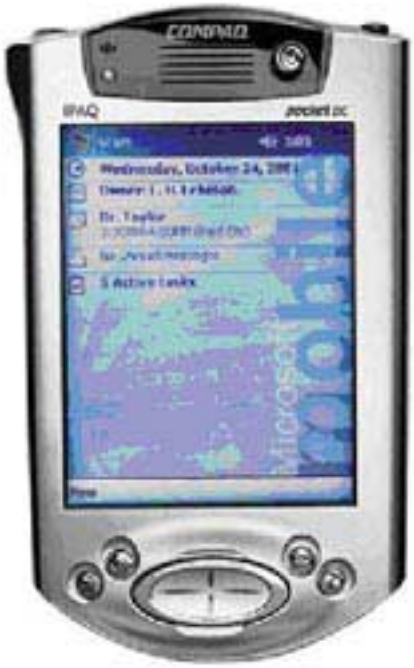


Figure 31. iPaq 3870 with Pocket PC 2002 operating system and 206Mhz Intel StrongARM 32bit RISC Processor.

Two different devices were given to each test family: a PC without a keyboard (a table PC) and a handheld computer. The handheld computer was an iPAQ and the bigger device was a Fujitsu Stylistic LT P-600 tablet PC with a Cisco Aironet 350 WLAN card. The Fujitsu had Windows 2000 as the operating system and Java for the Java Mobile TV client. The latter parts of the field tests were done using an HTML version of mobile TV and Java was no longer needed; InternetExplorer with the newest version of Microsoft MediaPlayer were enough.

Figure 32. Fujitsu Stylistic LT P-600 is a tablet computer with 800 x 600 true color display.

The test system for families was built around a high-speed (4 Mb/s) ADSL Internet connection. A few families had already Internet connections, in which case we upgraded the speed for the time of the test period. One family had a cable modem connection and another a VPN-based connection; those were used without modification. For the rest of the families we rented an ADSL connection and an A-Link RoadRunner 44 ADSL-router with 4-port switch from Soon Communications. For the families who already had an ADSL connection, we used an SMC Networks Barricade 4-port Broadband Router to get a free Ethernet port for our WLAN base station.

We used the Cisco Aironet 350 Wireless access point as the WLAN base station. Normally, all devices were configured to use the DHCP protocol to get IP addresses, which made setting up the system simple. Once the ADSL modem and the base station were connected, mobile TV could be accessed through the wireless connection. In one case we could not use automatically assigned addresses because of the existing settings, and in the case of the VPN-based connection we could not find a suitable VPN client for the iPAQ in time. In most cases we were able to place the WLAN base station so that mobile TV covered the entire home.

6.5 Field trial usergroups

When the field trial users were selected, the aim was choose as “ordinary” people as possible. A total of 81 people participated in the field trial - 45 men and 36 women. The participants were classified into 5 groups according to the main place they used mobile television. Spare-time users, 34, were in the majority. They mainly used the service in Tampere city centre; 9 student participants used the service mainly at the University of Tampere; 7 users were able to use the service in their workplace; and the family users, 18 adults and 13 children, used mobile television at home.

Figure 33. Mobile television in a coffee house.

The youngest user was 4 years old and the oldest 72 years old. The average age of a user was a little under 31. The age distribution is presented in Table 5. 18 test users were still at comprehensive school or had graduated from there, 14 users had graduated from secondary school, 5 had vocational education, 23 users had polytechnical education, 3 had Bachelor of Science degrees and 13 had Master of Science degrees. Two had a post-graduate degree. One respondent did not give details of her education and 2 of the childen had not reached school age. The users worked in several different areas: education, engineering, cleaning, building and customer service.

The estimates of television viewing times during the week varied from 2 hours up to 40 hours, as can be seen in Table 6.

Table 5. Age distribution.

Age group	NO. OF MEMBERS
0-12	10
13-20	12
21-30	24
31-40	15
41-50	12
51-60	3
61+	5

Table 6. Estimates of television viewing.

Viewing time per week	FREQUENCY
0-5 h/w	7
6-10 h/w	30
11-15 h/w	22
16-20 h/w	12
21-25 h/w	4
26-30 h/w	0
31-35 h/w	3
36-40 h/w	2
No answer	1

Most of the field trial participants, 52, considered themselves very experienced or experienced computer users; 14 thought they were relatively experienced users; 3 stated that they did not have very much experience; and 1 did not answer the question. The children were not asked this question. Computer use times per week varied a lot, as can be seen in Table 7.

Table 7. Use of computer, hours per week.

Hours per week	At work	At home	Children
0-1 h	6	8	1
1-4 h	15	23	1
4-7 h	6	15	2
7-10 h	5	10	4
10-20 h	9	8	3
> 20 h	21	4	0
No answer	8	2	0

About 90 % of test users used a mobile phone and computer regularly. A PDA or electronical calendar was used regularly by a little under 10 % of the interviewees. About one-quarter used a DVD player and three out of five used teletext. About two-thirds of the test users used video, a radio and a CD player regularly. About 65 % used video and 60 % teletext at least once a week.

Nineteen users were willing to spend a maximum of 20 € per month on a mobile phone; 26 would spend 21–40 €; 16 users 41–60 €; 6 users 61–80 €; 5 users 100 €; and 1 user 200 € per month. Two children would not spend anything on a mobile phone and 6 people did not answer.

Most adult users browsed the Internet less than 10 hours per week (see Table 8). Six children used the Internet daily and four children used it every once in a while. The time spent on the Internet varies from 30 minutes to 5 hours at time. One did not answer the question. Forty-four of all users never chatted on the net and 33 users never used discussion groups on the Internet. Chat was used occasionally by 26 users, while 33 users occasionally participated in discussion groups. Six people chatted often and 12 often participated in discussion groups. Five people did not answer the question about chat and 3 about discussion groups.

Table 8. Time used for Internet browsing per week.

Time (adults)	Frequency
No browsing	1
0-1 h/w	4
1-4	18
4-7	18
7-10	10
10-20	6
Over 20 h/ w	0
Connection open all day long	12
No answer	1

The adults were asked about the main reason they watched television. Many of them chose more than one alternative. The most popular reason was relaxation and entertainment (61) and the second most popular was acquiring information (16). Other alternatives were chosen casually. Besides watching television, using teletext and video were popular among all field test participants. All but one of adults gave an answer when asked about their knowledge of digital television. Most (48) thought they knew the basics. Thirteen thought they really know nothing and 8 considered themselves experts in the field. Most (47) were interested in digital television on a moderate level and 20 thought they were very interested in it. Three repsondents were not really interested. About one-fifth of the adults interviewed had ordered chargeable channel packages.

6.6 Results

6.6.1 The use

Different user groups

The field trial user groups were spare-time users, students, workers, family adults, and family children. Figure 34 presents average logins per person in the different user goups according to the log information. On average, the spare-time users logged into the mobile television service 5.5 times, students 8.2, workers 6.9, adults in the families 14.8 and children in the families 13.2 times.

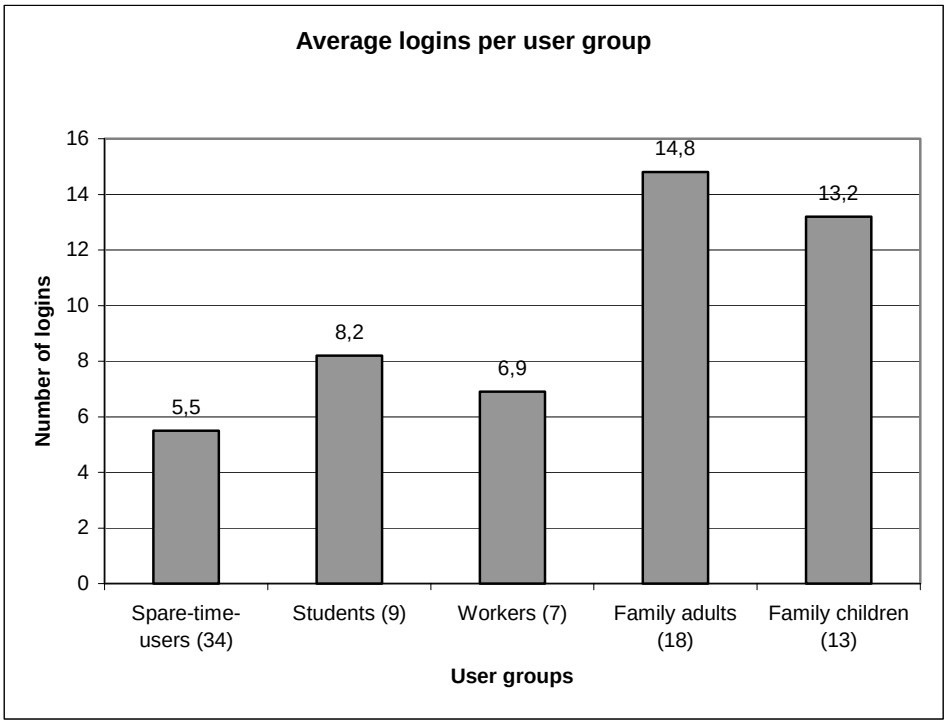


Figure 34. Average number of logins per person in user groups.

For all users (81 users), the average number of logins was 9.2 per person, and they watched an average of 2.3 programs per login. The spare-time users only watched 1.7 programs per login. The mobile television was mainly used in the main testing environment assigned to them. The environment seems to have affected the amount of use. The families used it the most as they were able to use it at home (see picture 9.6). Surprisingly, children under the age of 12 were the most enthusiastic users. They watched children's programs (Pikku Kakkonen), for example, in the late evening.

The spare-time users used it the least as they only used it while passing by Keskustori (in the city centere) on their way to work or school. The wintertime also made it difficult to use mobile television as the WLAN in the city centre only functions outdoors. The place also limited the workers' use since their main testing enviroment was at work. They also said that they couldn't find time to use mobile television during the working day and thought mobile television was not so useful in work-related issues. The students mostly used the service at the

university, which limited their use during late nights and weekends. Mobile television would have been used more by all groups if the trial environment had been as extensive as the mobile phone enviroment.

> *"Every day. I watched it every day in the beginning. When the wintertime and snow came I watched it maybe once a week"* [68]
>
> Man age 17 (spare-time user group)

Figure 35. User from the worker's group.

Many users used to watch only a short part of a program and then jumped to another program (see Figure 35). This could be analogous to channel hopping. This behavior is, in part, a consequence of the technical difficulties - e.g. slow program loading – which meant that they were not able to view the first program or they did not have the patience to wait for it to appear. The test users also browsed through the program lists to see recently broadcast programs.

> *"I checked the news a couple of times just for my own interest. I might have had something to follow. Otherwise, I just checked*

[68] "Joka päivä. Katsoin alkuun joka päivä. Sitten kun lumet tuli niin ehkä kerran viikossa."

what's up in the channels. I seldom watched the whole program. I just watched the beginning of the program and if it was interesting, I watched it. If it wasn't, I watched something else. Also, if I had to go somewhere, I quit." [69]

Man age 15 (spare-time user group)

Age and gender

Men used mobile television a more (mean = 9.9 logins) than women (mean = 8.4 logins). There was no gender-related difference in the number of watched programs per login; women watched 2.5 programs per login while men watched 2.3 programs per login. Children under the age of 12 and adults from 41 to 50 were the most enthusiastic users. This is explained by the fact that many family users, who used the service at home, were in these age groups. Young adults from 21 to 30 used the service less than other groups (see Figure 36). This might be due to the many spare-time users in this group, which used mobile television less than the other groups (1.7 logins per person on average). There were also several spare-time users in the age groups 13-20, 31-40 and 61+. The number of family members' logins increased the number of average logins in the age group 31-40, compared with the 13-20 and 61+ groups.

[69] " Kerran pari taisin vilkaista uutisia mielenkiinnon vuosi. Taisi olla jokin juttu mitä piti seurata. Muuten katseli mitä tulee kanavilta ja klikkaili sen mukaan. Harvemmin jaksoin katsoa ohjelman loppuun. Katoin vain alkua ja jos kiinnosti katoin, mutta jos ei, niin katoin jotain muuta. Joskus myöskin ohjelmat jäi kesken, kun piti mennä johonkin "

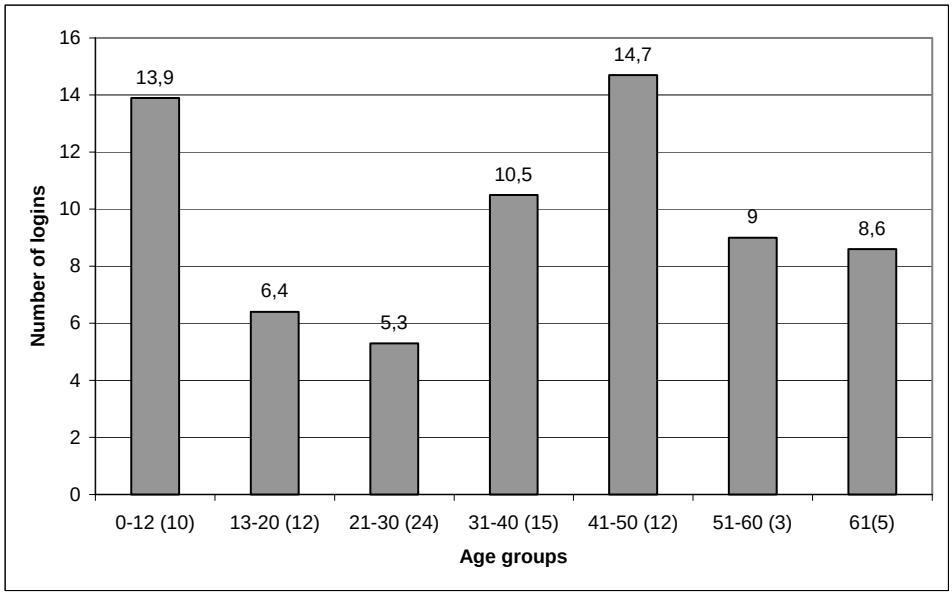


Figure 36. Average logins per person in age groups.

As previously mentioned, families used mobile television the most. A nine-year-old boy said that he sometimes watched the programs so often that there was nothing left to watch (see Chapter 6.6.6). On the other hand, a twelve-year-old girl said that she didn't watch so much because the channels that she usually watches were not in the trial.

> *"I browsed it everyday. Every once in a while I didn't have anything to watch because I had browsed through them all."* [70]
>
> Boy age 9 (family children)

Days of the week

Mobile TV was used more during weekdays than during weekends (Figure 37). Thursday and Friday were the days the devices were given to the spare-time users. This stands out in the chart, but there is no actual difference in the amount of use between weekdays.

[70] "Selasin joka päivä. Välillä mulla oli sillain, että mulla ei ole yhtään ohjelmaa katsottavana kun olin käynyt kaikki läpi."

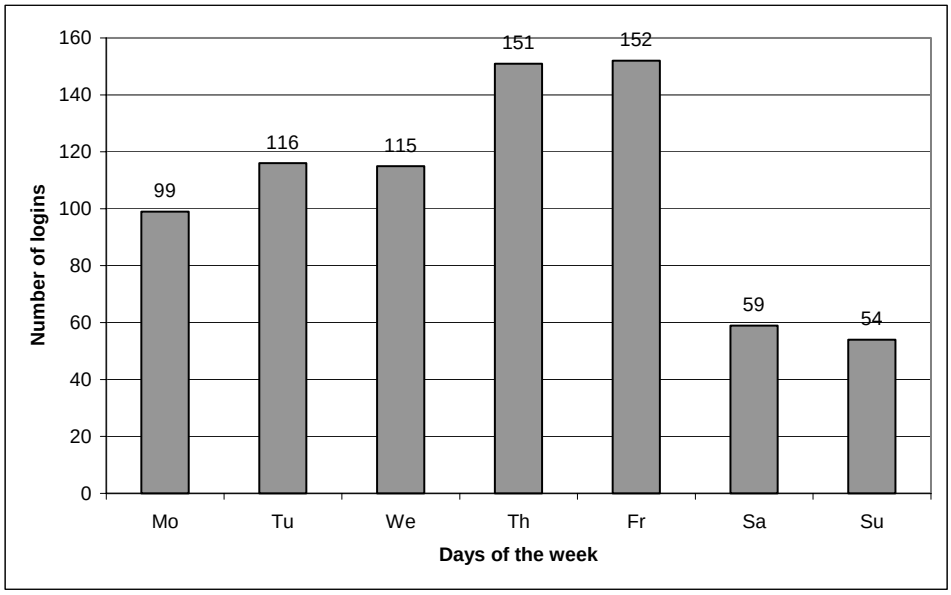


Figure 37. Logins on different days of the week.

Families used Mobile TV more than the other groups during weekends (Figure 38), which was expected, but the family adults used it a little less then than at other times. For the children, Friday was the most popular day. The spare-time users, students and workers mainly used it on weekdays, since they were passing through the city centre, attending classes at the university or at work. There was no difference between men and women with regard to which days they used the service.

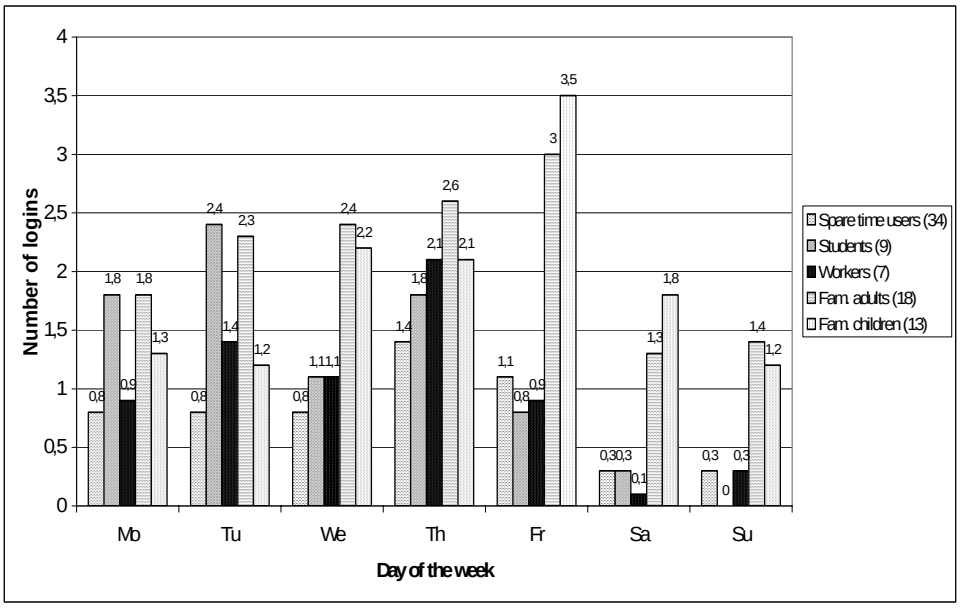


Figure 38. Average logins per person by user group and day of the week.

Time of day

The most popular viewing time was from 12 noon to 8 in the evening (Figure 39). The morning hours from 8 to 12 were as popular as the late evening hours from 8 to midnight. Mobile television was only used a few times during the night hours.

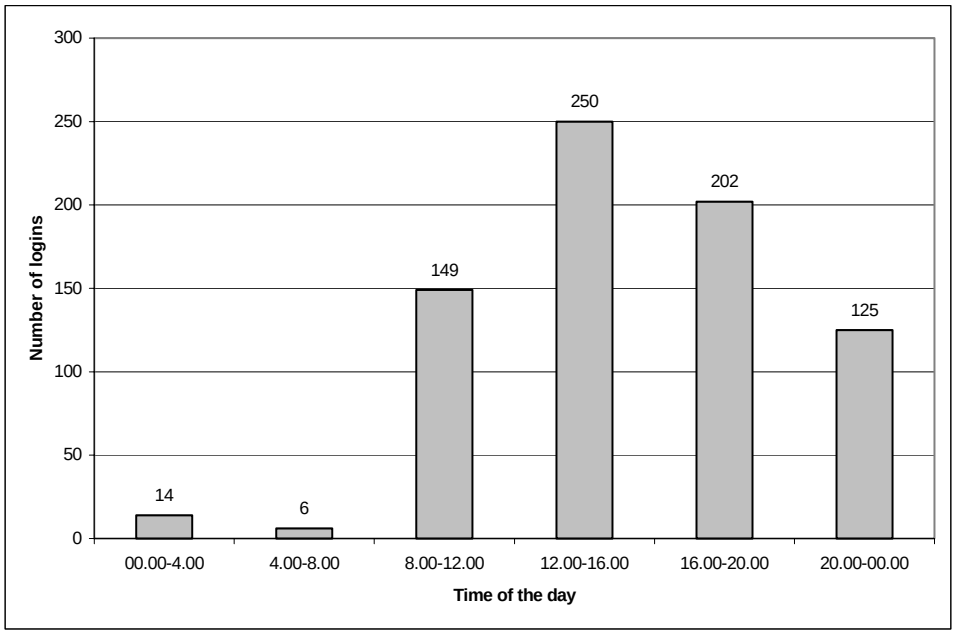


Figure 39. Logins by time of day.

Men and women used the service the same amount at different times of the day except for the morning hours (Figure 40), when men used it more. This is partially explained by the shift work of a couple of the male users. When they had the morning off they might have used mobile television since it offered more programs than regular television at those hours.

> *"I like to sleep late in the morning so I watched morning television programs when I woke up. I also watched it during the night hours when I was awake. Earlier, I have even woken up to watch morning television. Now I didn't do that. I slept as long as I liked and watched it when I woke."* [71]
>
> Man age 50 (family user)

[71] "Mä olen varsin paljon katsellut esimerkiksi kun olen hyvin aamu uninen sit kun heräilen niin katon noita aamuteeveen ohjelmia. Samoin kun yöllä valvoskelen niin katson sitten öiseen aikaan aikalailla…Olen herännyt joskus katsomaan aamuteeveetä. Nyt mä en sitä tehnyt. Sai nukkua niin pitkään kuin nukutti ja katsoa sen jälkeen."

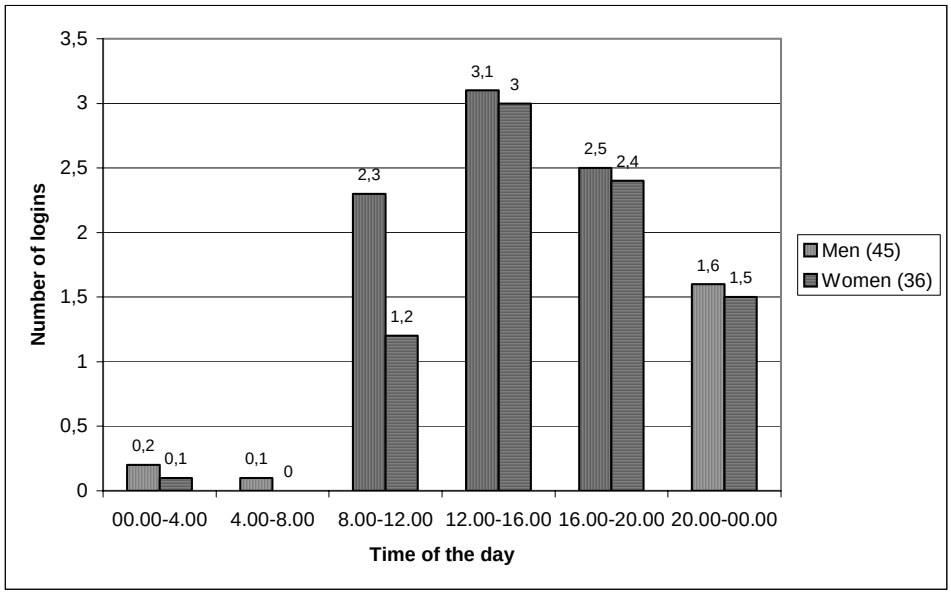


Figure 40. Average logins by gender and time of day.

The spare-time users, students and workers used it the most during the daytime, from 8 o'clock to 4 o'clock (Figure 41). The students and workers had most login events in the afternoons. It's possible that they used the service while having lunch, after lunch or when having some other break during the day.

> *"I watched it before and after lectures. I chose short programs so there was enough time to watch them. "* [72]
>
> Man age 26 (student group)

> *"I carried it with me almost all the time because I'm here near the university. I have meals there so I thought I would use it there."* [73]
>
> Man age 28 (spare-time group)

[72] "Ennen luentoja ja luentojen jälkeen katsoin, kun valitsi lyhyitä ohjelmia ennätti katsoa välissä."

[73] "Se oli kyllä mukana melkein koko ajan, koska mä olen tässä yliopiston lähellä ja käyn siellä syömässä niin mä ajattelin käyttää sitä siellä."

In the families, both adults and children used most in the evenings (Figure 41). This can also be seen from the number of logins in different age groups (Figure 42). There were also several login events in the daytime hours from 12 o'clock to 4 o’clock.

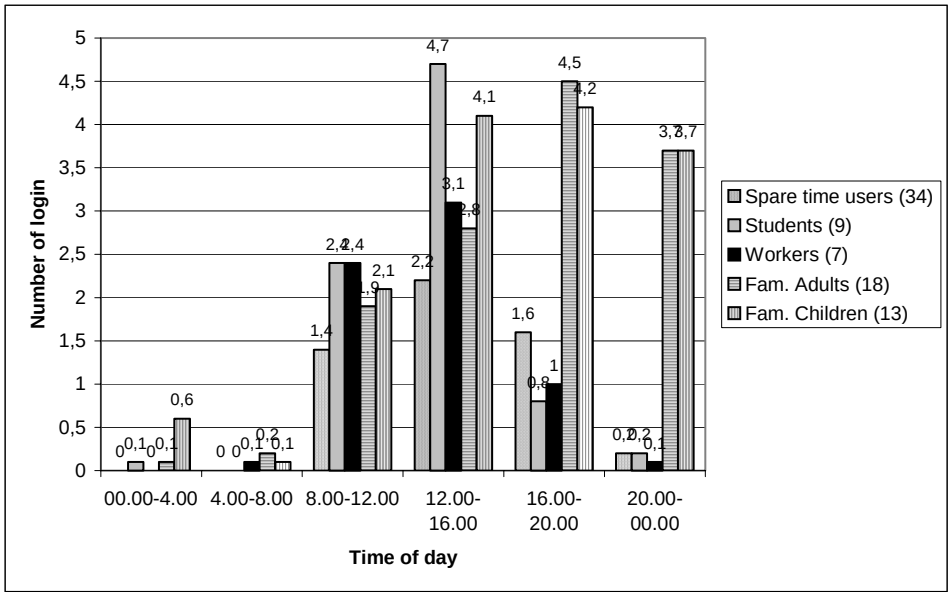


Figure 41. Average logins per person by user group and time of day.

Thechildren mostly used mobile television between 4 p.m. and 8 p.m. Surprisingly, they also used it a lot in the late evening hours, between 8 o’clock and midnight. All the other groups mostly used the service between 12 noon and 4 p.m. It was hardly used at all during the night hours from midnight to 8 o’clock in the morning.

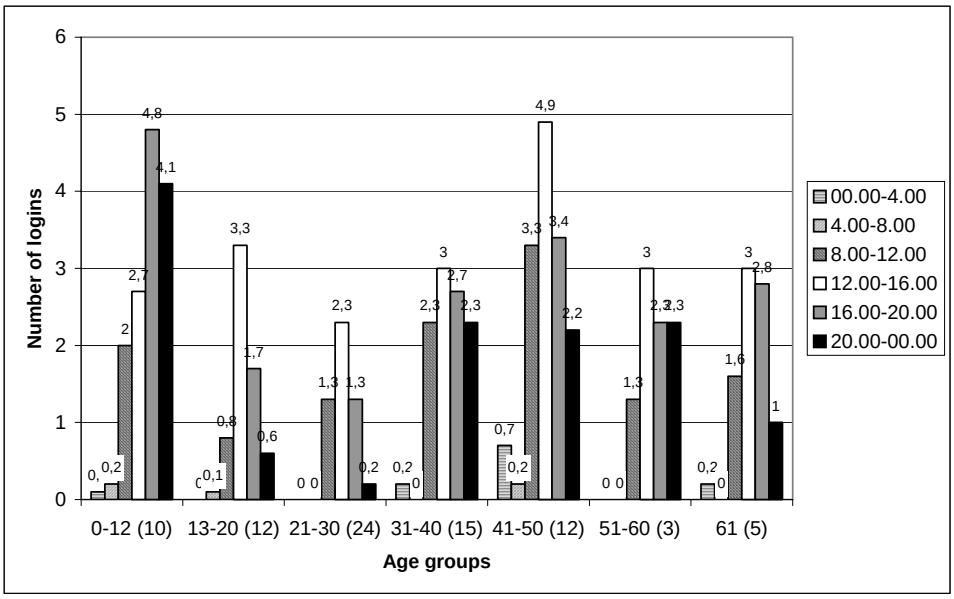


Figure 42. Average logins per person by age group and time of day.

Changes in the number of logins during the trial

The service was most used during the first day of the trial (Figure 43). That was the day the users got the devices. There were several logins on the second day as well. The number of logins began diminish from the third day of the testing period.

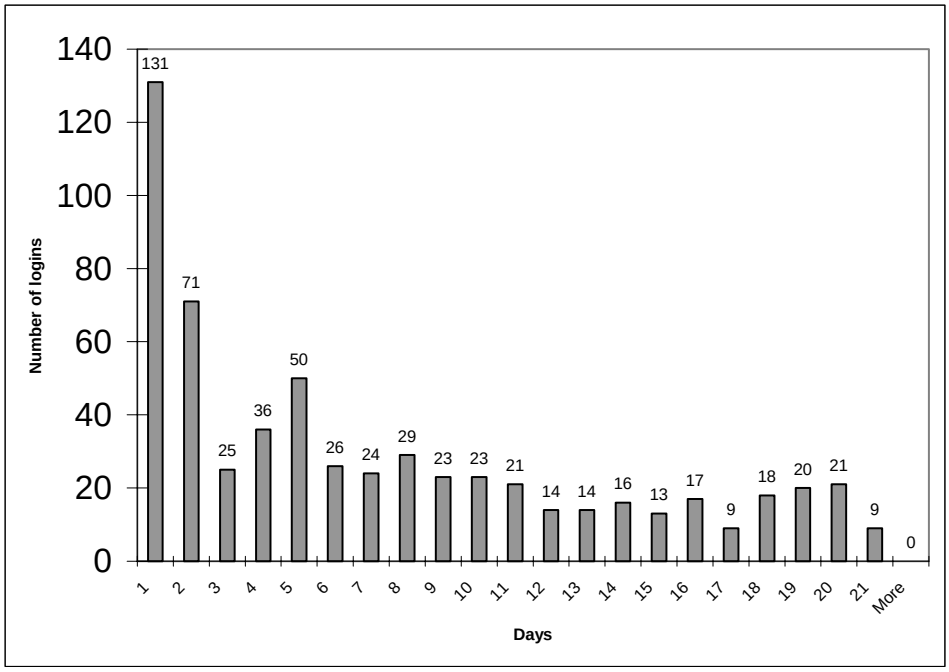


Figure 43. Number of logins during the first 3 weeks. Number 1 represents the first day, etc.

There is noticeable peak in the number of logins during the last couple of days of the period. Many users used the service on the last day of the testing period. This can be seen from Figure 44, in which the column representing the last using day is the highest. Perhaps the users wanted to prepare for the final interview. Figures 43 and 44 are read in the following way: Figure 43 presents the total number of logins during the first day, second day, etc., to the 21st day of the testing period. Thus logins are not related to one certain date. Figure 44 presents the total number of logins during all users' last day, the second-to-last day, etc. The test periods were not of equal length, so the final days overlap.

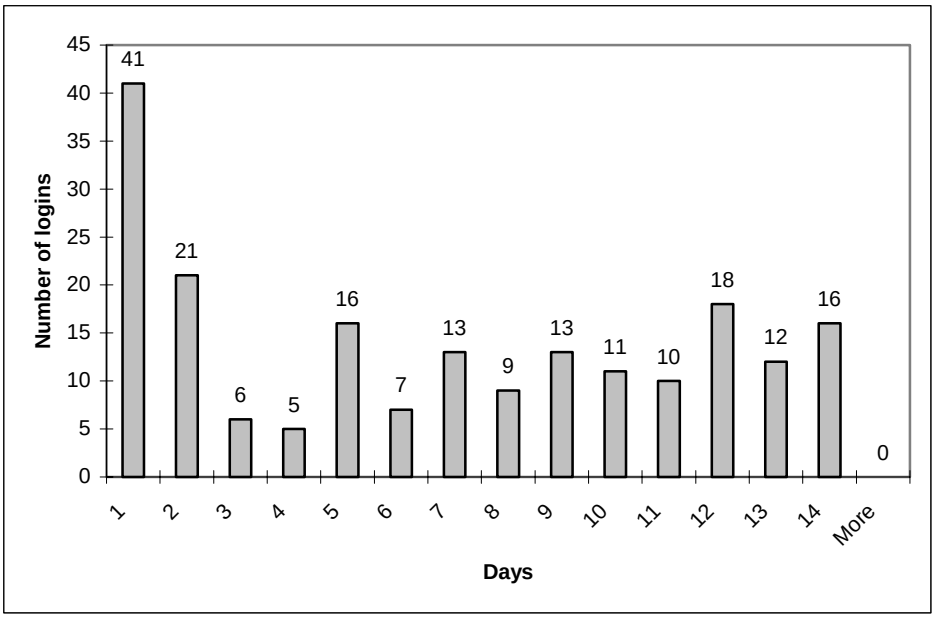


Figure 44. Number of logins during the final 2 weeks. Number 1 represents the last day, etc.

The reasons for the diminished use towards the end of the period are most probably the limited viewing area and technical difficulties. Although enthusiastic at the beginning, the users might not have been so willing to make the effort to watch mobile television. As the situation often is in trials, most users did not adapt to mobile television as a part of their daily lives.

6.6.2 Content

In general

The users hoped that the same content would be available in mobile television as in regular television. Even if all the programs were not so suitable for mobile viewing (e.g. movies) it would feel strange if some programs mentioned in the TV guide were missing from mobile television. In this trial the users missed the MTV3 programs, some of which came along 1.5 months after the beginning of trial. Even so, it was confusing that some of the programs were missing. The idea of special mobile television content was not familiar to the users – they

thought the content should be same as for regular television. Some of viewers commented that they would be interested in the special content designed for mobile television. They mentioned that the content could be, e.g., micromovies, summaries of existing programs or indexed programs.

> *"Anyhow, there should be the same programs available as in regular television. Now it was irritating because all the programs and channels were not included. You expected that they would all be there. "* [74]
>
> Man, age 24 (Student group)

> *"Could it be possible to make programs more suitable for this device- e.g. sum essential things up and shorten them?"* [75]
>
> Woman, age 24 (Student group)

One important thing that came up is the length of the programs. The users said they would wmainly watch short programs - news and current affairs programs were most often mentioned as examples. Most users viewed short programs or only parts of programs. Part of this has to do with technical difficulties in the picture quality and part with the viewing situation: people don't spend such long times in public places, so the duration of use of the mobile device is quite short. The users in the family group selected longer programs, but, for them, the viewing situation was different as they mainly used their devices at home. Private spaces seem to offer better opportunities to watch television than public places. The questionaire supports the results from the interviews, as, according to the users, the place affects the program choice (grade 3.8 on a scale of 1–5, Table 13).

> *"I wouldn't want to watch any long ones, maybe I watched some news. I would probably watch some short sketches just tp kill time and for fun."* [76]
>
> Man, age 24 (Spare-time users group)

---

[74] "Kuitenkin ajattelee, että televisiossa pitäisi olla kaikki ohjelmat kuin normaalissakin televisiossa. Nytkin ärsytti se, että ei saanut kaikkia ohjelmia ja kanavia mitä on. Ehkä olettaisi, että kaikki on."

[75] "Voisiko ohjelmista saada paremmin tähän laitteeseen sopivia, esim. tiivistää ja lyhentää olennaisia asioita."

[76] "En mitään pitkää haluais katsoa, varmaan jotain uutisia katsoisin. Ehkä jotain lyhyitä sketsejä vois kattoo. Ihan niin kuin ajankuluna ja viihteenä."

Figure 45. Children watching Mobile television together.

The users, especially the younger ones, hoped for more entertainment and series. They also wished for more channels. At the beginning of the trial (for 1.5 months) they were able to watch programs from channels TV1 and TV2 in the mobile context. MTV3 came along on 22.11.2002 for the last 3 months of the trial. It was expected that people would view MTV3 more as during the first field trial period many test users said they would watch mobile television more if MTV3 were available. Part of this has to do with the fact that more entertainment was hoped for and the younger test users in particular felt that the YLE channels (TV1 and TV2) mainly provide news and current affairs programs. Due to copyright issues the number of programs from MTV3 that could be viewed was very much restricted. For example, any foreign series and movies could not be viewed, so MTV3 provided mainly news and current affair programs for this trial.

In the following chapters most of the figures and tables are divided into two parts: the time before MTV3 was part of the trial (before 22.11.2002) and the time MTV3 was part of the trial (22.11.2002 onwards). As will be seen later, the most popular programs were much the same during the whole trial and the MTV3 programs do not clearly stand out. In total, TV1 was viewed 426 times and TV2 344 times before 22.11.2002. After 22.11.2002, TV1 was viewed 426

times, TV2 395 times and MTV3 159 times. The results would probably have been a bit different if all programs from MTV3 had been available.

Most watched programs

All programs viewed were first studied as individual programs - this means that all episodes of a program series were separated from one another. The goal was to find the most popular single program or episode of a program.

As can been seen in Figure 46, the most popular single episodes before 22.11.2002 were two episodes of *Pikku Kakkonen* and an episode of *Sätkyjä ja tärinöitä*. The most popular episode of *Pikku Kakkonen* was viewed 8 times before 22.11.2002. In the third place is an episode of *Muumilaakson tarinoita*, an episode of *Jalka & Lamppu* and an episode of *Ajankohtainen kakkonen*. These were viewed 6 times.

The most watched single programs from 22.11.2002 onwards were single episodes of *Vaaleanpunainen pantteri*, *Kova laki* and *Richard Scarryn touhukas maailma*. These were viewed 5 times (Figure 47). Although MTV3 was available at this time, only one MTV3 program can be seen in the figure: an episode of *Karpolla on asiaa*.

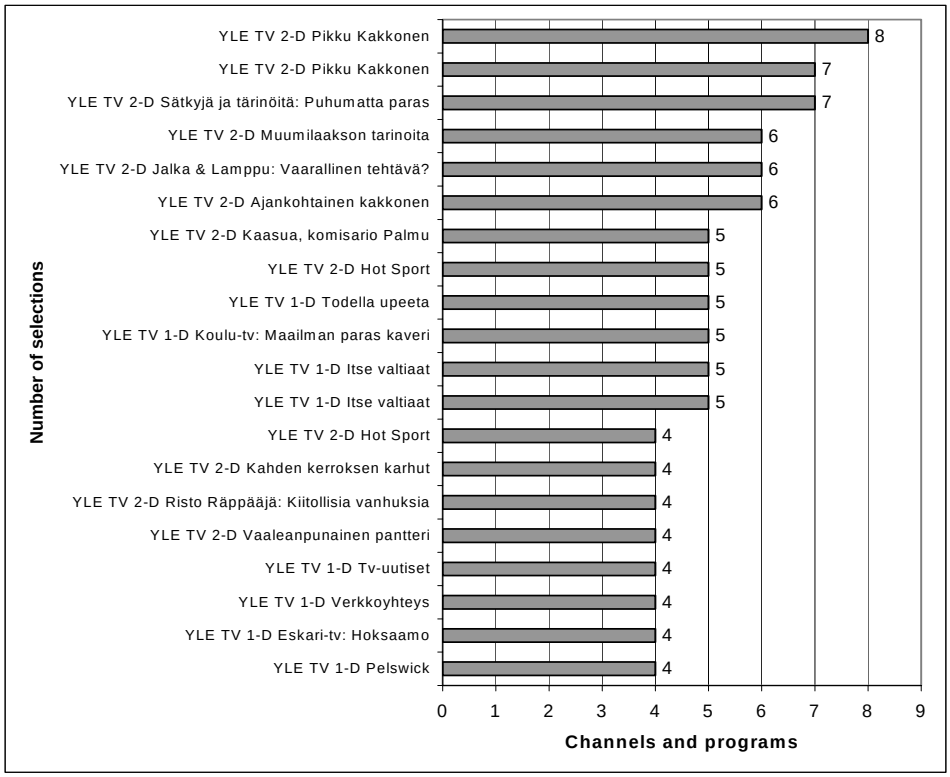


Figure 46. Most watched single programs and episodes of series before 22.11.2002.

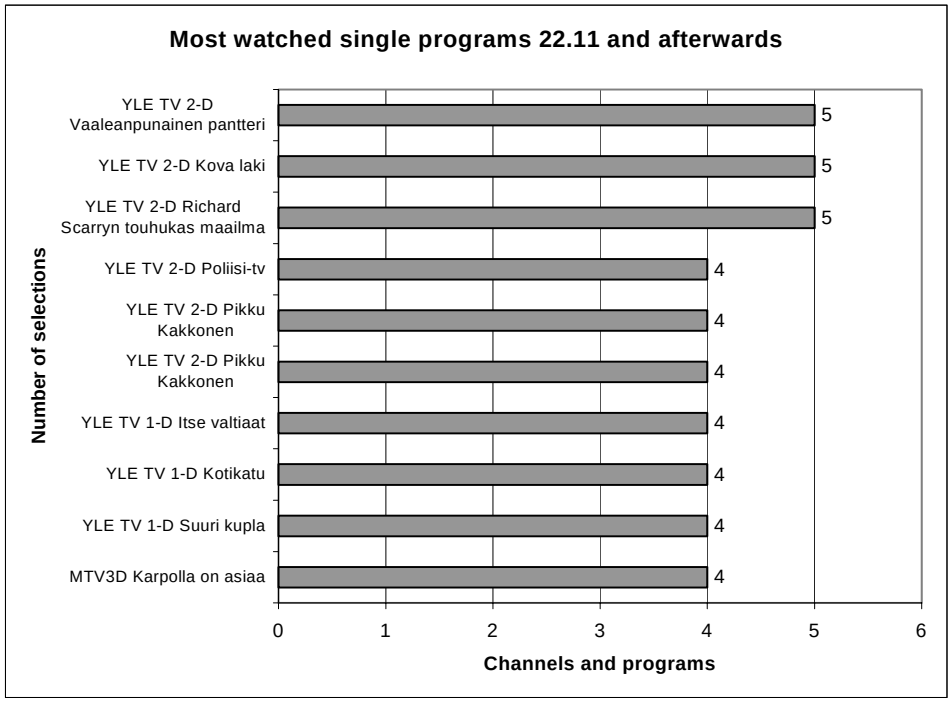


Figure 47. Most watched single programs and episodes of series 22.11 2002 onwards.

The users said that they would mainly watch news and short current affairs programs on mobile television. In previous studies users emphasised the importance of keeping up to date on news events with mobile television. In Figures 46 and 47 individual news and current affairs programs don't stand out. One reason for this is that there are so many different news programs available that during the trial it was quite unlikely that the users happened to watch exactly the same individual news broadcast. If all the different news broadcasts are put under one category, it can be seen that news was the most viewed program on mobile television (see Appendices T,U,V and W).

Figures 46, 47 and Table 9 show that children's programs were viewed lots of times, and, as mentioned in previous chapters, children were very enthusiastic users of mobile television. Foreign programs were not watched very much as the subtitles were missing. Instead, animations seemed to be popular. For example, *Itsevaltiaat* was viewed by both adults and children.

> *"Short ones, news type of programs. Animated cartoons worked very well, even though I don't usually watch them. It was fun to watch them for that. Bad sound didn't cause trouble watching Pink Panther. Clear graphics would be good thing. "* [77]
>
> Woman, age 24 (Student group)

Interestingly, morning programs like *Huomenta Suomi, Ihana aamu* and *Ykkösen aamu-TV* were quite popular, even if they aren't as short as many of the other most popular programs. There might be some interesting topics in these programs and people like to view them at other times of the day. Most of the programs that were viewed were quite short. Only a few of the most viewed programs lasted almost one hour (e.g. *Kova laki, Inhimillinen tekijä, Kotikatu*). These programs were mostly viewed in families and it can be seen that they were among the most popular programs viewed by family adults (Appendices T and U). Even though the users chose longer programs, they did not necessarily watch the whole program. The MTV3 programs were not viewed very much. Only a few programs from MTV3 ended up on the most watched programs list: *Huomenta Suomi, Ihana aamu, Joka kodin asuntomarkkinat* and *Tulosruutu*. But, again, it must be remembered that not all of MTV3's content was available.

[77] "Lyhyet, uutiset, tulosruutu- tyyppiset, piirretyt. Piirretyt toimi hirveen hyvin, vaikka muuten ei tuu katettua. Tuon kautta ne oli hauskoja. Vaaleanpunaista pantteria huono ääni ei haitannut. Selkeä grafiikka olisi hyvä."

Table 9. Most watched programs before and after 22.11.2002.

Programs watched most times by all users before 22.11.2002	Programs watched most times by all users after 22.11.2002
1. News broadcasts 103 (TV-uutiset 48)	1. News broadcasts 91 (TV-uutiset 35)
2. Pikku Kakkonen 25	2. Pikku Kakkonen 32
3. Itsevaltiaat 20	3. Koulu-tv 23
4. Koulu-TV 17	4. Arttu 20
5. Hot Sport 15	5. Itsevaltiaat 20
6. Ykkösen aamu-tv 15	6. Huomenta Suomi 19
7. Muumilaakson tarinoita 14	7. Richard Scarryn touhukas maailma 16
8. Sätkyjä ja tärinöitä 13	8. Ihana Aamu 15
9. Urheiluruutu 13	9. Sätkyjä ja tärinöitä 15
10. Se on siinä 12	10. Angela Anakonda 14
11. Ajankohtainen kakkonen 11	11. Kova laki 14
12. Vaaleanpunainen pantteri 11	12. Muumilaakson tarinoita 14
	13. Kuningaskuluttaja 13
	14. Vaaleanpunainen pantteri 13
	15. Franklin 12
	16. Joka kodin asuntomarkkinat 12
	17. Inhimillinen tekijä 11
	18. Kotikatu 11
	19. Tilt.tv 11
	20. Ykkösen aamu-tv 11
	21. Joulukalenteri 10
	22. Tulosruutu 10

In all user groups, except for the family children, the news was the most often viewed program, both before and after 22.11.2002 (Appendices T and U) . The students and the workers mainly viewed news, the spare-time users and family adults viewed programs from all categories. The length of the chosen programs was a bit longer in the families group. Family children mainly viewed children's programs (*Pikku Kakkonen* was the most popular) but also some programs that are more intended for adults - like *Itsevaltiaat* and *Agrippina*. These programs are quite suitable for children but some parents mentioned that with mobile television it might be difficult to prevent the children viewing some programs that are more of an adult nature. Some interviewees said that they also watched

programs that they don't usually watch, because they were now more easily available.

In all age groups, except for the age group 0–12 years, news broadcasts were the most often viewed program, both before and after 22.11.2002 (Appendices V and W). In the age group 0–12 years, *Pikku Kakkonen* was the most popular program. In these tables the number of program selections is so small that one program that seems very popular can actually be just one test user's favourite program. This is why no further judgements should be made on the basis of these numbers.

Men and women viewed much the same programs – news being the most popular in both groups (Tables 10 and 11). Men viewed news more times that women did. On average, men watched 2.8 news programs while women watched 1.8. Children's programs also stand out. When comparing the most viewed programs by men and women before 22.11.2002, it can be seen that sports programs and the current affairs programs *Ajankohtainen kakkonen* and *Kotimaa.Nyt* are missing from the women's list. After 22.11.2002, children's programs and interest in sports and morning programs stand out clearly in the men's list. In the women's list there are a couple of foreign series, *Kova laki* and *Frasier*, and the Finnish drama *Kotikatu*. Also very high on the women's list is the MTV3 program *Ihana Aamu*. These programs are not on the men's list (Table 11).

Even though men viewed sports programs like *Urheiluruutu* and *Tulosruutu*, a few users commented that sports are not suited to mobile television. The picture quality was so poor that it was very hard to follow hockey.

> *"I watched downhill racing. It was kind of annoying when the guy stopped in the middle of the hill. It was difficult to follow sports."* [78]
>
> Man, age 50 (Family user group)

[78] "Mä katsoin syöksylaskua jälkeen päin niin se oli kieltämättä vähän kiusallista kun kaveri pysähtyi keskelle rinnettä. Urheilun seuraaminen oli aika hankalaa".

"Sports don't fit at the moment since fast moves are too fast for the device. They also appear so unclear and slow that I don't bother to watch them at all." [79]

Woman, age 41 (Family user group)

Table 10. Programs that men and women watched most before 22.11.2002.

Programs watched most by men before 22.11.2002		Programs watched most by women before 22.11.2002	
1	News broadcasts 69 (TV-uutiset 32)	1.	News broadcasts 33 (TV-uutiset 16)
2	Pikku Kakkonen 16	2.	Itsevaltiaat 9
3	Hot Sport 12	3.	Pikku Kakkonen 9
4	Koulu-tv 12	4.	Muumilaakson tarinoita 8
5	Itsevaltiaat 11	5.	Sätkyjä ja tärinöitä 8
6	Urheiluruutu 11	6.	Se on siinä 7
7	Ykkösen aamu-tv 10	7.	Etälukio 5
8	Ajankohtainen kakkonen 9	8.	Frasier 5
9	Kotimaa. Nyt 9	9.	Koulu-tv 5
10	Kotikatsomo 8	10.	Leikin varjolla 5
11	Merilinja 8	11.	Ykkösen aamu-tv 5
12	Uusikino 8		
13	BUU-klubben 7		
14	Komisario Palmu 7		
15	Vaaleanpunainen pantteri 7		
16	Dokumenttiprojekti 6		
17	Kakkosen syyssää 6		
18	Kypsymättömät 6		
19	Muumilaakson tarinoita 6		
20	Saviset ja Vahaset 6		
21	Uutisvuoto 6		
22	Veturi 6		
23	Poliisi-tv 5		
24	Risto Räppääjä 5		
25	Se on siinä 5		
26	Sätkyjä ja tärinöitä 5		
27	Todella upeeta 5		
28	Tää on seksii!! 5		
29	Verkkoyhteys 5		
30	Yönäytös 5		

[79] "Urheiluohjelmat ei tällä hetkellä sovi, koska nopeat liikkeet laitteelle liian nopeita. Kuvat tulee niin epäselvästi ja hitaasti, että ei viitsi katsoa ollenkaan. Urheilu kaikista huonoin."

Table 11. Programs that men and women watched most after 22.11.2002.

Programs watched most by men after 22.11.2002	Programs watched most by women after 22.11.2002
1 News broadcasts 58 (TV–uutiset 26)	1 News broaddcasts32 (TV-uutiset 9)
2 Pikku Kakkonen 27	2 Ihana aamu 11
3 Koulu-tv 15	3 Kotikatu 11
4 Arttu 14	4 Huomenta Suomi 10
5 Itsevaltiaat 12	5 Kova laki 10
6 Sätkyjä ja tärinöitä 11	6 Itsevaltiaat 8
7 Vaaleanpunainen pantteri 11	7 Koulu-tv 8
8 Richard Scarryn touhukas maailma 10	8 Angela Anakonda 7
9 Huomenta Suomi 9	9 Frasier 7
10 Muumilaakson tarinoita 9	10 Joka kodin asuntomarkkinat 7
11 Ykkösen aamu-tv 9	11 Kuningaskuluttaja 7
12 Franklin 8	
13 Joulukalenteri 8	
14 Urheiluruutu 7	
15 Angela Anakonda 7	
16 Tulosruutu 7	

Most viewed channels

Before 22.11.2002, the top four theme channels were Favourites, Movies, Children and Entertainment. The Favourites channel was shown to the users while they were thinking about how to use mobile television, which is why the number of selections is so high. In reality, the Favourites channel was not actively used. The users said that it felt strange to add an already watched program to the Favourites. People seldom watched the same programs several times. The feature would have been used more if it had been possible to add a favourite series to the Favourites channels and it had updated the latest episode automatically. The users seemed to be interested in movies, even though movies were not viewed very much. The children's active use of mobile television can also be seen in Figures 48 and 49. The Theme channels were a nice and easy way for children to find their own programs. As mentioned earlier, the users wanted more entertainment and they tried to find it by viewing the Entertainment theme channel both before and after 22.11.2002. The programs were mainly viewed through the TV menu; the OMAT menu was not used very much. This means that, altogether, the theme channels were not viewed much.

"MTV 3 would have been nice because of all the series shown there. TV 1 and TV 2 have so many documentaries, which I don't like to follow. More entertainment programs" [80]

Woman, age 22 (Spare-time user group)

"More series like Salatut elämät and Teho-osasto, and foreign series. I would leave both TV1 and TV2 away from the service, because there are no programs I like to watch. Instead of them, Sub-TV and MTV's music channel." [81]

Woman, age 12 (Family user group)

"Short programs like Kuningaskuluttaja and Karpolla on asiaa. They last less than half an hour or one hour." [82]

Man, age 27 (Workers group)

[80] "Kolmoskanava olis ollut hyvä, sieltä tulee kaikkia sarjoja. Ykköseltä ja Kakkoselta tulee niin paljon asiaohjelmia, en jaksa niitä katsoa. Enemmän viihdettä."

[81] "Kaikkia sarjoja niin kuin salattuja elämiä, teho-osastoa ja ulkomaisia sarjoja. Mä jättäisin ykkösen ja kakkosen kanavat ihan kokonaan pois, ei sieltä tule mitään. Ja sitten tilalle tietysti SUB-TV ja MTV:n musiikkikanava."

[82] "Hyviä Kuningaskuluttaja ja Karpolla on asiaa, eli lyhyet puolen tunnin tai tunninkin pätkät."

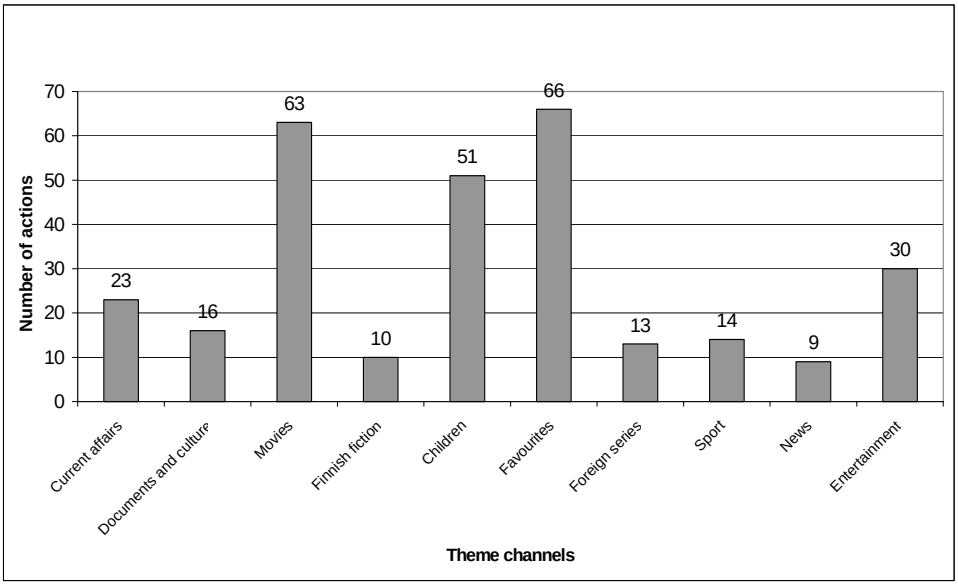


Figure 48. The amount of use of the theme channels before 22.11.2002.

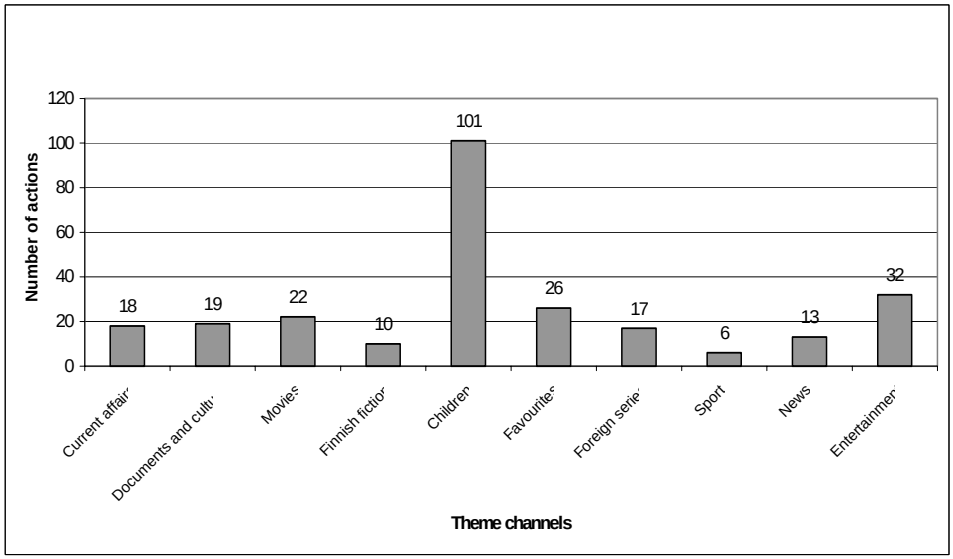


Figure 49. The amount of use of the theme channels from 22.11 onwards.

The use of additional services

The additional services offered the users a chance to modify the Favourites channel, search for programs, play games, and view the TV guide or a program's additional information. Throughout the trial the search and TV guide where the most often used additional services. The idea of using television for anything other than watching programs seemed to be unfamiliar to the users. Although the additional services were introduced to the users, many did not really think about them or remember them and they were not used very much. The additional services were also located under two different main menus, so they were not so easy to notice.

Figure 50. The Pen Tablet was mostly used at home.

One difficulty was the fact that some program-related additional services could only have been used if the program was first selected for watching. Some problems that the users faced with the interface could have been prevented if they had used the additional services. For example, some found it difficult to find a program if they couldn't remember the channel that it was on. They tried to find it by going through days and channels in TV menu, instead of entering the name of the program in the search engine. As another example of the use of the additional services, it can be seen in the log information that the test users often glanced at the TV guide (110 times) but seldom had closer look at any particualr program's information (35 times). The users gave an average grade of 3.1 (Table 13) to the sufficiency of useful features.

Game

A game was included in mobile television at the end of the trial. It was available to three families. The parents in particular felt that they don't want to play any games on mobile television because they don't play any other games either. The children played other games on the Internet and felt that the game was quite nice to play with the Fujitsu. Still, the game feature was hardly used at all. Some thought that the game could be separate from the television programs, but one family hoped that if there were a game on mobile television, it should not be like a traditional computer game. Instead, it could be like a quiz about a movie or TV series.

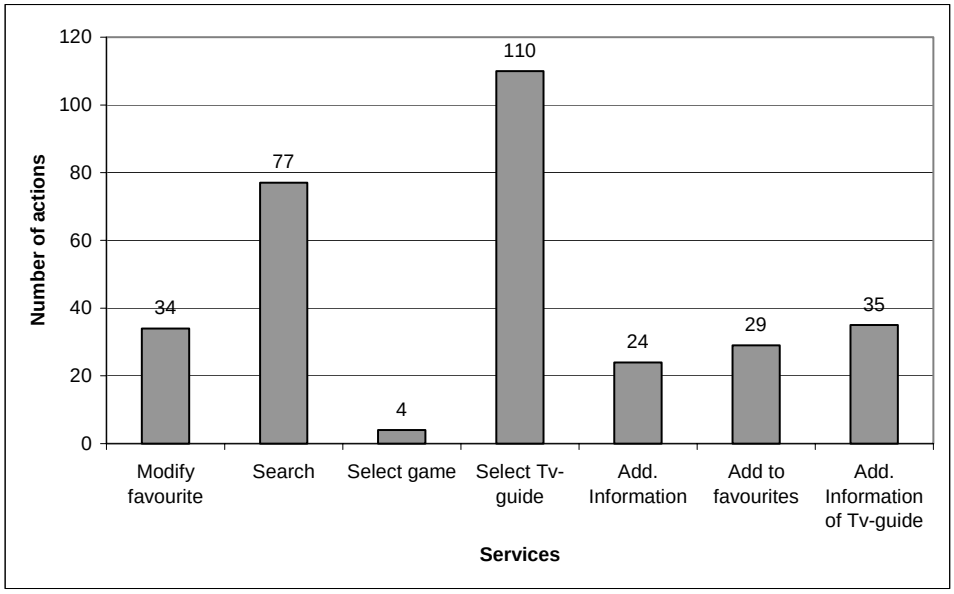


Figure 51. The amount of use of the additional services during the trial.

Chapters

The idea of chapters was experienced as a good feature but there should be some improvements in the implementation. The users wanted to be able to skip straight to a certain part of the program instead of guessing which of the chapters is the one that includes the part of the program they wanted to see. So it should

be easier to recognise certain chapters. The images next to the chapters were not informative enough to help the users find certain chapters. Although the chapter feature was presented to users when the devices were given out, many of them did not really realize how to put them into use. In the final interview they said they had not thought of or remembered the feature.

> *"Easy to use, yeah, but in my opinion programs divided into chapters was worth nothing. You can't know the exact place of the short piece you are looking for. The navigation is unusable in that when you start it from wrong point it takes some time to get back…"* [83]
>
> Woman, age 39 (Family user group)

> *"I used chapters. It was a really good feature. Sometimes I watched half of the program and after that went to do something else, and then watched the rest of the program."* [84]
>
> Woman, age 39 (Family user group)

6.6.3 Payment

One of the main things that came up is that many forms of payment (Internet, mobile phone, TV licence, satellite channels, etc.) already exist. The users suggested that the mobile television payment could be a part of some other existing cost. A new payment is not desired. Maybe an increase in an existing cost would be better than a totally new cost?

Most users found it difficult to think about paying. It was hard to say how much one program should cost and how large a monthly payment should be. The field

[83] "Helppo käyttää joo mutta esim. se missä oli esim. jaksoittain ne ohjelmat, sillä ei mun mielestä ole mitään virkaa. Koska sä et voi tietää missä kohtaa se on se juttu. Se navigointi on sillain epäkäytettävää, et kun sä käynnistät sen väärästä kohtaan menee aikaa kun pääset takaisin…"

[84] "Jaksojen etsiskelyä oikeastaan ainoastaan. Se on tosi hyvä. Joskus katsoin puolet ohjelmasta ja menin tekemään jotain muuta ja sitten katsoin toisen puolen ohjelmasta."

test users, and the Futuuri exhibition visitors, gave some estimates but the numbers should be carefully considered (Table 12).

Table 12. Estimates of possible costs.

	Workers (n=7)	**Students (n=9)**	**Spare-time users (n=34)**	**Families (n=31)**	**Futuuri visitors (n=46)**
Price per program	less than 0.5 €	less than 0.5 €	less than 0.5 €	0.2-1 €	0.5 € (news)
Price per month	3-10 €	about 20 €	about 20 €	15-50 €	13.5 €
Method of payment	Monthly (4) Per program (1) Per time used (1)	Monthly (6) Per program (4) Per time used (2)	Monthly (9) Per program (7) Per time used (5) Combinations (7)	Monthly (9) Per time used or per program (3) Combinations (4)	Monthly (22) Per program (23)

The families had extreme difficulty with stating the price and were very reluctant to add new costs existing ones. The students were also very reluctant to pay as they wished to cut out all the extra costs. The users in the workers group were more willing to pay than the others. Most of their jobs were related to mobile devices or digital television in some way, so for them paying for mobile services seemed quite natural.

Surprisingly, the workers group and the Futuuri exhibition visitors were willing to pay less than the other groups as a monthly payment. As already mentioned, the workers' jobs were related to mobile devices or digital television, but the exhibition visitors were more interested in the topic as regular users: The exhibition was aimed at people interested in the latest content and technologies of digital media and image (e.g., service providers, software vendors, equipment and system suppliers, etc.).

According to the users, there should be different ways of paying: pay per time, pay per program, monthly payment and combinations of these. The chosen paying option is connected to the *amount of use*, *content*, *areas of use* and *technical reliability*. If there is a lot use or the content is interesting on the whole, the monthly payment is the most suitable option. If there are just a few programs of interest, pay per program would most likely be selected. People would naturally be willing to pay more and choose monthly payment if mobile

television would function without restrictions of place (networks) and technology (quality of the programs).

> *"It depends on the situations, which is the best way to pay. I don't know why I have never videod morning television, but watched it on mobile television. This might change if it were chargeable or I woke up earlier to watch it."* [85]
>
> Man, age 50 (family user group)

The users stressed the importance of getting what they have paid for. This means that the technology must be ready and flawless. The users also want to know more about the content of a TV program in advance if they have to decide which program they are going to pay for (pay per program): you can't just go channel-hopping as with traditional television or the bill gets too big.

Some comments made by users suggest that they would be willing to pay more for programs - e.g., while travelling.

> *"If I had to travel to Helsinki by train on my way to work I would probably pay more. In my situation I would hardly pay anything at all because the home television is enough."* [86]
>
> Man, age 18 (Spare-time user group)

> *"If the prices were like in this trial, I would pay it right away. But if they were much more, like five euro per program, it would be too much. On the other hand, I might pay that five euro on the train, it depends so much on the situation."* [87]
>
> Woman, age 25 (Workers group)

---

[85] "Hyvin tilannekohtainen mikä maksu sopii. En tiedä miksi en koskaan ole ottanut aamuteeveetä nauhalle. Mutta mobtv:llä tuli katsottua mutta ehkä se sitten jäisi jos se maksaisi tai tulisi noustua aikaisemmin."

[86] "Jos mä kävisin junalla Helsingissä töissä niin sitten varmaan osaisin maksaa siitä enemmän. Tässä elämäntilanteessa ei olisi valmis paljon panostamaan. Toistaiseksi riittää kotona oleva televisio."

[87] "Jos hinnat on sitä, mitä tuossa testauksessa niin on yks hailee, mut jos on jotain järisyttävän korkeita, jos yks ohjelma maksaa vaikka viis euroo niin se on jo aivan liikaa. Mutta toisaalta junassa ehkä vois maksaa sen viis euroa, se riippuu ehdottomasti siitä paikasta."

The users also brought up the question of the price of the device that is needed. They supposed that the device would be very expensive and thought that you need to be able to do other things (Internet, word processing, phoning, e-mail, etc.) besides view mobile television with it.

Figure 52 presents the distribution of the total account balances of test users. For the trial, programs were priced from 20 cents to 1 euro. The trial did not cost the users anything. Pricing was meant to make it easier for the users to think about the possible expense of mobile television. Each time a test user chose a program the price of the program was added to his/her personal account. Since the test users did not pay for the use, the figure does not indicate their willingness to pay for mobile television; rather, it shows the amount of use.

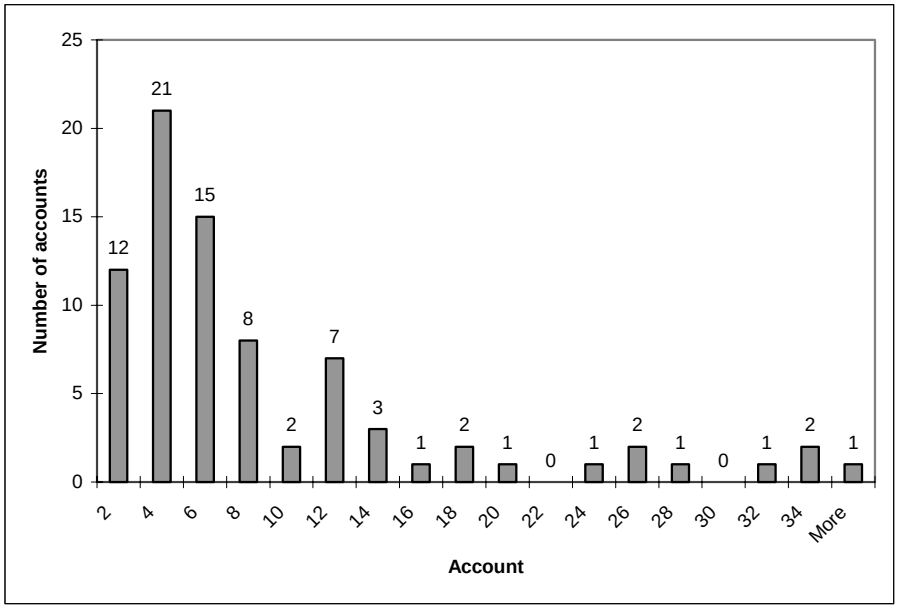


Figure 52. Distribution of total account balances of each user. The first column represents account balances from 0 to 2 euro, the second from 2 to 4 euro, etc.

6.6.4 Usability

The field trial test users were given a questionnaire about usability, satisfaction and watching habits. They graded each feature on a scale from 1 to 5. The higher

the grade, the better the user regarded the corresponding feature. Grade 3 means that the user is uncertain about his/her opinion. The users were most satisfied with the learnability and memorability of mobile television. They found mobile television easy to use. They were not so satisfied with the speed and technical efficiency of the service. It was not considered very important as a source of information.

Table 13. Averages of usability, satisfaction and watching habits grades (N=). The grades are presented in parentheses after each graded feature.

Technical efficiency	2	Watches only short programs or parts of programs	3
Ease of use	**3.9**	The place affects program choice	**3.8**
Speed	**2.9**	Satisfaction with mobile television	**3.0**
Speed in program loading	**3.3**	Satisfaction with quality of picture	**3.4**
Learnability	**4.4**	Satisfaction with quality of sound	**3.3**
Memorability	**4.3**	Satisfaction with battery duration	**3.4**
Sufficient amount of useful features	**3.1**	Satisfaction with display	**3.6**
Suitability of current programs	**3.2**	Usefulness	**3.1**
Watches different programs than on regular Tv	**3.4**	Importance as a source of information	**2.4**

Ease of use

Generally, mobile television was rather easy to use - as can beseen in Table 13. On a scale from 1 to 5, ease of use got an average grade of 3.9, learnablity 4.4 and memorability 4.3. The users reported that the menus were rather quick and easy to use - hey learned how to use them with a short demonstration and remembered how to get to mobile television on their own. It has to be remembered that the users mainly watched programs, additional services were not used that much. The reason for that might be that the additional services were difficult to find under the main menu (Figure 53). They were not visible in the main menu and the menu names were not descriptive enough. So, some difficulties existed with the use of the menus. The users also had to learn to use both the device and the mobile television service.

Picture 53. Main menu on the smaller device.

The "Omat" (=own) menu refers to something the user has created for him/herself, such as a favourites channel. This name does not represent the theme channels that are placed under it, and the "quit" command was not easily available in this menu. The "TV" and "Ohjelma" (=program) menus were confusing: the users tried to start viewing the program from the "Ohjelma" menu, which consists of additional information on the programs.

It was quick and easy to go through the menus, even if the menu names weren't very descriptive. The contents of the menu could be seen with one click of the menu name. The main menu was also visible most of the time. In the small devices it disappeared when programs were watched. When the program list was scrolled, the main menu disappeared, causing some confusion. Overall, the menus resembled the use of a computer, so it was easy to understand how to use them.

> *"It wasn't difficult. There were some things that were difficult to remember, e.g. how to go to the different menus. But after that it was easy. But I didn't remember what was under the main menus."* [88]
>
> Man, age 29 (Spare-time user group)

The user interface was heavily based on text. This caused problems for illiterate children from the login to browsing the programs' names. For children, the use of picture images with the names of the TV programs was an important thing. If you can't read, you can still start you favourite show by clicking the image. Even though the loading times of the pictures were sometimes slow, the images were

[88] "Ei ollut vaikeuksia, mutta sellaisia pieniä muistijuttuja, että ei aina muistanut miten niihin valikoihin mennään, mutta kun ne aukes niin se oli hyvin yksinkertaista. Ei muistanut valmiiksi mitä minkäkin valikon alla on."

important for the children. There were other things that were difficult for the younger users, for example the use of the on-screen keyboard. Older siblings or parents helped them to get started on viewing the programs.

In addition to this, the adjustment of volume and screen brightness should be more easily available.

Device

The devices are introduced in Chapter 6.4. The smaller device (PDA) was easier to carry and the users had mobile television with them regularly, except for the users in the family group. They mainly used mobile television in their homes. The Fujitsu was too big to carry around, but the users mentioned that it is a suitable size for taking in the car or to the summer-cottage.

Because of the small screen size, the smaller device is mainly for personal use. If viewers wanted to see the programs properly, they needed to place the screen right in front of them. This meant they had to be very close to each other if they were watching it together. Most people experience proximity with strangers inconvenient. Many interviewees stated this clearly. Mostly younger test users mentioned that they could watch programs on the smaller device as a group.

> *"In some situations it might be nice to watch it with a friend. If we had enough time, it was summertime and we were hanging around in the city to meet friends, then it would be nice to use mobile television."* [89]
>
> Woman, age 19 (Spare-time user group)

Some users mentioned that in spite of the fact that they perceived mobile television as a personal device, they might occasionally watch it together with somebody else, e.g. a close family member. According to the users, it might also be possible to watch mobile television with someone else on special occasions, such as travelling.

---

[89] "Joissakin tilanteissa voisi olla ihan kiva katsoa just kaverin kanssa. Jos olisi kunnolla aikaa, olisi kesä ja muuten vaan hengailemassa kaupungilla ja näkisi kavereita, niin voisi kaivaa ja katsoa TV:tä."

> *"It is personal because of the size of the device - like the mobile phone is. You don't give it to anyone very easily because it is for you personal use - to family members maybe, but not to anyone else. "* [90]
>
> Man, age 27 (Spare-time user group)

The battery's duration should be carefully considered when mobile television is developed. The backlight must stay on while watching programs or the picture is too dark and watching a program becomes impossible. If the backlight is on all the time, the battery runs out faster. In the field trial the test users gave an average of 3.4 points for the duration of batteries, on a scale of 1 to 5. Reflections on the screen, especially outdoors during the daytime, also made the viewing somewhat unpleasant. The display was estimated at 3.6 points on average.

> *"Because we were able to choose, I used the bigger device. Of course, if you were travelling, you would probably choose the smaller one as it is big enough and much more handy."* [91]
>
> Man age 50 (family user group)

The sound level should be higher. The users thought it was poor, even when they used headphones. If the environment was a bit noisy, they could not hear properly.

Some users had difficulty with the pen. Older people in particular found it difficult to see the small letters and numbers on the on-screen keyboard. Often, they hit the wrong keys by accident because their hands were shaking. Use of the stylus pen was new to most of the users and it required some practice.

> *"I was too quick with the pen. Every time I clicked something it took a while and during that waiting time I managed to click*

[90] "Melko henkilökohtainen just sen kokonsa takia. Vähän samanlaisena kuin kännykkä, että sitä ei kovin helposti kenellekään anneta. Se on henkilökohtainen. Ehkä nyt perheen kesken vois tietysti jakaa."

[91] "Koska nyt oli valinnan vapaus, niin aina otti sen isomman koneen. Mutta tietysti jos on reissussa, niin tuo pienempi kone on riittävä ja paljon kätevämpi."

again. After that it did the function twice and I was lost somewhere in the service." [92]

Man, age 29, (Spare-time users group)

"Due to my sight I was nervous about using the pen, so my hands were shaking. It was difficult to hit the right spot because the display and the pen's point were small. It was also difficult to find the programs. I got a wrong page many times. The English manuals were difficult to understand. If I could support my hands, it was easier to use." [93]

Man, age 67 (Spare-time users group)

Some users were afraid they would break the device, especially the iPaq, so some kind of cover is needed for it. The screen on the Jornada was protected by a metal cover, which the users thought a good thing.

"In the trial the situation was that you were afraid.. But if the device had been your own, I would have stitched, or otherwise got, a cover for it. The mobile phone is already so common that nobody keeps it in a bag any more." [94]

Woman, age 30 (Spare-time user group)

"The device is quite small, it is easy to carry around and the batteries last a long time. It is as easy to carry as a mobile phone. The other device, the Compaq, is bigger and heavier, so I probably wouldn't carry it around with me. But this other device

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[92] "Olin liian nopea sen kynän kanssa, aina kun klikkas jotain niin se mietti jotain ja sitten klikkasin jo toisen kerran – sitten se niin kuin teki sen kaksi kertaa ja sen jälkeen olin ties missä valikossa."

[93] "Osittain näkökyvystä johtuen jännitti kynää käyttäessään eli kädet tärisi. Vaikea osua oikeisiin kohtiin, pieni näyttö ja pieni kynän kärki. Ohjelmien hakukin oli vaikeeta, tuli monta kertaa väärä sivu. Myös englannin kieliset manuaalit haittasivat. Kun oli tukea käsille niin onnistui hyvin."

[94] "Nyt oli tietysti sellainen, että pelkäsi... Mutta jälleen kerran, jos ajattelee, että se olisi ollut oma niin mä olisin ommellut sille jonkun tai olisi ollut joku säilytyskotelo. Sen suojaamisen kannalta. Että kännykkähän alkaa olla jo niin käyttöesine, ettei kukaan säilyttele niitä enää missään pusseissa. Se aika meni jo."

is fine because it is small and it had a cover on it, so you dared to put it in to your pocket as well." [95]

Man, age 29 (Spare-time user group)

The users in the families who watched longer programs on the bigger device mentioned that it was difficult to find the proper position (for good angle of view) for watching. The device also got unpleasantly hot while watching.

Technical problems related to trial and prototype

Some usability problems that came up were caused by the ambitious and complex implementation of the prototype. In part, the grade for technical efficiency, 2.5, reflects prototype problems. These problems won't exist when the technology of the system is ready and functions reliably. Still, these issues need to be considered now as they offer some general suggestions for the development of the mobile television user interface.

First of all, there were too many phases before being able to watch a program. The situations in which the mobile device is used don't necessarily last very long, so the TV programs need to be available quickly. The users suggested there should be a shortcut to mobile television on the desktop. Login should be as quick and easy as possible.

"The whole process. It took too long to see the news during a coffee break, the coffee was already cold before you managed to get the program on. Some kind of shortcut to the programs would have been nice. Some clicks and that's it." [96]

Man, age 29 (Spare-time user *group*)

---

[95] "Laite on aika pieni, kulkee hyvin mukana ja akut kestää hyvin pitkään. Kyllä se kulkee mukana kuin matkapuhelin. Tää on jo niin pieni. Compaq:n laite oli vähän isompi. Sehän ei ollut mulla mutta olen tutustunut siihen muuten, se on vähän painavampi ja isompi. Sitä ei ehkä olisi tullut kuljetettua mukana. Sanotaan että tää on hyvä, tää on pieni ja tässä on tää suoja näytön päällä, niin sen uskaltaa laittaa taskuunkin. Se on ihan kivan kokoinen."

[96] "Ihan se koko prosessi eli jos mä halusin tässä kahvia juodessani, että katsonpa nyt uutiset, niin siihen näppäilyyn meni niin kauan, että kahvi olikin jo kylmää. Semmoinen oikotie olisi ollut paljon kivempi. Et nyt, tästä näin, pari näppäintä ja se on siinä."

> *"The favourite channel helps a little but it should be possible to select the channel right away, and the login should be quicker. Now it is too difficult."* [97]
>
> Man, age 27 (Workers group)

Sometimes the user had to wait some time for programs to start or images to load. The users hoped for some visible information during these waiting times, e.g. why it was taking so long, estimated waiting time or some such. Spped in loading was given 3.3 points and speed in functioning was given 2.9 points on average.

The starting times of the programs according to the TV guide's time schedule was problematic and caused some confusion. If programs were late, the users first saw the end of the previous program before the actual program started. On some occasions the users thought they had selected a wrong program.

> *"I thought that it showed the wrong program when the programs were late and it started with the end of the previous program. The news was so short that you had to watchthe whole thing before you could see the program you wanted."* [98]
>
> Man, age 39 (Workers group)

> *"When the Myyrmanni accident was on, the programs were so late that it showed the wrong programs. The programs were evidently recorded by the time schedule because the timing was poor."* [99]
>
> Man, age 28 (Spare-time-users)

---

[97] "Toi suosikit nyt auttaa jonkun verran, mutta jos olis mahdollista, että mobbi olis suoraan oma ohjelmansa, eli siitä pystyis suoraan valitsemaan sen kanavan, että se sisäänkirjautuminen olis vähän nopeampi!!! Se loggautuminen häiritsi, siitä katselusta tehtiin kauhean vaikeeta."

[98] "Luuli, että näyttää väärän ohjelman, kun ohjelmat oli myöhässä ja näkyi edellisen ohjelman loppu. Uutislähetys ennen Uutisvuotoa oli niin lyhyt, että sen joutui katsomaan kokonaan, ennen kuin pääsi haluamaansa ohjelmaan käsiksi."

[99] "Kun oli tämä Myyrmanni niin ohjelmat oli myöhässä, että tuli ihan väärää ohjelmaa niistä. Sieltä tuli edellistä tai seuraavaa ohjelmaa. Ne on ilmeisesti nauhoitettu kellonajan mukaan, koska iissä oli aina ylimääräistä."

The users had some problems with the settings of the devices. Sometimes the settings seemed to disappear on their own and the users couldn't adjust them by themselves. All things related to the WLAN and its settings were unfamiliar to the users. For the future, it is important that users don't have to care about the settings or think about the networks. All the networks should function in seamless co-operation without special user operations.

> *"If there were some problems with the device I couldn't handle them. Those settings. I can check the Internet settings on my home computer but I could not do it with this. "* [100]
>
> Woman, age 33

The quality of the programs improved by the end of the trial. Before that, short parts were occasionally missing from the programs or the picture jammed or the sound and picture were not running simultaneously. Some problems remained even after the improvement. Quality of picture was given 3.4 points while quality of voice was given 3.3 points on average.

There were some differences in the users' opinions on the quality of the programs. When the test users talked about the quality, they compared it with regular television. They said the picture wasn't as good as in normal television due to missing parts and jamming. This was brought up most strongly in the homes, as they had the other devices there for comparison. An exception to this was the people who were familiar with mobile devices and the quality of mobile video. They were impressed with the quality, as they knew the technical limitation. For example, the Futuuri exhibition visitors were generally positively surprised at the high quality of the videos.

Some test users used mobile television in a way that radio is used. They didn't necessarily concentrate on the picture but listened to the sound. If they heard something interesting, they looked at the picture. Still more test users expressed the importance of picture quality. This makes one wonder what the quality of picture should be like.

---

[100] "Jos ei toimi niin ei ainakaan osaa itse ratkaista missä se vika vois olla. Niitä laitteen asetuksia. Kotikoneessa osaa katsoa ne internet-asetukset ja muut mutta tässä ei sitä ollut."

It was hoped that one could rewind and forward the programs. The users also wanted to be able to return to a certain part of the program after a short break or if they had seen the rest of the program at home on a regular television.

In this trial there were no subtitles in the programs. The users thought they are necessary and should be there.

6.6.5 Viewing habits and usage situations

Tv-anytime

The killer for mobile television seems to be TV-anytime. According to the interviews, the opportunity to watch TV programs at anytime, independently from the broadcasting time, is the main reason for obtaining mobile television in the future. Some users browsed through all the TV programs available. They did not necessarily watch all the programs but they wanted to see what TV programs had been broadcast during the previous week.

Picture 54. Children watching Pikku Kakkonen in bed.

Viewing programs on demand is a desired feature. Users across age groups fancied this idea:

"At a certain time of the day I have lots of time to watch programs, then it would be nice to be able to select those programs you have missed." [101]

Man, age 57 (Spare-time user group)

"Because it would be easier to see the news, I would probably watch even more than I do now because the programs are available so easily. Now there are programs that I don't watch. That makes it good, like the video type recorder, you don't need to be around when the program is broadcast." [102]

Man, age 29 (Spare-time user group)

"It doesn't matter that the programs are one day late. It is nice that you can watch them when you want to. It will bring some quality to your watching habits because you choose the programs you really want to see." [103]

Woman, age 33 (Spare-time user group)

Killing time, to be up to date, micro breaks

Killing time was the main reason for using mobile television. The users had some extra time to kill with television. Often in these situations the users would have read the afternoon papers. Those newspapers could, perhaps, be considered competitors to mobile television. Still, some interviewees mentioned that TV makes it easier to relax than reading.

---

[101] "Tiettyyn aikaan päivästä on paljonkin aikaa katsoa ohjelmia, silloin olisi kiva jos vois poimia näitä ohjelmia mitä on mahdollisesti jäänyt katsomatta."

[102] "Koska se saatavuus olisi paljon helpompaa niillä uutisilla esimerkiksi, koska ne voisi katsoa koska vaan. Niin varmasti tulisi katsottua enemmän, entistä enemmän. Koska nyt on sellaisia ohjelmia, jotka jää väkisinkin tietenkin katsomatta. Tästä ne olisi helppo, koska ne on siellä arkistossa. Se on vähän niin kuin videonauhuri, se siitä tekee hyvän, ei tarvitse olla paikalla silloin kun se tulee suorana."

[103] "Sillä ei ole merkitystä, että ne on päivän myöhässä. Se on kuitenkin kiva, että sieltä voi itse valita silloin kun itselle sopii se haluttu ohjelma. Se tuo varmasti laatua siihen omaan katseluun. Tästä ei tule niin kuin toljotettua telkkaria vaan tulee valittua ne. Itse on enemmän sen koneen herra, että saa itse päättää mitä sieltä haluaa oikeasti katsoa."

The users watched programs they had missed, or tried to stay updated on the news. Sometimes they also viewed some programs that they would never otherwise have watched. Some examples of usage situations during the trial were: eating alone at work, waiting in the car while one's wife went to the pharmacy, watching news about current events, spending time outdoors or watching different channels/programs to those at home. As the size of the testing environment was restricted, there where quite a few genuine usage situations as on many occasions the users had to make the effort to go to the test environment to use the device.

> *"We watched the news when Hotakainen got his Finlandia award. It was discussed widely and many people saw the news."* [104]
>
> Man, age 48 (Workers group)

> *"It would have been nice to see the news during the Myyrmanni accident because I wasn't able to follow it on my mobile phone. On these kinds of special occasions and if you are waiting for something."* [105]
>
> Man, age 28 (Spare-time users group)

> *"If I had to eat alone in this gloomy place, I took it with me."* [106]
>
> Woman, age 25 (Workers group)

> *"At this moment I have so much time that I went there and tried it just for fun."* [107]
>
> Woman, age 22 (Spare-time users group)

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[104] "Yhden uutiset katsottiin silloin kun Hotakainen sai Finlandia palkinnon, siitä syntyi laaja keskustelu aiheesta. Siinä kävi useampia ihmisiä katsomassa sitä uutislähetystä."

[105] "Mulle tuli mieleen tän Myyrmannin iskun aikaa olis ollut mielenkiintoista katsoa uutislähetyksiä kun oli liikkeellä, koska mulla ei ole sellaista puhelinta, millä mä saisin esimerkiksi wap-uutiset, oli pimennossa että mitä on tapahtunut. Eli tällaisissa erikoistilanteissa ja silloin kun odottaa..."

[106] "Silloin kun jouduin yksin syömään täällä kolkossa tilassa. Silloin otin sen kaveriksi."

[107] ""On nyt niin paljon aikaa, että lähdin sinne ihan huvikseni testailemaan."

Tv-anywhere

The interviewees were asked to imagine what kind of situations they would watch mobile television in in the future if they could use it in any place they liked. After using the prototype and getting the idea of the mobile television, it was quite easy for them to come up with ideas on possible places. Some even commented that the idea of the mobile television itself changed their daily routines, as they found themselves in many situations where mobile television could be useful.

The users gave the following examples of possible places: local bus, train, car, park, playground, waiting room and boat. In these places mobile television could replace the newspaper. Children would like to take mobile television to school.

> *"It's something extra in waiting situations. Let's say that when you go to bus stop and smoke 4 cigarettes you could replace it by watching "Pink Panther". Or when travelling, you have to kill time. This would make killing time more pleasant. Maybe this could replace "Iltasanomat."* [108]
>
> Man, age 28 (Spare-time users group)

> *"It would be nice to get a WLAN in the playground. I could watch the Internet and this while my kid was playing."* [109]
>
> Man, age 27 (Workers group)

> *"The use for mobile television will be on the move, e.g. on the way to the summer place. The kids already have gameboys and walkmans. "* [110]
>
> Man, age 48 (Workers group)

---

[108] "Se on enemmän tällainen lisä johonkin odotusaikaan. Sanotaan kun sä menet bussipysäkille ja röökaat neljä röökiä niin sen voisi korvata katsomalla yhden 'Vaalean punaisen pantterin'. Tai jos matkustaa, kaikkialla missä pitää kuluttaa aikaa. Se voisi tehdä siitä miellyttävämpää siitä ajan kuluttamisesta. Ja ehkä 'Iltasanomien' korvaajan tästä voisi saada."

[109] "Ai kun sais johonkin leikkikentälle WLANin, voisin katsella siellä nettiä ja tätä kun lapsi siinä leikkii."

[110] "Mobiilitelevision käyttö tulee olemaan sellaista liikkuvaa. Esimerkiksi mökkimatkalle, nytkin lapsilla on gameboyt ja korvalappustereot."

Surfing the television programs

Most mobile television watching sessions lasted less than 10 minutes (Figure 55). Mobile television was used to check what programs had been broadcast by regular television during the previous week. People would watch programs they had missed or for some other reason wanted to see it or part of it again. This means that they want to be able to view the programs as they had them on videotape. Being able to rewind, pass forward or skip to some specific scene is necessary. The limited watching area and technical difficulties were also reasons for the short viewing sessions.

> *"It was so handy. I could watch what was broadcast a week ago if a buddy told me about an already broadcast good program. This probably happened twice."* [111]
>
> Man, age 15 (Spare-time user group)

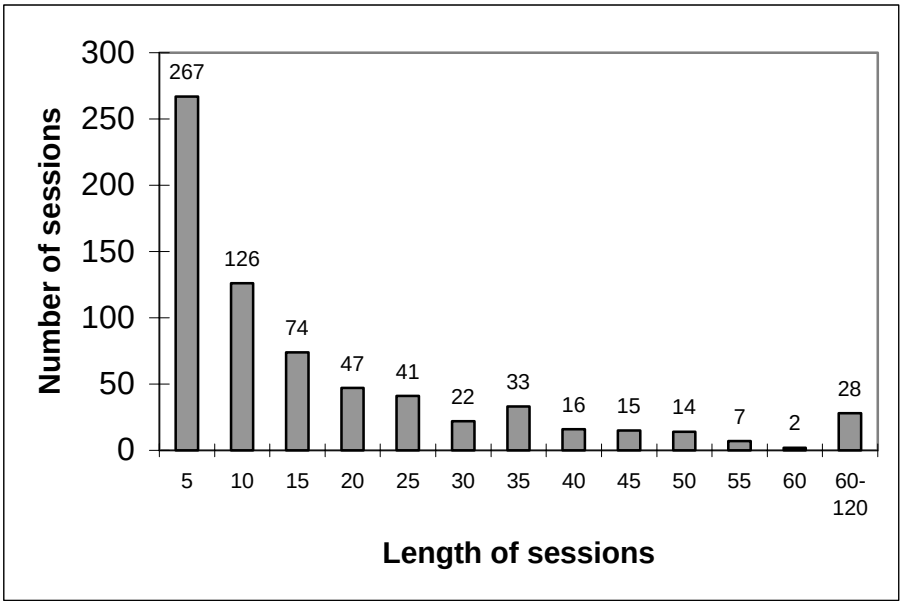

Figure 55. Distribution of session lengths. The first column presents sessions which were 0–5 minutes long, the second presents sessions which were 5–10 minutes long, etc.

[111] "Se oli tosi kätevää. Pystyi katsomaan mitä viikko sitten tuli esim. jos joku kaveri kertoi jo esitetystä hyvästä ohjelmasta. Taisi olla kaksi tällaista kertaa."

People usually watched programs for some minutes (Figure 56). Most programs were not viewwed for more than four minutes. The viewing time for individual programs supports the results from the interviews. People used to surf, watch short programs or parts of programs. Occasional slowness in program loading also explains the large number of programs viewed for 0 to 2 minutes. People selected programs but did not want to wait for them to load and on many occasions ended up canceling the loading. As was reported in Chapter 6.3, programs of unknown length (95 programs) are not included in the distribution. It was assumed that the unknown programs would be similar in length to the known programs. According to that assumption, the estimated average length of the unknown programs would be 3 minutes 45 seconds and the range would be from 10 seconds to 30 minutes 38 seconds and median 1 minute 15 seconds, and two-thirds of the programs would be watched for less than four minutes. This would not change the distribution of program lengths significantly.

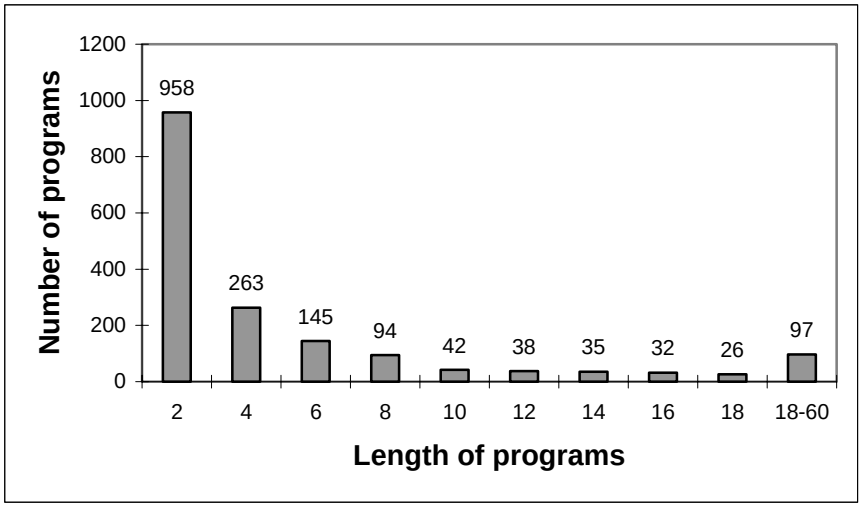

Figure 56. Watching times of individual programs. The first column presents the number of programs that were watched for 0–2 minutes, the second column presents programs that were watched 2–4 minutes, etc.

In the mobile context people would mainly watch shorter programs, but available time also affects program choice. Several users commented that if there was plenty of time, they would watch longer programs:

> *"If it was summer, I could spend time in the city centre and watch a series with some friends. Maybe I would just check the news if I was waiting for a bus."* [112]
>
> Man, age 18 (Spare-time user group)

> *"Perhaps short programs are nicer but when thinking about travelling by train, longer programs would also go well."* [113]
>
> Man, age 27 (Spare-time user group)

Personal versus communal television

Mobile television would mostly be viewed in situations where you are alone, but the younger test users would use it also as a group. Most test users stressed that the presence of other people in a public place wouldn't affect what programs they would watch. Still, there were a few contradictory comments, so possibly the programs viewed in public places would be quite neutral.

Because of the small screen size, the smaller device is mainly for personal use. If viewers wanted to see the programs properly, they needed to place the screen right in front of them. This means that they have to be very close to each other if they are watching it together. Many interviewees clearly stated that proximity with strange people would be inconvenient. Mostly younger test users mentioned that they could watch programs on the smaller device as a group.

Some users brought up the idea that it could be possible to create an image for themselves by watching certain programs in public places, e.g. sport programs give an athletic impression.

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[112] "Jos olis kesä niin keskustorilla vois istuskella ja katsella jotain sarjaakin kaverin kanssa. Mutta jos vain odottaa bussia, niin silloin ehkä vain vilkasis uutiset."

[113] Ehkä lyhyet ohjelmat ovat mukavampia mutta kun taas ajattelee jotain junamatkaa niin siinä pidempikin ohjelma menisi ihan mukavasti.

"It has nothing to do with not wanting to disturb others, but you wanna keep a low profile. You can also be stamped as some sort of techno freak…" [114]

Man, age 39, (Workers group)

"It wouldn't affect me. People listen to my conversations on the phone all the time, so I don't care if somebody sees." [115]

Man, age 27, (Workers group)

"That's an interesting point. It could have some effect. This is also emphasized in TV research…how you should answer this question in order to be a sophisticated citizen who watches documentaries about current affairs and nature. That's not true at all. It's fun. Is television watching still linked to some values…" [116]

Man, age 48, (Workers group)

New ideas

The on-demand feature was such a joy for the users that most of them suggested there should be all possible TV content available. When the test users were given new ideas, most users found them interesting. Only a few test users spontaneously mentioned that they would be interested in programs specially tailored for mobile television. The idea of mobile television was new to the users and that made it difficult for them to think about the use as different from regular television.

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[114] "Ei liity siihen, ettei halua häiritä muita, vaan siitä, että haluaa pitää matalaa profiilia ja siitä tulee sellainen teknofriikin leima otsaan..."

[115] "Ei se vaikuttaisi, kyllähän ne ihmiset jatkuvasti kuuntelee mun puhelinkeskustelujanikin, ei häiritse että muut näkee."

[116] "Mielenkiintoinen juttu. Kyllä se vois vaikuttaa joissain määrin. Kyllähän tämä asia TV-tutkimuksissa painottuu... Miten sinun tulisi vastata tähän kysymykseen ollaksesi sivistynyt kansalainen, joka katsoo ajankohtaisohjelmia ja luontodokumentteja. Mikä ei pidä paikkaansa yhtään. Se on hupaisaa, liittyykö television katseluun jonkinlaista arvolatausta edelleenkin..."

Some new features related to programs were brought up:
- summaries of existing programs (you can stay with a series)
- indexed programs (you can skip to some interesting part/scene)
- links to websites (you can easily view additional information)
- games related to programs (e.g. a quiz about the events in the series)

Mobile television should be linked to television at home. As a rule, people wanted to watch the bigger screen size if possible. It should be possible to transfer information between the two devices: mobile television and home television. That would make it possible to join the best features of both devices: bigger screen of regular television and on-demand feature of mobile television.

An issue brought up by the families is how to control what children are watching when all the programs are available all the time. There needs to be a way for parents to control what programs are viewed.

6.6.6 Cases

One single user from the workers group and one family were selected for the cases. The family represented a normal family who have been in the trial. They took part at the end of the trial, so all the services were available and most of the technical problems had been solved. The single user was selected because she had some interesting opinions of mobile television and its use, even though she hadn't used it so much during the trial. Besides that, she is interested in new technologies.

Case Family

The family case describes the use of mobile television by a family. The family comprised four members: mother age 39, father age 45 and two boys aged are five and nine. They used the mobile digital television from 23.1– 24.2.2003. The mother and the boys were interviewed, and the father answered the questions by email.

At the beginning of the trial the users were asked to fill in a background information form (see Appendix Q). The family members gave the following estimates of how they use other media equipment (Table 14).

Table 14. Use of other media equipment.

	Father	Mother	Older boy	Younger boy
Watch home television hours/week	20	15	2	12
Browse Internet	10–20 hours per week	7–10 hours per week	½ hour at a time	5 hours at a time
Mobile phone fees (euro per month)	100	50	10	-

Both parents estimated that they are on the experienced level as a computer users. None of them had used a PDA device before but, in the interview, said that both the device and the mobile television were rather easy to use. All the family members used the Fujitsu because they could not use the iPaq at home. Only once did the father use the iPaq at the cafe in the city centre.

Table 15 shows the login times for each family member during the five weeks they had mobile television. Because they all mainly used the same Fujitsu, all the logins are at different times. The **father** had 25 login events in seventeen days; during seven days he used the mobile television tow or three times per day. Usually he watched programs in the morning and then in the evening for the second time if he used it twice or more during the same day. He used mobile television most on Mondays. The **mother** had 20 login events in twelve days; during five days she had two or three different login events, otherwise only one per day. The **younger** boy had 20 login events. He mainly used mobile television once a day and weekday nights. All his logins were between 19.30 and 23.00; and only once on a Saturday. During the fourth trial week he watched mobile television every weekday. The **older** boy had 21 login events in ten days. During the second day of the trial, on a Friday, he had six different login events between 11.49 and 23.31.

Altogether, they had 86 login events during the trial. All the family members had almost the same number of logins. A few times (6) they passed the device from one to another after the first one had watched the mobile television for less than fifteen minutes. So the sessions have sometimes been quite short - on one occasion the younger boy only watched it for 3 minutes before he gave the device to the older boy. Based on logins, Friday was the most popular day for

them to use mobile television. The first Friday was the most popular day during the whole trial, which is significant. Like the other families in the trial, the weekends were not popular times for mobile television. They mainly used mobile television during the afternoons and evenings - only eight times before noon. After 9 p.m. they had 24 login events.

Table 15. Family members' login times over five weeks. (M= Mother, F= Father, O= Older boy, Y= Younger boy)

Week 1	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
				M 12:37	M 09:09	O 10:18	O 11:02
				O 13:51	O 11:49	O 13:58	F 12:35
				M 15:10	O 13:19	M 19:48	O 14:35
				O 15:18	M 15:20	Y 21:02	F 19:17
				M 18:48	M 16:20	O 23:18	O 19:58
				O 19:58	O 16:29		
					Y 19:32		
					Y 20:37		
					O 21:14		
					Y 21:17		
					O 22:43		
					O 23:31		
2	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	F 7:23	F 9:45	F 15:47	F 14:57	Y 21:55	M 15:41	F 19:52
	O 12:11	M 18:03	M 19:19	F 19:57	F 22:14	M 17:00	
	M 19:09		F 20:23			M 19:10	
	F 20:43		Y 21:29			O 20:07	
						F 00:12	
3	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	O 7:10	F 14:07	F 12:16	Y 21:25	Y 21:34	F 16:07	F 16:36
	F 21:17	O 14:23	Y 21:42		F 22:38		
	F 21:51	Y 22:15	M 21:54				
		F 23:07	Y 22:53				
4	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	F 14:14	Y 20:37	Y 20:47	O 19:33	F 11:10		
	M 20:07		O 20:50	Y 20:09	Y 20:42		
	F 20:13			M 20:20			
	F 20:56			Y 21:49			
	M 21:15						
	Y 22:27						
5	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	F 14:52	Y 19:33	M 15:46	M 15:40			
	Y 20:19		Y 21:17	M 18:42			

The programs they selected the most are in Table 16. It is worth noticing that the same program could be selected several times per one family member. The numbers after the program's name represents the selected object – events from the log data. So the number can include several different episodes of the program and/or the same episode could have been selected several times. In addition to these programs, all the family members had several programs they only selected once. The father selected a total of 34 different TV programs, the mother 16, the younger boy 16 and the older boy 18.

Table 16. Programs selected by the family members.

Programs selected by **the father**	Programs selected by **the mother**
News broadcasts 16 (TV–uutiset 8)	Kova laki 9
Kuningaskuluttaja 3	Taitoluistelun EM-kilpailut 3
Uutisvuoto 2	Sinun tähtesi 3
Joonas Hytönen show 2	Joka kodin asuntomarkkinat 2
Ykkösen aamu-tv 2	FST: Marianne-rouva 2
Tänään otsikoissa 2	
Super Bowl 2	
Inhimillinen tekijä 2	

Programs selected by **the younger boy**	Programs selected by **the older boy**
Pikku Kakkonen 16	Koulu-tv 7
Vaaleanpunainen pantteri 2	Franklin 3
Arttu 2	Peliuutiset 3
	Sätkyjä ja tärinöitä 2
	Angela Anakonda 2
	Richard Scarryn touhukas maailma 2

The mother

In the interview the mother said that she used mobile television less than she expected before the trial. The main reason for that was that she wasn't able to use the mobile television because of technical problems when she would have had time. She often watched mobile television in bed and mentioned that it was difficult to get into the right position (angle of view) and the device warmed up.

She liked to watch the programs from the bigger device and mentioned that she wouldn't watch the programs from a mobile phone if that were possible.

She mainly used mobile television just for watching programs and didn't use any additional services except chapters. On four occasions she just browsed different channels and only selected one program, or none. She watched the same programs on mobile television as she usually watches on the home television, but now she didn't need to videotape what she usually does every day as she watched the programs when it was suitable for her. That was a very good feature of mobile television according her. She also mentioned that she had listened to a music program on mobile television and watched another television program on the home television at the same time. Based on that, she said she would like it if there were programsthat are shorter and don't need eye contact on mobile television. She also wished that all the Finnish channels were there, and especially more series because she usually watches only foreign series and thought that she could even watch a movie on mobile television.

An exception to watching the programs from the beginning to the end was a Swedish program in which the subtitles were missing. She couldn't concentrate long enough and had to watch it by chapters. She noticed that she sometimes selected the programs from the chapters anyway, and that was a good feature of mobile television - except the way the chapters have been implemented needs improvement. Sometimes, if the programs were late, she saw the end of the previous program first, and that was confusing.

> *"I used chapters. It was really good feature. Sometimes I watched half of the program and after that went to do something else, and then watched the rest of the program. It was easy to continue watching through the chapters."* [117]

Table 17 gives one date on which the mother used mobile television. The first column gives the different action times, when she had done something in the service - e.g. she had logged in at 18:48 and, from the description column, the device she used was the Fujitsu. Then, in the same minute, she had selected

[117] "Käytin jaksojen etsiskelyä. Se on tosi hyvä. Joskus katsoin puolet ohjelmasta ja menin tekemään muuta. Ja sitten taas jatkoin. Oli helppo mennä siitä."

a channel. The channel she selected was TV2 and the day the programs were broadcast was 17.1, as can be seen from the description column. After that, she selected a TV program (select object), 'Kova laki'. She didn't watch the program but instead selected the first chapter of the program (select program-related operation, select automatically-generated chapter). After that she added the program to her favourites (select program-related operation, lisää suosikkeihin). Then she went back to the TV2 channel (select channel) and selected a different program, 'Eurodekkari: Komisario Montalbano'. But she didn't watch that program either because after one minute she selected a new program, 'Leikin varjolla' again. She watched that program for about three minutes and then went back to the same channel, TV 2. On 23.1 she selected a new channel, TV 1. From that channel she selected the 'A-studion Atlas' program, which had been broadcast about ten minutes earlier on digital television. The time she spent from the login to the last action (select object) was ten minutes.

Table 17. The mother's use on 23.1.2003.

TIME	ACTION	PROGRAM	AIRTIME	DESCRIPTION
18:48:24	login		.	HTML_FUJITSU from x.x.x.x
18:48:50	select channel		.	YLE TV 2 17.1.2003
18:48:58	select object	Kova laki	17.1 22:30 (TV 2)	
18:50:37	select program-related operation	Kova laki	17.1 22:30 (TV 2)	Jaksot
18:50:44	select automatically-generated chapter	Kova laki	17.1 22:30 (TV 2)	1
18:51:44	select program-related operation	Kova laki	17.1 22:30 (TV 2)	Lisää suosikkeihin
18:51:48	select channel		.	YLE TV 2 17.1.2003
18:53:38	select object	Eurodekkari: Komisario Montalbano	17.1 23:15 (TV 2)	
18:54:40	select object	Leikin varjolla	17.1 22:05 (TV 2)	
18:57:33	select channel		.	YLE TV 2 17.1.2003
18:58:31	select channel		.	YLE TV 1 23.1.2003
18:58:45	select object	A-studion Atlas	23.1 18:45 (TV 1)	

The father

The father thought that one good feature of mobile television is that you can move around with it. The father had used the devices on the couch, at the kitchen table, in bed, with a neighbour and once at the cafe in the city centre. He mainly

watched programs that had been shown the same day. He selected a program that had been broadcast on an earlier day on just seven occasions. He was mainly interested in news and current affairs programs, although he mentioned that there was sometimes a real need to watch, e.g., a documentary afterwards if he had missed the program. At the beginning of the trial the father used the additional services but after a few days he was just watching television programs. He wished that all the same programs would be available to mobile television as are in the cable channels. On the negative side he mentioned that the quality of the picture was sometimes poor and the sound and the picture came different times. Also, the angle of view should be wider, especially if you want to watch it with other people. He noticed that if mobile television would function for six hours, his long train journeys would at least feel shorter. Table 18 shows an example of one occasion on which the father used mobile television. Besides the same actions as the mother, the father has also checked additional information on 'Ajankohtainen kakkonen'.

Table 18. The father's use on 29.1.2003.

TIME	ACTION	PROGRAM	AIRTIME	DESCRIPTION
15:47:04	Login		.	HTML_FUJITSU from x.x.x.x
15:47:23	select channel		.	YLE TV 1 29.1.2003
15:48:20	select channel		.	YLE TV 2 29.1.2003
15:48:39	select object	Tänään otsikoissa	29.1 14:40 (TV 2)	
15:50:59	select channel		.	YLE TV 2 29.1.2003
15:51:05	select object	Ajankohtainen kakkonen	29.1 13:50 (TV 2)	
16:01:22	select channel		.	MTV3D 29.1.2003
16:01:40	select program-related operation	Ajankohtainen kakkonen	29.1 13:50 (TV 2)	Lisätiedot
16:02:11	select channel		.	YLE TV 1 29.1.2003
16:02:40	select object	Tv-uutiset	29.1 13:00 (TV 1)	
16:09:00	select channel		.	YLE TV 2 29.1.2003
16:09:14	select object	Satumaa	29.1 15:40 (TV 2)	
16:17:21	select channel		.	MTV3D 29.1.2003
16:17:37	select channel		.	YLE TV 1 29.1.2003
16:17:44	select object	Iines	29.1 16:05 (TV 1)	

On the background information form **the parents** stated that the main purpose of watching television is relaxation for the mother and acquisition of information for the father. This can also be seen in the way they watched mobile television.

The father mainly selected news broadcasts or programs related to current affairs, while the mother selected entertainment programs. During the trial the father left most of the current affairs programs for viewing on mobile television.

The parents also wished that it were possible to control what the children were watching - because all the programs are available over seven days, they can't be sure what their children are watching.

> *"Programs that are not suitable for children don't fit with mobile television. It is difficult to keep an eye on what they watch during the days when I'm working because all the programs are available. It should be possible to control it somehow."* [118]

The younger boy, age five

The program the younger boy selected most often was 'Pikku Kakkonen'. He changed his viewing habits so much that after the trial he couldn't remember when 'Pikku Kakkonen' is broadcast on television in real time. Otherwise, he occasionally selected children's programs. Eighteen times he selected programs that had been broadcast that same day and fifteen times programs that had been broadcast on earlier days.

> *"He watched something else during the Pikku Kakkonen broadcast and watched it later on mobile television." (Mother)"I can't remember when it's broadcast on normal television any more" (Younger boy)*[119]

Table 18 gives as an example of one time the younger boy used mobile television. The time he spent from the login to the last action (select object) was 1 hour and 43 minutes. He watched the first four programs he selected for more than twenty minutes per program.

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[118] "Mob-tv:lle ei sovi sellaiset ohjelmat, joita lapset eivät saa katsoa. Vaikeampi seurata kun on viikko taakse päin ja mä olen töissä, hän voi katsoa vaikka mitä. Samanlainen lukko kuin esim. kännykässä"

[119] "Hän hoksasi, että Pikku Kakkosen aikaan ei katsonut sitä vaan katsoi sen sieltä myöhemmin."(Mother) "En muista enää milloin se tulee". (Younger boy)

Table 19. The younger boy's use on 14.2.2003.

TIME	ACTION	PROGRAM	AIRTIME	DESCRIPTION
20:42:41	login		.	HTML_FUJITSU from x.x.x.x
20:42:46	select channel		.	YLE TV 2 14.2.2003
20:43:10	select object	Richard Scarryn touhukas maailma	14.2 16:55 (TV 2)	
21:04:01	select channel		.	YLE TV 2 14.2.2003
21:04:13	select object	TV2: Merirosvolaiva	14.2 17:20 (TV 2)	
21:34:18	select channel		.	YLE TV 1 14.2.2003
21:35:40	select channel		.	YLE TV 2 13.2.2003
21:36:24	select object	Arttu	13.2 16:55 (TV 2)	
21:59:00	select channel		.	YLE TV 2 10.2.2003
21:59:36	select object	Timo menee esikouluun	10.2 16:55 (TV 2)	
22:22:33	select channel		.	YLE TV 2 10.2.2003
22:22:53	select object	TV2: Soiselisoi: Kummitusjuna	10.2 16:50 (TV 2)	
22:25:12	select channel		.	YLE TV 2 10.2.2003
22:25:50	select object	TV2: Ralle Ryökäle: Myyntitykki	10.2 16:40 (TV 2)	

He could not read, so he needed help from his older brother or parents to get started on viewing the programs, especially for login. After a while he learned how to scroll the available programs and pick one out based on the picture of the program.

> *"He couldn't use the keyboard so we used it for him. At the end of the trial he was able to select Pikku Kakkonen from the program list based on the picture of the program. He also selected other programs according to the pictures." (Mother)*[120]

The older boy, age 9

The older boy quite often selected chapters of 'Koulu-tv' or some news and also children's programs. He would have like the foreign series he follows at home to be available on mobile television too. He usually selected programs that had

[120] "Hän ei osannut sitä näppäimistöä käyttää joten olemme aina näpytelleet hänen puolestaan. Lopuksi osasi sisäänkirjautumisen jälkeen mennä itse eteen päin ja tiesi kuvan perusteella, että tuossa on Pikku Kakkonen... Muutenkin valitsi ohjelmia kuvan perusteella." (Mother)

been broadcast on earlier days, and only twice selected a program that had been shown the same day. A couple of times he just glanced at what was available on the channels. He didn't select all the programs but still mentioned that there was nothing interesting to watch.

> *"Sometimes I didn't have anything left to watch because I had gone through them all."* [121]

Table 20 is an example of one occasion on which the older boy used mobile television. Almost straight away he browsed through TV1 programs from different days. After that he found a program that he watched for about fourteen minutes, then browsed the days left from TV 1. The time he spent from the login to the last action (select object) was 55 minutes.

Table 20. The older boys use on 12.2.2003.

TIME	ACTION	PROGRAM	AIRTIME	DESCRIPTION
20:50:00	login		.	HTML_FUJITSU from x.x.x.x
20:50:05	select channel		.	YLE TV 1 6.2.2003
20:50:31	select object	Angela Anakonda	6.2 15:40 (TV 1)	
21:02:23	select channel		.	YLE TV 1 6.2.2003
21:02:55	select channel		.	YLE TV 1 7.2.2003
21:03:34	select channel		.	YLE TV 1 8.2.2003
21:04:21	select channel		.	YLE TV 1 9.2.2003
21:05:02	select channel		.	YLE TV 1 10.2.2003
21:05:39	select object	Koulu-tv: Prisma.jr	10.2 12:30 (TV 1)	
21:19:14	select channel		.	YLE TV 1 11.2.2003
21:19:57	select channel		.	YLE TV 1 12.2.2003
21:20:37	select object	Koulu-tv: Prisma.jr	12.2 10:10 (TV 1)	
21:21:50	select channel		.	YLE TV 2 6.2.2003
21:22:12	select object	Arttu	6.2 16:55 (TV 2)	
21:45:05	select channel		.	YLE TV 2 7.2.2003
21:45:23	select object	Richard Scarryn touhukas maailma	7.2 16:55 (TV 2)	

[121] "Välillä mulla on siten, ettei mulla ole yhtään ohjelmaa katottavana kun mä olen käynyt kaikki läpi."

In the future they would like to use mobile television basically everywhere, but especially while travelling. The children could watch television in the back seat and the older boy would like to take the device to school. They thought the prices of the programs were too high, even though they didn't expect it to be free of charge. They thought that the charge for mobile television should be included in some current price. The mother preferred pay per month and would pay about 25 euro per month if the programs were those she wants to watch. The father would like to pay per program, but if mobile television would work everywhere, he would like to pay monthly. He estimated that the amounts could be about 40 euro per month and 0.5 euro per program. A new idea they came up with was that there should be a clock to follow how much of the program is left for watching. There should also be the possibility of ordering movies for mobile television, like renting videos from a video rental shop.

Case Single user

The single user case is a 34-year-old woman. She used the service in the city centre and in the University main building. On the background information form she estimated that she watches television for about 15 hours per week at home, browses the Internet for 7-10 hours per week and is willing to spend about 50 euro per month for her mobile phone. As a computer user she estimated that she is on the experienced level but had not used a PDA device before the trial. She used mobile television between 2.1 and 13.2.2003. The device she used was the iPaq.

The use

She used the mobile television on three different days during the trial, besides the time she had the device. That was less than she expected but she was busy and felt it too troublesome to walk to a certain place just to watch television. However, she mentioned that it was only awareness of the trial that made her think about possible usage situations for mobile television, so she had some interesting opinions on mobile television, even if the real use was less than some other users.

”After I got the device I started to be more aware of situations in which I could have used it if it had been possible. Only the awareness of the service gave me new ideas on the different possibilities for use. Even that broke my week’s routines.” [122]

The **first** time (See Table 21) she used it was like getting familiar with the service: she picked up different additional services - like search, TV-guide, modify favourites, check account - or other program-related operations - like added a program to favourites, viewed program chapters, looked at additional information on programs and the TV guide’s additional information. The session lasted 10 minutes and the programs she selected were broadcast the same day.

Table 21. The first time use.

TIME	ACTION	PROGRAM	AIRTIME	DESCRIPTION
14:16:42	login			HTML from x.x.x.x
14:18:48	select channel			YLE TV 1 2.1.2003
14:20:13	select object	Neljä vuodenaikaa Provencessa	2.1. 13:20 (TV 1)	
14:22:16	select program-related operation	Neljä vuodenaikaa Provencessa	2.1. 13:20 (TV 1)	Lisää suosikkeihin
14:22:24	select program-related operation	Neljä vuodenaikaa Provencessa	2.1. 13:20 (TV 1)	Jaksot
14:22:52	select program-related operation	Neljä vuodenaikaa Provencessa	2.1. 13:20 (TV 1)	Lisätiedot
14:23:46	search			todella
14:23:51	select object	Todella upeeta	2.1. 00:20 (TV 1)	
14:24:13	select tv guide			Thu Jan 02 14:24:13
14:24:37	select program-related operation	Matlock	2.1. 09:15 (TV 1)	Ohjelmaoppaan lisatiedot
14:25:00	modify favourite			
14:25:17	check account			
14:26:34	logout			

The **second** time was more like watching programs. Before watching any program she browsed through some channels. The channels she selected for browsing were broadcast the same day or on the previous two. Then she picked up a program that had come the preceding day but only watched it for a couple

[122] ”Sen jälkeen kun mä sain sen, mä aloin oleen hirveen paljon tietoisempi niistä kohdista, joissa mä voisin sitä käyttää, jos olisi voinut. Laitteen saaminen itsessään, vaikka mä en olisi käyttänyt sitä ollenkaan, mulle oli tarjottu uusi ajatus siitä, että voisi olla tällainen laite, rikkoi niitä mun arjen rutiineja.”

of minutes. After that she selected another entertainment program from a different channel.

Table 22. The use the second time.

TIME	ACTION	PROGRAM	AIRTIME	DESCRIPTION
13:34:25	login		.	HTML from x.x.x.x
13:34:58	select channel		.	MTV3D 26.1.2003
13:35:04	logout		.	
13:35:48	login		.	HTML frsom x.x.x.x
13:36:46	select channel		.	YLE TV 1 30.1.2003
13:37:30	select channel		.	MTV3D 29.1.2003
13:39:11	select channel		.	MTV3D 28.1.2003
13:40:04	select channel		.	YLE TV 2 29.1.2003
13:40:39	select object	Kodin kääntöpiiri	29.1 18:35 (TV 2)	
13:44:16	select channel		.	YLE TV 1 29.1.2003
13:45:05	select object	Opettajat	29.1 22:35 (TV 1)	

The **third** time she selected channels and watched a few minutes of the programs (three different programs in thirty minutes). The programs she selected were like television documentaries. She watched the mobile television with a friend.

Table 23. The use the third time.

TIME	ACTION	PROGRAM	AIRTIME	DESCRIPTION
15:07:01	login		.	HTML from x.x.x.x
15:07:17	select channel		.	YLE TV 1 30.1.2003
15:07:56	select object	Tutkittu juttu: Haasteena aivot	30.1 17:10 (TV 1)	
15:18:37	select channel		.	MTV3D 30.1.2003
15:19:26	select object	45minuuttia	30.1 10:35 (MTV 3)	
15:20:31	logout		.	
15:34:12	login		.	HTML from x.x.x.x
15:34:34	select channel		.	YLE TV 2 28.1.2003
15:35:21	select object	Inhimillinen tekijä	28.1 22:05 (TV 2)	
15:41:22	logout		.	

On both the second and third occasions she logged out in the middle of the session but continued to watch again almost right away. All her login events were during the afternoons. This might be caused by the way the trial was

organised but she also mentioned that she wouldn't watch any TV commercials in the mornings. She also mentioned that she would probably watch more entertainment programs in the evenings.

> *"Evenings are time for me to 'charge my batteries' so I don't demand anything from myself. It is connected to how watching television got its relevance through the time of the day, e.g. mornings are a very sensitive time for me, I couldn't watch commercials then."* [123]

Content

In the interview she mentioned that the first time she used the mobile television she was so excited about the service that she couldn't actually concentrate on watching a program; instead, she wanted to see if there was something more interesting left.

> *"At the beginning the use was like selecting something and watching it for just a while and almost right away wanting to change it to something more exciting. I got the feeling I sometimes have in sales. There are so many nice things in the sale that you can't decide which one you really want to buy, and then you don't buy anything. So I didn't actually start to watch anything."* [124]

She also said that she didn't use the additional services after the first time because she just wanted to watch the programs.

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[123] "Ilta-aika on mulle niin selkeesti akkujen latausta, enkä vaadi itseltäni mitään. Se liittyy mulla tähän, että teeveen katselu merkityksellistyy vuorokauden aikojen kautta. Esimerkiksi aamu on hyvin herkkää aikaa, en kestä katsoa esim. mainoksia."

[124] "Aluksi mä huomasin, että se oli sellaista, että valitsi jonkun ja katsoi vähän aikaa. Ja sitten totesi, että en mä halua tätä, olisko tuolla jotain jännempää. Sitten tuli se olo, mikä on joskus kun on alennusmyynneissä, et ajattelet, että haluat ostaa tän ihanan. Mutta sitten siellä on toikin ihana ja toi ja ne on kaikki hirveen halvalla. Ja sit sä et ostakaan mitään. Sitä ei sitten oikein alkanutkaan katsoa mitään."

> *”I had the purpose of watching the programs every time I used the service.”* [125]

On one occasion she got a headache from watching it for too long and started to wonder if the programs should be shorter, lasting less than fifteen minutes. The news would be perfect because it is short and you can watch it anywhere, even if you weren’t so interested. Also, short parts of television programs, especially created for mobile television, that lastedthe bus or train journey to work would be fine. The programs she selected on the third occasion were like television documentaries. With these kinds of programs, she noticed that the content is more important than the quality of the picture.

> *”Last time I got a headache from using it for too long so I started to womder if I really could use this. At least the programs should be shorter so that you could immerse yourself in programs, like fifteen minutes.”* [126]

> *”I watched the program ’Inhimillinen tekijä’ both at home and on mobile television. When the picture was smaller, the content became more important. You listened the program more intensively, so the issues got a totally different value... For example, one talk show was funny, like listening to the radio. It doesn’t matter, even if you don’t watch it all the time, butl the picture makes it more alive than just listening to the radio.”* [127]

She also realised that even familiar television programs might be difficult to follow on the small mobile television’s screen if the film was fast or otherwise dissimilar to normal.

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[125] ”Aina kun mä yritin päästä tähän niin mulla oli se tarkoitus katsella ohjelmia.”

[126] ”Tosin se viime kertainen päänsärky oli paha takapakki, aloin oikeasti miettimään voinko käyttää. Sen takia niiden pitäisi olla lyhyempiä ohjelmia, joihin voisi uppoutua vaikka viideksitoista minuutiksi.”

[127] ”Katsoin Inhimillistä tekijää sekä kotona että mobilta. Kun kuva on pienempi, teknologiana sellainen, että se sisältö on ykkönen. Aivan toisella tavalla kuunteli mitä ne sanoo, asiat sai ihan erilailla painoarvoa... Sitten esimerkiksi se keskusteluohjelma oli hauska, vähän sellainen radiotyyppinen, ettei kauheasti haittaa vaikka sä et sitä koko ajan tölläisikään mutta silti se kuva tekee siitä vähän elävämmän kuin radio-ohjelma.”

”The series ’Opettajat’ was familiar to me. When I watch it on the home television I don’t notice any strange filming. But when I watched it on the mobile television I was amazed at how it was and I couldn’t get hold of the speech because the camera moved so fast.” [128]

Payment

When she was thinking about the payment, how much she is willing to pay for mobile television, she thought she would prefer to pay per program she would then know how much she had paid and could watch however much she liked. She thought that the pay per month fee was probably too high. Anyway, the amount should be less than the mobile phone fee per month because then it would not feel so big. One euro per program would be a quite reasonable price per program for her if she was travelling and had time to watch the program. If it were more, she probably would leave it without watching.

”The prices seemed to be quite cheap. I probably wouldn’t even give one second’s thought to whether or not I could afford them. Of course, it would be different if you had to pay for the whole time you used it. It makes it difficult if there is a counter ticking all the time in your head and you start to wonder if it is worth every cent. I would prefer to pay something and then watch it for however long you liked. It wouldn’t be so hasty then.” [129]

[128] ”Sarja Opettajat mitä yritin seurata siitä, se on mulle hirveän tuttu sarja. Kun mä katson sitä teeveestä niin mä en huomaa ollenkaan, että siinä ois mitään erikoisia kameran sisäänajoja. Mutta kun mä katsoin tosta niin mä oli ihan, että miten tää näin menee ja mä en saa tuosta puheesta selvää, koska kamera liikkuu niin nopeesti.”

[129] ”Ne hinnat mitä niissä oli vaikutti ihan halvoilta. En varmaan miettisi sekuntiakaan voinko pistää tuollaisen hinnan johonkin ohjelmaan. Tietysti se olisi eri asia jos siitä maksaisi erikseen siitä koko ajasta. Se olisi mikä siinä olisi hankalaa, mikä on kännykänkin kanssa, että laskuri koko ajan tikittäisi päässä ja miettisi, että onko joka sekunti sen arvoista. Enemmän ehkä jos se olisi jotenkin kohtuu hintaista niin mä preferoisin sitä, että olisi joku sellainen, että okei nyt mä olen maksanut tän verran ja nyt mä katson sen mitä katson. Siinä ei olisi sellaista hirveää hätäisyyttä.”

”It could be pay per program because I could pay more for one program than another. Pay per month would probably be too expensive, like the ADSL connection to the Internet still is. ” [130]

”If the charge were 40 euro per month, I wouldn’t pay it, but if it were 35 it would feel much less. I would compare it with my mobile phone fee-, as, I believe, would many other people. If it were less, it would be fine. How much I’d be willing to pay per program depends on the situation. While travelling I would probably pay one euro per program I’m used to watching. But if it were more, I would start to think that this program can’t be so important to me because I didn’t video it. Those example prices were really reasonable.” [131]

Usability

She thought the mobile television was easy to use and she didn’t have any difficulty with using the menus. At the beginning of her trial there were some problems with the device. In the interview she mentioned that these problems with the device made her think of mobile television more as a computerthat had the means to watch television, not as a (mobile) television. The reason for this was her thinking that computers have these kinds of problems whereas televisions do not. She also mentioned that after picking up one program she was

[130] ”Se voisi olla ohjelmakohtainen. Koska ihan selvästi mä olisin valmis maksaan joistakin enemmän kuin toisista. Sit mä arvelen, että se kuukausikohtainen, kun ajattelee tuota ADSL:kin niin se on vielä aika tyyris, jos se on jotenkin samassa suhteessa, se olisi aivan liikaa.”

[131] ”Jos se olisi nelkyt euroa kuussa, mä ajattelisin, että en mä sitä tarvi, mutta jos se olisi kolkytviis euroa kuussa niin se kuulostaisi jo henkisesti vähemmältä. Koska mä vertaisin, ja uskon, että monet ihmiset hahmottaisi sen suhteessa omaan kännykkä-laskuunsa. Jos se olisi sitä vähemmän niin se tuntuisi, ettei se olekaan niin paljoa. Sitten ohjelmakohtaisesti, se riippuisi paikasta, jos olet pitkällä junamatkalla, sä olet varmasti valmis maksamaan enemmän. Ei varmaan olisi kauhea kynnys maksaa euro jostain hyvästä ohjelmasta, jota seuraat yleensäkin, haluat nähdä. Mutta voisi olla kynnys maksaa paljon enemmän, koska sitten alkaisi jo ajatella, että enhän mä ottanut tätä videolle, eihän tämä ole mulle kovin tärkeä. Mutta ne viitteelliset hinnat oli todella kohtuullisia.”

shocked that the picture jammed. Television programs don't do that, or at least there is announcement about a technical problem on the screen.

> *"At first I thought that I'm a person who would get it because of TV. Thanks to the difficulties in use, I noticed that the PDA works and is good. TV would go as a by-product. For me, it began to turn into a computer ."* [132]

She noted that the device was a little difficult to hold. There was no logical place to keep it. It feels like you should keep it down on your knees, but then it reflects the light and you can't see. She would like to have it in a portrait position in one hand.

Viewing habits and usage situations

For her, Tv-anytime would be the thing to give additional value to mobile television. She has some programs that she likes to watch but doesn't even consider videoing them. But she would like to watch them if she has an empty moment. She mentioned that mobile television could be like using a mobile phone during waiting times. In those situations you don't really need to use a mobile phone but you do because you don't have anything else to do. These places could be e.g. banks, bus stops, cafes and while travelling. Mobile television could help one to relax and take one's mind off things.

> *"For me, it would be a substitute for the mobile phone. I'm the kind of person who tends to think 'who can I call?' when I'm waiting for something. It's expensive. If it were cheaper than calling, I think I would choose that. For me, calling during waiting situations is just a way of killing time, I'm not really seeking social contact. So, all these waiting situations; banks, bus stops and probably cafes where you are waiting for someone."* [133]

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[132] "Aluksi ajattelin olevani ihminen, joka hankkisi sen nimenomaan teeveen takia. Mutta kun oli kaikkia käyttövaikeuksia niin mä huomasin, että se pda on hyvä ja toimiva. Teevee voisi mennä sivutuotteena. Se alkoi muuttua mulle tietokoneeksi enemmän."

[133] "Kyllä mä luulen, että siitä tulisi paljon niin kuin kännykän korvike, koska mä olen huomannut, että olen niitä ihmisiä, joille kännykkä on tuottanut sellaisen tunteen, että jos mä esimerkiksi venailen jossain, niin mä alan hirveän nopeasti räpläämään, että kenelle soittaisi. Siitä tulee kallista. Jos se tulisi yhtään halvemmaksi kuin soittaminen, niin mä luulen, että mä valitsisin ton. Koska mulle se soitteleminen odottamistilanteissa on ihan vaan, ettei siinä hae edes oikeasti kontaktia vaan tappaa aikaa. Eli kaikki paikat missä odotellaan; pankit, bussipysäkit ja varmaan kahvilat, joissa odottaa toista ihmistä, nää hetket."

> *"When I was returning from a business trip, I thought that would be the moment to use mobile television. There are moments when I don't have the energy to do anything else. For some reason it is not always enough just listen to music. The picture gives something more. Mobile television would better for creating a bubble to lock yourself in."* [134]

Quite soon after using mobile television she noticed that she couldn't watch the same 'soap operas' on the mobile television as she sometimes watched on the home television. In the interview she said that she felt like some kind of television addict, who had to watch her favourite series on that ridiculously small screen in a public place the next day. She noticed that telling other people which programs she follows is a totally different thing to watching a television program in a public place with no explanation of why she is watching that program. She wondered whether mobile television would become as common as mobile phones and change viewing habits so that it would be acceptable to watch even 'soap operas' in public places. She also mentioned that she felt little bit silly having equipment like that in a place where other people were eating. She mentioned that it was totally different to being home - e.g. she tried not to empathise with the program so much as others could have seen the feelings the program invoked.

> *"When I had my first fair watching session I found the series that I've been following but haven't yet seen. I started to watch it. It was pretty interesting since, in principle, it is an easy-to-follow program, the BBC's drama of good quality. There shouldn't be anything to be ashamed of. I still got a feeling that I am some television addict who sits here watching it next day. It's interesting that the relationship to the program was so intimate. I didn't want to share it with anybody, want people to know I watch these things, although there was nothing to be ashamed of…For me, it would be buses and trains. For some reason, watching is*

[134] "Mulle tuli mieleeni kun mä palasin työmatkoilta, että se olis nyt just. Kun on jotain sellaisia hetkiä kun ei jaksa mitään muuta niin tätä mä jaksaisin. Ja sitten se, että esimerkiksi juna kun tulee työmatkalta, jostain syystä esimerkiksi musiikin kuuntelu ei yksistään riittäisi mutta se kun siinä on se kuva. Tuollainen loisi paremmin sen kuplan johon voisi sulkeutua."

not so embarrassing there. It would also be easier to keep it to myself." [135]

On the background information form she stated that the main purpose of television for her is both relaxation and acquisition of information. In the interview she said that the first time she used mobile television she realised that she could have watched so-called "good" programs that she had abandoned at home the day before because they were not relaxing enough. But still, she wasn't sure if those moments when she wanted to watch mobile television were suitable for that kind of content. She mentioned that, for her, the main use of mobile television is to spend time and get away from working and everyday life. But she also mentioned that the possibility that other people around her might see what she is watching might have an effect on it, so she would watch those more acceptable programs.

"I got the feeling that I wasn't concentrating if it was a serious kind of program. I quit watching. I still value them. Mobile television might have affected me so that I sometimes watched them. I don't know…maybe it was just for entertainment." [136]

"The situations would vary a lot. Then it comes to your companion. With some people you like to emphasize a professional relationship and with others the entertainment. " [137]

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[135] "Sitten kun oli toi ensimmäinen kunnollinen katselukerta niin silloin mä löysin yhden sarjan mitä mä olen seurannut, enkä ollut nähnyt. Sitä mä aloin kattoon. Se oli aika mielenkiintoista, koska se oli periaatteessa sellainen ohjelma mitä oli helppo seurata, BBC:n laatudraamaa, ei mitään hävettävää mutta kyllä siinä kuitenkin tuli vähän sellainen saundi, että mikä mä nyt oikein olen, joku hirveä televisioaddikti, että täällä istun seuraavana päivänä katsomassa. Se oli jännä, että siitä tuli jotenkin kauhean intiimi suhde siihen ohjelmaan... että mä en halua jakaa sitä kenenkään kanssa, enkä mä halua, että noi ihmiset tietää, että mä katon näitä vaikka niissä ei ole mitään hävettävää... mulle se olisi varmaan enemmän just bussit ja junat. Niissä se jostain syystä olisi niin hävettävää. Ja siellä se olis jotenkin helpompi pitää sillain jotenkin rajattuna."

[136] "Mulla on se ongelma, että mä en jaksa keskittyä, jää kesken jos se on vakava mielistä. Kyllä mä arvostan niitä. Mobiili voisi vaikuttaa, että voisi joskus tulla katottua niitä. En tiedä…voisi kyllä kääntyä viihdevehkeeksi"

[137] "Paikat eroaisi varmasti hirveesti ja just se kenen kanssa on liikkeellä. Joihinkin ihmisiin haluaa korostaa enemmän sitä työpuolta ja toisten kanssa sitä viihteellisyyttä."

6.6.7 New ideas

The on-demand feature was such a joy for the users that most of them suggested there should be all possible TV content available. When new ideas were suggested to the test users, most found them interesting. Only a few spontaneously mentioned that they would be interested in programs that were specially tailored for mobile television. The idea of mobile television was new to the users and that made it difficult to think about the use as different to regular television.

Some new features related to programs were mentioned:
- summaries of existing programs (you can stay with a series)
- indexed programs (you can skip to some interesting part/scene)
- links to websites (you can easily view any additional information)
- games related to programs (e.g. a quiz about the events in the series)

Mobile television should be linked to television at home. As a rule, people want to watch the bigger screen size if possible. It should be possible to transfer information between the two devices: mobile television and home television. That would make it possible to join the good features of both devices: bigger screen of regular television and on-demand feature of mobile television.

An issue brought up in the families group is how to control what children are watching when all the programs are available all the time; there needs to be a way for parents to control which programs are viewed.

6.6.8 Summary of field trial results and suggestions

In general, the idea of mobile television was well accepted. People found the idea of ”mobile watching” fascinating. A couple of hundred people were willing to participate in the field trial.

Tv-anytime was the most popular feature of mobile television. According to the interviews, the possibility of watching TV programs at anytime, independently of the broadcasting time, is the main reason to obtain mobile television. Nowadays, people’s schedules are often irregular, so the freedom to watch

favourite programs at a suitable time was highly valued. Some users browsed through all the programs available. They did not necessarily watch all the programs but they wanted to see what programs had been broadcast during the previous week.

The trial set-up and technical issues set limits on the TV-anywhere feature. If the feature had been available, the use of the service would have been more regular and frequent. The interviewees were asked to image the kind of situations in which they would watch mobile television in the future, if they could use it in any place they liked. The users in the field trial thought they would most probably use mobile television in situations where they have to wait or get up to date on current affairs. These are situations in which people usually read newspapers or use their mobile phones to call somebody or play games. Mobile television could replace these actions.

According to the field trial study, mobile television seems to be television rather than some kind of a mobile station. The users hoped that all the same content would be available on mobile television as on regular television, even if all programs were not so suitable for mobile television. The users thought that it would be confusing if some of the programs were missing. They liked to browse through recently broadcast TV programs and select interesting ones - e.g. favourite series and missed programs. Even though they wanted the content of the mobile television service to be like normal televison, many interviewees mentioned that it should be possible to use the device for purposes other than watching television. It could be used, for example, for text editing, telephoning and getting onto the Internet.

On the other hand, the users thought it most likely that they would watch shorter programs. The experts thought the content of mobile television should differ from the content of regular television. They thought that the content of regular television is not enough for mobile television to be interesting to the public. There should be changes to traditional program formats. However, the experts stressed that programs should be shorter in the mobile context too.

News and children's programs were the most popular programs. These are the most suitable genres for the first implemetations of mobile digital television. The popularity of the mobile television among the children was a surprise. Perhaps

the possibility to watch children's programs at a suitable time, even late evenings, was the reason for that. Mobile television might also have been a little bit like a toy for children. Perhaps the threshold to start using mobile television was not so high for the children - they did not yet have any barriers to watching television programs on this kind of small device.

People perceived mobile television as regular TV and compared it to the one at home. Using it for purposes other than watching was strange for most users. This could change when the use of MHP services in home digital television increases and becomes more widely used. Then people would probably expect to find the same familiar features in mobile digital television.

The users in the field trial preferred the smaller device, the pocket PC, to carry around. The interviewees were not asked to compare the two types of smaller devices with each other. However, the Jornada users brought up more positive comments spontaneously. Comments were made about about flatness and lightness of the device. A display cover was also thought necessary. The bigger one would be suitable for situations when there is no need to carry the device around. These situations could include traveling, staying at the summer cottage, etc., or it might be available in a coffee house or on a train.

The study points out that the pocket-size mobile television is a personal device. It is watched alone. One reason for that is the small size of the display. It's not pleasant to watch it together with friends. Also, if viewers want to watch the pocket-size television together, they needed to place the screen right in front of them. This means that they have to be very close to each other. Most people experience proximity with other people inconvenient. However, there where situations when it would have been nice to view mobile television together. Maybe a fractionaly smaller size of mobile television is needed - bigger than the iPaq but smaller than the Pen tablet.

People found it difficult to estimate the best way of paying for the service. Half of all interviewees in the field trial and "Futuuri" exhibition said that they would prefer the pay-per-view method of payment and the other half preferred to pay monthly. Heavy users would probably choose a fixed price, while people who didn't use it so much would prefer pay-per-view.

People thought mobile television was rather easy to use. However, their way of using it was not diversified. Additional features were not used so much. This can be seen as a usability problem if the users did not find these features. It’s also possible that some other usability problems would have appeared if the addditional services had been used more. Even though the small size of the devices sets limits on the user interface design, it should be carefully considered. The experts stressed the importance of usability, and it also came up in the visualisation tests.

Mobile television in different testing environments

The users thought that the place affects program choice. On a scale of 1 to 5, the effect of place got an average grade of 3.8. In this trial we had four different kinds of testing environments for mobile television: home, outdoors (central square in city centre), café/restaurant and workplace. All these environments required different things and different forms of use. Some general points are discussed below. Although the users thought the place affected program choicse, most test users stressed that the presence of other people in a public place wouldn't affect what programs they would watch. Still, there were some contradictory comments.

Home

The users liked to organise their lives at home without the TV guide's time schedule, so TV-anytime was experienced as more important due to the fact that the television device was mobile. A few users commented that you sometimes want to watch something in private, view a different program than the rest of the family, or you might want to take mobile television into the garage while you are working there. Mobile television was easier to move around than regular television. Mobile television could not replace the television at home because people want to view certain things on the bigger screen and users at home also want to view teletext and foreign channels. At home, the users were able to use two different sizes of mobile television, and they preferred the bigger device. This was mainly due to the fact that the screen was bigger and they didn’t have to carry the device with them outside the home. Instead, they used to watch it in different places, like in the living room, at the kitchen table, in bed, etc.

Examples of usage situations at home:

- Adults watched some programs after the children had gone to bed without disturbance.
- Adults watched programs not so suitable for children. (Adult family members were worried about how to control what the children were watching on mobile television. Also, as there was the Internet connection, parents felt that they weren't able to control which sites their children viewed.)
- If two interesting programs happened to be on the air at the same time, one person watched a program on the regular television and the other viewed it later on mobile television.
- Some people slept in and watched a morning program later in the day.

In short, mobile television was just an extra television at home and replaced the video recorder. The users enjoyed the extra connection to the Internet, as usually there is only one computer with Internet access at home. Now, different family members could surf the net at the same time, or one family member could play computer games while other viewed the Internet.

Outdoors (central square in city centre)

The time of year had a great affect on the experience of using mobile television outdoors. The users said that they could spend time in the park during the summertime and view some television programs. But as the weather was very cold during our trial, the usage outside was very troublesome. Using the stylus while wearing gloves was clumsy, and the batteries ran out quicker in the cold weather. Screen reflections made viewing difficult and the noise in the city centre (e.g. traffic) made it almost impossible to hear the sound; the mobile television volume level was quite low. One important thing is that there are no places to set the device down in the city centre. One must be able to use mobile television with one hand because people often have a shopping bag, child or pet in the other. Programs and settings (volume, brightness, etc.) need to be quickly accessible. Outdoors, the use could be like the use of mobile phones during short breaks. Nowadays people often use mobile phones to entertain themselves during these micro breaks - e.g. call a friend, play mobile phone games, etc.

Instead of that, they could use mobile television to kill time. This kind of use could also be possible in cafes, restaurants and workplaces.

Café/ restaurant

People go to cafes and restaurants to eat and socialize, and television could offer an interesting topic of conversation. As there is usually more than one person around the table, the bigger device would be more suitable. If a person eats alone and likes to read at the same time, mobile television could replace the newspaper. In these places you can set the device on the table, but it would be nice if there were support for it. The noise level in these places is rather high, so special attention needs to be paid to the sound level. Most likely the use of headphones is required. This is also because other customers might be disturbed if mobile television was played too loud. As in other public places, cafes and restaurants are places where people want to display a socially acceptable image of themselves, so the enviroment might have an effect on program choice.

Workplace

At workplaces with an Internet connection there is no special need to watch television programs. The information that would be sought from mobile television is also available on the Internet - e.g.news. Mobile television would be more suitable in places were people are not constantly working with a computer; maybe in places where people spend their breaks from work alone and require some entertainment - it was suggested that people working on ships might enjoy mobile television. As a rule, it is not acceptable to view television at the workplace during working time. Sometimes it would be nice to view something that is related to work, but recording a program and viewing it at work is often too troublesome. Some users commented that they would use mobile television for working or watching during work-related traveling or other breaks. The device should be available for working purposes, like text editing, calendar, etc.

7. Conclusions and further work

It is generally agreed that mobile television *could be* interesting for the end-user in many situations. Public and private transportation vehicles and most public places hold potential for mobile television services. Even in homes, small mobile television receivers are interesting, both as a private television set and as a way of establishing closer interaction with the television programs. From the business standpoint, mobile television offers the broadcaster new audiences, the teleoperators transmission opportunities and the equipment manufacturers new receiver products. The first mobile television experiments were launched in Asia in the end of the nineties.

This study emperically investigated people´s *real* interest in mobile television. This was done by interviewing a large number of people - both normal users and media experts - and by building a prototype system that was tested by ordinary users over one month in WLAN hot-spot areas. Almost the program content of the three leading Finnish digital TV channels was offered to the users in the trial, thus forming a highly realistic simulation environment. To test the TV-on-demand feature, the users were given access to all programs transmitted during the previous week. The importance of terminal size was studied by offering the trial users both a pocket-sized PDA and an A5-sized tablet PC. Technically, the trial system showed sufficient performance and video quality, but additional product development has to be done before the reliability is at a satisfactory level.

The extensive interviews *before* the trial reflected varying opinions on the general need for this technology. The opinions also differed on technical issues, like terminal size, need for interactive services (e.g. program search, links) and integration with existing devices. Current TV programs were considered a suitable basis for mobile use, but in a shorter and remade format, and with alternative forms of subtitling, maybe focused on smaller groups. TV-on demand was mostly considered a high-potential feature. The mobile service was seen more as a wireless multimedia device than television. It was considered suitable for public places - where it has to compete with other media - as a time killer, a filler of empty moments and a buffer for privacy. It was also seen to have a place at home, as a more interactive device than normal TV. The experts considered

the value chain of the mobile television business to be complex, with many actors, including the media consumer as a producer of media content. A broadcaster or a teleoperator were seen to be the potential founders of a mobile TV service.

The field trial both verified and disproved these pre-trial opinions. The users were fascinated by the mobile service. Against expectations, the trial users clearly considered the service to be television, not wireless multimedia. This underlines the fact that new services should be rooted in old, known user interaces. Programs were selected by channel, not by topic, and the same broad program supply as in normal TV was hoped for. The most liked feature was - quite expectedly - the possibility of watching programs from the archive whenever you want. Typically, the user surfed through the program lists and checked what had passed unnoticed. The users normally watched short programs or pieces from longer programs. Children in particular – even preschoolers - liked the service; in some cases so much so that it replaced the ordinary television. News programs were, as expected, most popular among the adults, whereas sport was less popular than expected. Additional program information was seldom retrieved and searches - that were supposed to be attractive - were even more rare. Typical use would be when waiting for something or when killing time, or more generally in the same situations, where you would normally read an evening newspaper. The users were also ready to pay for the service, about the same as for a newspaper.

This study clearly indicated that the mobile device is, in many respects, better suited to interactive applications than normal television. This notion is the starting point for a follow-up project, called FRENDI. Here we will study a situation in which the interactive parts of television content are routed to a combined mobile device/remote controller, whereas normal television shows the one-way audiovisual parts of the content. Other topics for future research are how to remake television content so that it optimally suits mobile devices - e.g. by using automatic summary and indexing methods - and how peer-to-peer solutions can be utilised in the efficient distribution of media content while observing the rights of the content owners. Another interesting issue is how to parametrise the broadcasts so that they serve mobile reception with small antennae.

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Appendix A: Background information form of consumer study (chapter 4.2)

Mobiili digitelevisio projekti

Mobiili digitelevisio projekti on käynnistynyt kesällä 2001. Projektissa tutkitaan digitaalitelevisioon liittyviä asioita. Tässä vaiheessa kartoitamme ihmisten mielipiteitä pienistä mukanakulkevista laitteista, joista voi katsoa TV-lähetyksiä. Hankkeessa ovat mukana VTT Tietotekniikka, Tampereen yliopisto, TEKES, Sonera, Sanoma-WSOY/ Swelcom, Alma Media, Elisa, Nokia ja Malibu Telecom.

Ikä: _____
Sukupuoli: *1) Nainen* *2) Mies*
Perhesuhteet: 1) Yksin asuva 2) Perheellinen 3) Muu, *mikä*?_____
Kotona asuvien lasten lukumäärä: _____

Mitä harrastat ja millaisista/ mistä asioista olet kiinnostunut?
_____
_____
_____
_____

Saako haastattelutilanteessa otettuja valokuvia käyttää tutkimustuloksia julkaistaessa? (Kuvia ei tulla yhdistämään haastateltavan nimeen tai vastauksiin.)

1) Kyllä *2) Ei*

Oletko kiinnostunut jatkossa osallistumaan mobiilitelevision koekäyttöön?

1) Kyllä *2) En*

Jos vastasit kyllä, kirjoita tähän yhteystietosi. Yhteystietojasi ei tulla käyttämään muuhun tarkoitukseen.

Nimi: _____
Puhelin: _____
Sähköposti: _____

Appendix B: Age distribution of women and men interviewed during consumer study (chapter 4.2)

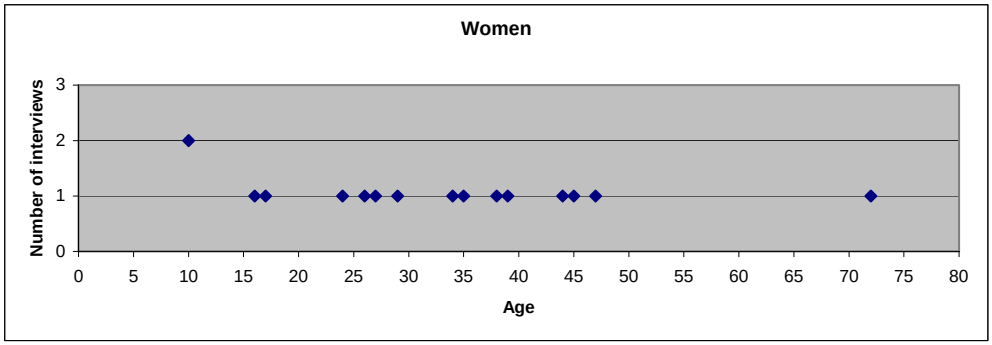


Figure 1. The age distribution of the interviewed women.

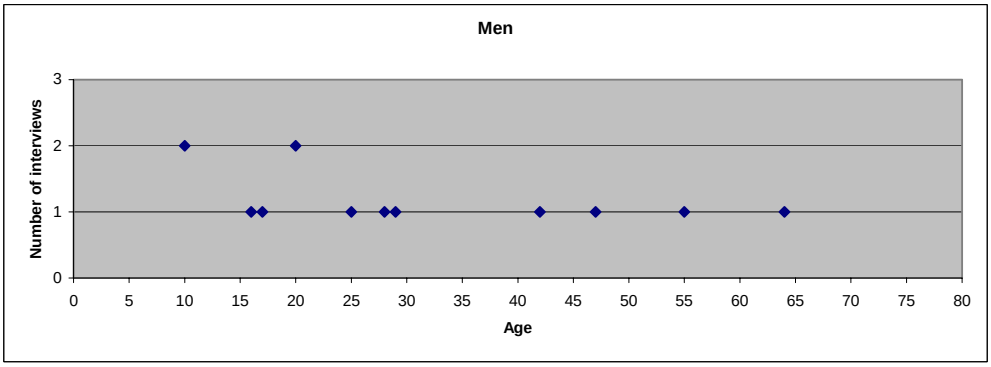


Figure 2. The age distribution of the interviewed men.

Appendix C: Selection of the device in different places during consumer study (chapter 4.2)

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
bus 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

Appendix D: Frame of expert interviews (chapter 4.3)

Taustatiedot

1. Nimi
2. Ikä
3. Nykyiset työtehtävät
4 Koulutus
5 Oma aikaisempi (digi)-TV-tausta

Haastattelukysymykset "liiketoimintamalli"

1. Hahmottele tähän paperille, ketä tarvitaan tekemään digi-TV ohjelmaa nykyään? (aina katselijaan asti päätyen)
    - Millainen toimintaketju muodostuu? (tuotantoyhtiö, jakelu, markkinointi, katsojat)
    - Millaisia rooleja eri toimijoilla on?
2. Merkitse tähän paperille myös, miten tämä toimintaketju muuttuu (vai muuttuuko se) mobiilissa digitaali-TV:ssä?
    - Tarvitaanko uutta osaamista, millaista? Nimeä eri tahot.
    - Mikä on eri tahojen rooli tai painoarvo toimintaketjussa?
    - Mikä on operaattoreiden rooli mobiilissa televisiossa?
3. Millaisia eturistiriitoja voi ilmetä toimijoiden välillä? (kilpailuasetelmat)
4. Mihin yrityksenne sijoittuu mobiilitelevision toimintaketjussa?
5. Kenen tai keiden tulisi perustaa mobiili TV-kanava Suomeen?
    - (- Jos kanavan perustaa sisällön tuottaja, kuka hoitaa jakelun? (Digita, operaattori, sisällöntuottaja, joku muu?)
    - Jos kanavan perustaa jakelija, niin mistä tulee sisältö?)
    - Mikä muu taho voisi vastata mobiili TV:n toiminnasta kokonaisuutena?
6. Miten rahoittaisitte mobiilitelevision kokonaisuudessaan? Mistä business tulee kullekin toimijalle? (lupamaksut, mainostajat, kännykän lasku, muu?)
7. Miten rahoittaisitte oman osuutenne mobiilissa televisiossa?
8. Miten katselijat maksavat mobiili-TV:n katselusta? (operaattorien puhelin-maksut, tankkaus, pay-per-view, kuukausimaksu...)

Haastattelukysymykset "sisältö"

1. Millaiset ohjelmatyypit soveltuvat pienelle näytölle/mobiiliin digitaaliseen televisioon? Miten ohjelmatyyppejä pitäisi muuttaa? Esimerkkejä?

2. Millaisia ohjelmia ihmiset katsoisivat ollessaan liikkeellä esim. junassa?

3. Millaiset paikkasidonnaiset palvelut soveltuvat mobiilitelevisioon?

4. Mikä on mielipiteesi tiettyihin aiheisiin keskittyvistä teemakanavista mobiilitelevisiossa esim. urheilukanava, kulttuurikanava jne.?

5. Miten määrittelet interaktiivisen ohjelman? Onko sellaisia tällä hetkellä? Esimerkkejä?

6. Onko osia tai kokonaisuuksia nykyisistä tai tulevista digi-TV:n interaktiivisista ohjelmista siirrettävissä mobiiliin televisioon?

7. Ketkä tulevat tekemään sisältöä mobiilitelevisioon?
- ohjelmat
- lisäpalvelut
- muut

8. Miten mobiilissa digitaalisessa televisiossa voi mainostaa? Kuka hoitaa mainostamisen?

9. Millaisia muita asioita kuin TV-ohjelmia (esimerkiksi palveluita) voisi yhdistää mobiilitelevisioon?

Yhteiset kysymykset

1. Miten mobiili-TV tulisi markkinoida kuluttajille?
(Kannattaako puhua mukana kulkevasta televisiosta vai painottaa jotain aivan muuta lähestymistapaa? Myydäänkö televisiota, kännykkää vai jotain muuta? Markkinoidaanko sisältöä, laitetta, lisäpalvelua vai jotain muuta?)

2. Mikä olisi sinusta sopiva nimike mobiilille televisiolle? (TV, kännykkä, multimedialaite...)

3. Ketkä ovat mielestäsi mobiilitelevision mahdollisia käyttäjiä?

4. Millaisissa tilanteissa mobiilitelevisiota käytetään?

5. Millaisia asioita mobiili-TV:n kehityksessä tulisi mielestäsi erityisesti huomioida, jotta tuloksena olisi mahdollisimman onnistunut tuote?

6. Mitä mobiili-TV:n tulisi tarjota, jotta se kiinnostaisi sinua käyttäjänä?

Tämä kysymys vain sisältöpuoleen vastaavilta:

(7. Mikä olisi yrityksenne rooli mobiilin digitaalisen television toiminta/tuotantoketjussa?)

8. Millaisten reunaehtojen tulee täyttyä ennen kuin yrityksenne lähtee mukaan mobiili-TV toimintaan? (verkot, laitteet, markkina-alue...)

Tämä kysymys vain liiketoimintamalliin vastaavilta:

9. Millaisia muita asioita kuin TV-ohjelmia (esimerkiksi palveluita) voisi yhdistää mobiilitelevisioon?

Appendix E: The ranking of different services (chapter 4.3)

Nimi:_____

Aseta seuraavat asiat/palvelut sopivuusjärjestykseen, sen mukaan kuinka hyvin koet niiden sopivan TV-ohjelmien lisäksi mobiilitelevisioon?
1 = sopii näistä vaihtoehdoista parhaiten...jne.

___ HAKUTOIMINTA (Voit hakea ohjelmia tai lisätietoja hakusanalla.)
___ OHJELMIEN PISTEYTYS (Voit antaa pisteitä ohjelmalle tai katsoa mitä muut ovat antaneet.)
___ LINKIT (Etsii sinulle aiheeseen liittyvän muun aineiston, esim. uutisia, sarjataulukoita, kuvia...)
___ ARVOSTELUT (Voit lukea ohjelma-arvostelun.)
___ MUUT KATSOJAT (Näet ketkä muut katsovat ohjelmaa parasta aikaa ja katsojamäärän.)
___ PALAUTE (Voit lähettää palautetta ohjelmaan liittyen.)
___ CHAT (Voit osallistua ja katsoa.)
___ KESKUSTELUPALSTA (Voit osallistua ja lukea.)
___ MAKSUT (Pääset tarkistamaan omia mobiilitelevisioon liittyviä maksujasi.)
___ INTERAKTIIVISET OHJELMAT (Pääset osallistumaan ohjelmiin.)
___ PELIT (Voit pelata pelejä.)
___ ARKISTOKANAVA (Voit tallentaa ohjelmia ja katsoa niitä myöhemmin)

Appendix F: The most suitable services for mobile digital television besides TV programs (chapter 4.3)

SERVICE:	POINTS:*
SEARCH	13
LINKS	12
CHAT	9
GAMES	9
ARCHIVE	8
INTERACTIVE PROGRAMS	5
DISCUSSION GROUP	5
REVIEWS	3
PAYMENTS	3
FEEDBACK	2
PROGRAM RATINGS	2
OTHER VIEWERS	1

Appendix G: What makes mobile digital television interesting (chapter 4.3)

AREA OF EXPERTISE:	WHAT MAKES IT INTERESTING?
Content	Multimedia features are integrated with the mobile phone or the laptop. There is a way to search for information and entertainment.
Content	Push services are available, e.g. news from around the world.
Content	Television is integrated with the laptop. The news can be watched on the train.
Content	The device is cheap and lightweight. Television is integrated with some other device.
Content	Integrated device: games, communication services, chat and other forms of entertainment.
Content	Local news, map and local weather reports.
Content	Television is integrated with some other device.
Content	TV programs can be watched in mobile contexts.
Content	Other services are more interesting than TV programs.
Business model	The device fits into my pocket. Good picture quality, supertext-TV and a return path all available.
Business model	TV programs can be watched in mobile contexts. Supertext-TV.
Business model	Television is integrated with some other device, e.g. Communicator.
Business model	Television is integrated with the laptop. There are some new innovative program formats.
Business model	There is a way to communicate with others.
Business model	Television is integrated with some other device. On-demand services.
Business model	Mobile digital television is not a personal device. It can be watched in buses and trains.

Appendix H: Visualisation interview questions (first round of interviews) (chapter 4.4)

ALUKSI:
Kerrotaan lyhyesti projektista:
Mobiili digitelevisio projekti on käynnistynyt kesällä 2001. Projektissa tutkitaan mukana kuljetettavaan digitaalitelevisioon liittyviä asioita. Televisiosta voi katsoa ohjelmia haluamanaan aikana. Esim. Salattuja elämiä voi katsoa bussissa matkalla töihin tai kotona haluamanansa aikana. Tässä vaiheessa kartoitamme ihmisten mielipiteitä mahdollisista käyttöliittymistä: Miltä mukana kulkeva televisio voisi näyttää ja kuinka se voisi toimia?

ESITELLÄÄN LAITTEET
(Hankkeessa ovat mukana VTT Tietotekniikka, Tampereen yliopisto, TEKES, Sonera, Sanoma-WSOY/ Swelcom, Alma Media, Elisa, Digita Oy, Nokia ja Malibu Telecom.)

Kerrotaan visualisointitestien tarkoituksesta:
Visualisoinnit ovat kuvia siitä, miltä tällainen pienikokoinen mukana kulkeva TV voisi näyttää. Visualisointeja piirretään ennen varsinaisen laitteen tekemistä. Näiden kuvien avulla pyritään löytämään etukäteen virheet, joita näihin pieniin laitteisiin saattaa tulla. Yleinen virhe on, että yritetään tehdä liian vaikeaa tai monimutkaista laitetta.

Visualisointien avulla testataan miten tällaista pientä mukana kuljetettavaa televisiota olisi helppo käyttää.. Testauksen tavoitteena on löytää mahdolliset ongelmakohdat ja ne kohdat, jotka ovat käyttäjille helppoja oppia. Testauksen aikana kokeillaan kahta erikokoista TV-laitetta. Toinen on tarkoitettu taskussa mukana kuljetettavaksi. Toinen laite on vähän isompi ja sen ajatellaan kulkevan mukana laukussa, repussa tai vaikkapa auton penkillä.

VARSINAISEN TESTAUKSEN KULKU:
Kysy ikä (ja sukupuoli).
Pyydä testattavia ajattelemaan ääneen koko ajan.

1. Ensin kysytään ensivaikutelmasta:
   - kaikki visualisoinnit kerralla näkyvissä, ensin pienet, sitten isot näytöt
2. Käydään jokainen visualisointi yksitellen läpi TEHTÄVIEN avulla ja lisäkysymyksin, ensin pienet, sitten isot näytöt
3. Lopuksi vielä vertailua

- kaikki visualisoinnit kerralla näkyvissä, ensin pienet, sitten isot näytöt

Ensivaikutelma:
Onko käyttöliittymä sekava vai selkeä?
Mitkä kohdat herättävät huomiosi/kiinnostuksesi?
Mitä osaisit käyttää heti ja mitä et usko hallitsevasi?

Tehtävät:
1. Katso Ally McBealia kotikanavaltasi
2. Hae kanavia selailemalla Formula GP lähetys
   - Lisää ohjelma kotikanavallesi
   - Katso ohjelman tiedot
   - Lue siihen liittyvä arvostelu
3. Hae tietoa EU:n ja Etelä-Amerikan ”banaanisodan” loppumisesta
   - Lue/katso siihen liittyvä linkki
4. Säädä äänen voimakkuutta
5. Katso ketkä chattailevat tällä hetkellä

(Käydään ensin läpi kaikki metaforat yhdellä laitteella esim. ensin pieni näyttö ja sitten iso. Vaihdellaan metaforien aloitusjärjestystä, esim. koehenkilö 1 aloittaa ykkösestä ja 2 aloittaa kakkosesta jne.)

Lisäkysymykset:
Onko selvää missä vaiheessa käyttöliittymää edetään? (Tiesitkö koko ajan, mitä sinun pitäisi seuraavaksi tehdä tai miten esim. pääsisit alkuun?) Onko käyttöliittymä johdonmukainen ja eteneekö toiminnot luonnollisessa järjestyksessä, niin kuin sinä ajattelisit niiden etenevän? Mikä mättää? Pitäisikö näytöllä olla enemmän visuaalista informaatiota?
Onko käyttöliittymässä turhaa tietoa?
Kaipaatko apuvalikkoa ja mihin?

Loppuvertailu:
Mikä vaikuttaa vaikeimmalta/monimutkaisimmalta käyttöliittymältä?
Mikä helpoimmalta/yksinkertaisimmalta?
Mikä oli hauskin?
Mikä oli nopein?
Mitä näistä mieluiten voisit muokata itsellesi sopivaksi? Vai täytyykö muokata?
Millaisia muutoksia haluaisit tehdä?
Mikä on miellyttävin silmälle?
Mitä et ainakaan haluaisi ottaa käyttöön?

LOPUKSI:
Tuntuvatko termit vaikeilta?
Mitkä termit tuntuvat vaikeilta?
Miksi?
Onko ehdottaa parempia termejä?
Millainen vaikutelma mobiili-TV:stä syntyi?
Olisitko halukas osallistumaan mobiili-TV:n koekäyttöön?

Appendix I: Visualisation interview questions (second round of interviews) (chapter 4.4)

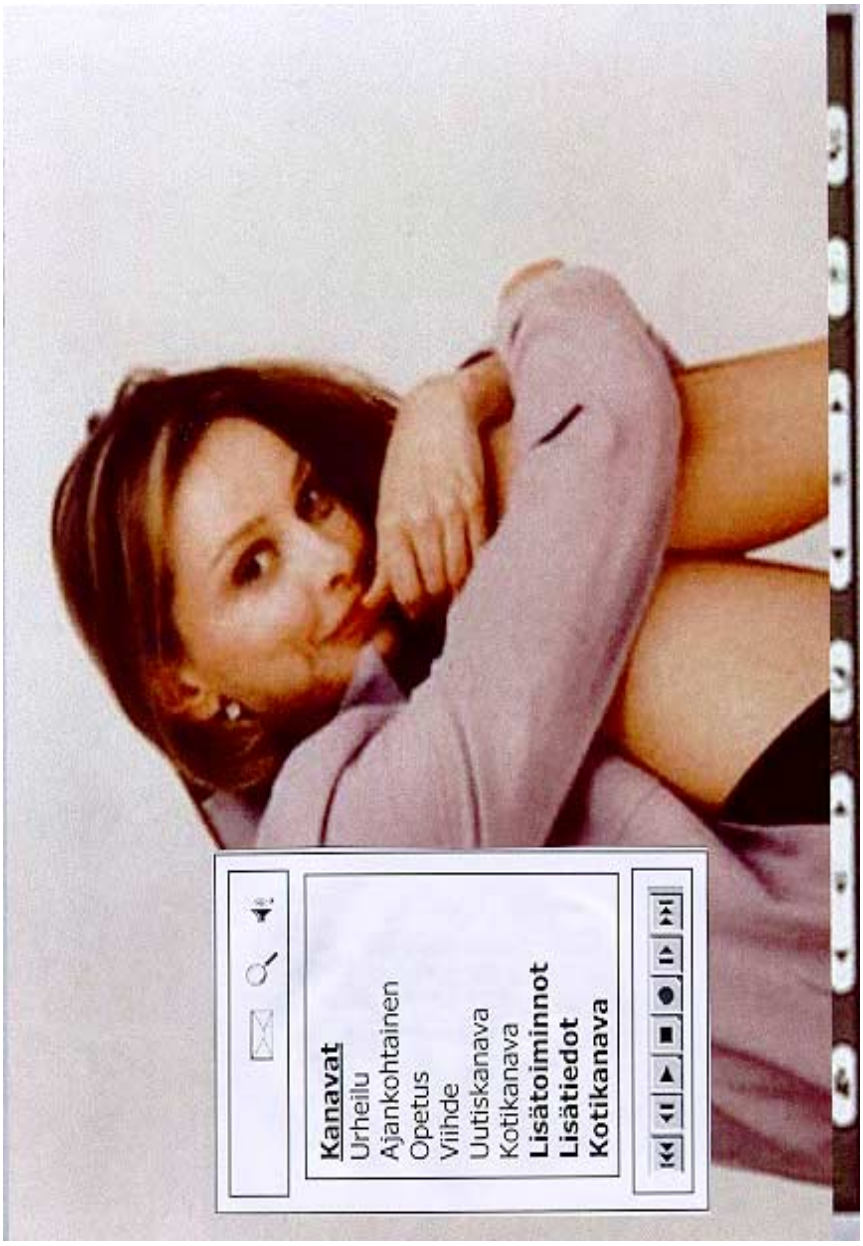
Testauksen kulku:
Ikä ja sukupuoli
Edetään metafora kerrallaan ja käydään läpi seuraavat vaiheet:

Tehtävät:
- Katso Ally McBealia kotikanavaltasi
- Hae kanavia selailemalla Formula GP lähetys
    - mistä katsoisit lisätietoja ohjelmasta?

Kysymykset:
- Onko selvää missä vaiheessa käyttöliittymää edetään? (Tiesitkö koko ajan, mitä sinun pitäisi seuraavaksi tehdä tai miten esim. pääsisit alkuun?)
- Onko käyttöliittymä johdonmukainen ja eteneekö toiminnot luonnollisessa järjestyksessä, niin kuin sinä ajattelisit niiden etenevän?
- Pitäisikö näytöllä olla enemmän visuaalista informaatiota/onko käyttöliittymässä turhaa tietoa?
- Kaipaatko apuvalikkoa?
- Oliko vaikeita termejä? Onko ehdottaa parempia vaihtoehtoja?
- Millaisen kouluarvosanan antaisit tälle käyttöliittymälle (4-10)?

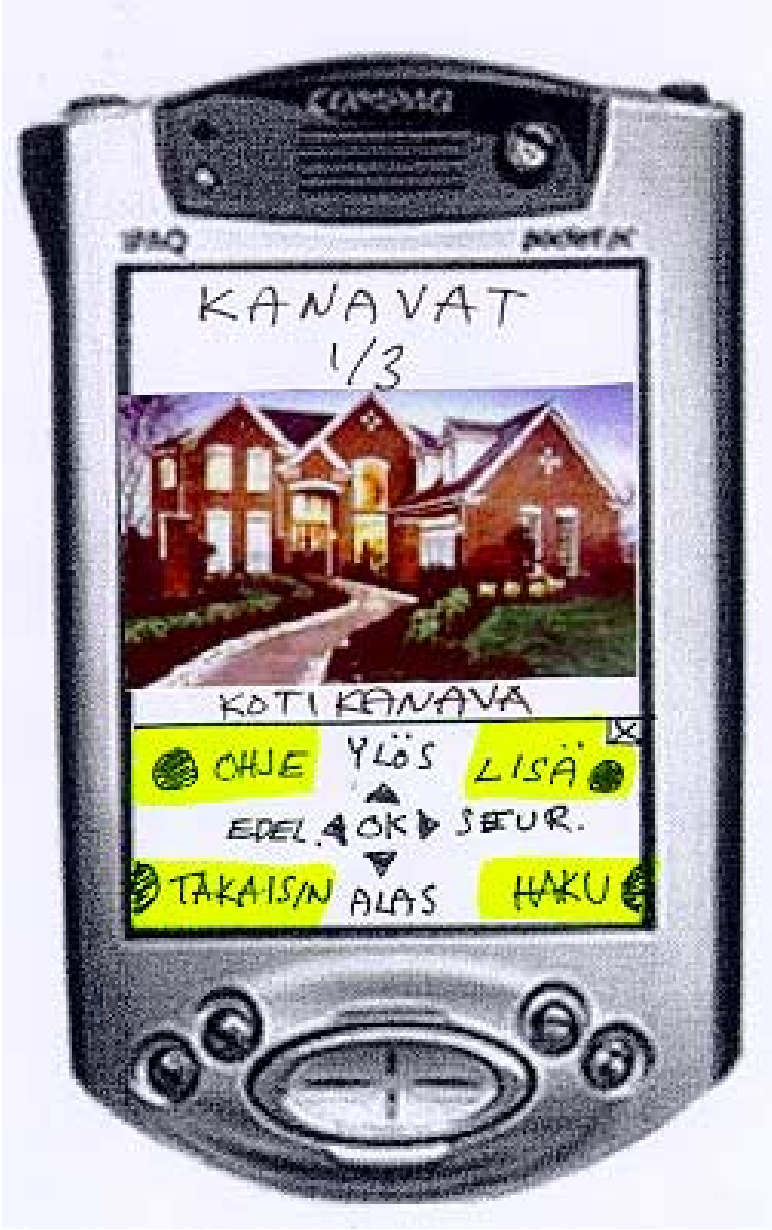
Lopuksi:
- Mikä näistä oli monimutkaisin tai vaikein?
- Mikä oli yksinkertaisin tai helpoin?
- Mikä oli nopein?
- Mikä näistä on sinun mielestäsi paras vaihtoehto ja miksi?
- Haluaisitko tehdä jotain muutoksia?
- Mitä et ainakaan haluaisi ottaa käyttöön?

Appendix J: Visualisation of the WWW metaphor on the bigger terminal (chapter 4.4)



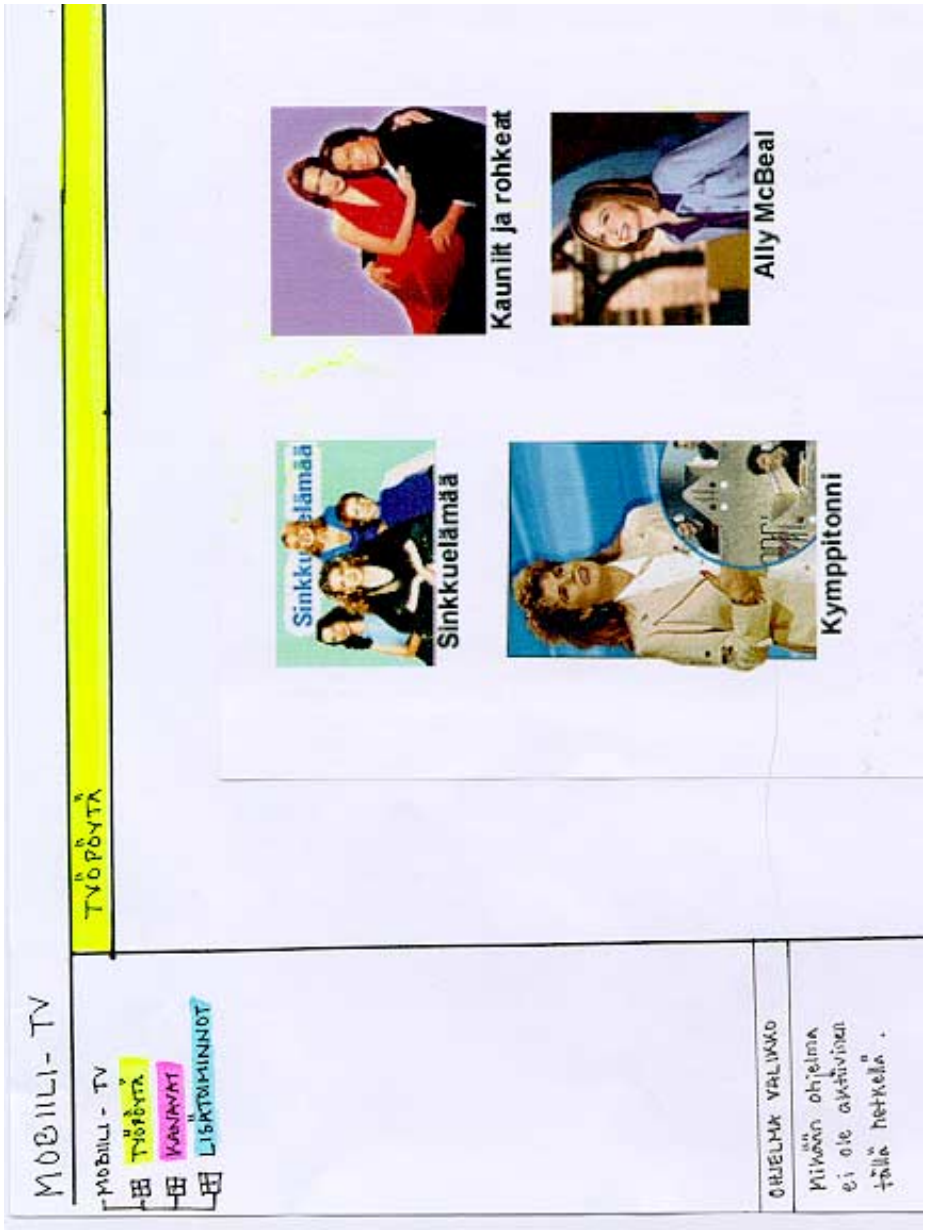
Appendix K: Visualisation of the file metaphor on the smaller terminal

Appendix L: Visualisation of the TV metaphor on the smaller terminal



Appendix M: Visualisation of the menu metaphor on the bigger terminal

Appendix N: Visualisation of the desktop metaphor on the bigger terminal



Appendix O: Questionaire in Futuuri exhibition (chapter 6.1)

VTT Tietotekniikka: Mobiilitelevisiokysely

1. Sukupuoli:

☑ CheckBox1 ☐ Mies

2. Syntymävuosi: _____

3. Kuvittele itsesi matkustamassa junassa. Sinulla on mukana mobiilitelevisio. Päätät katsoa elokuvan, joka jäi edellisenä iltana näkemättä.

Kuinka paljon olisit valmis maksamaan tämän elokuvan katsomisesta?_____

(Elokuva jää sinulle viikon ajaksi muistiin ja voit katsoa sen samaan hintaa myöhemminkin.)

4. Kuvittele seuraavaksi itsesi bussipysäkille. Sinulla on hetki aikaa katsoa aamulla tulleet uutiset mobiilitelevisiosta.

Paljonko olisit valmis maksamaan

uutisista?_____

5. Miten sinä mieluiten maksaisit mobiilitelevision käytöstä?

☐ Maksaisin erikseen jokaisesta ohjelmasta

☐ Maksaisin mieluiten kuukausimaksun

6. Kuinka paljon olisit valmis maksamaan mobiilitelevision käytöstä kuukaudessa? _____

7. Kuinka paljon olisit tällä hetkellä valmis maksamaan **matkapuhelimen** käytöstä kuukaudessa? _____

Kiitos vastauksistasi! Jos haluat osallistua elokuvalipun arvontaan, kirjoita nimesi ja puhelinnumerosi alle. Tietojasi käsitellään luottamuksellisesti. Voittajille ilmoitetaan henkilökohtaisesti.

Nimi ja puhelinnumero:

_____

Appendix P: Interview form (chapter 6.3)

Aloitus

1 Kuinka paljon olet ennättänyt käyttämään Mob-TV:tä? Onko ollut tekijöitä, jotka ovat nostaneet käyttökynnystäsi?

2 Kun ensialkuun käytit Mob-TV:tä, millaisia vaikeuksia kohtasit a) laitteen kanssa b) Mob-TV palvelun kanssa? Mikä tuntui ärsyttävältä ja hankalalta a) laitteen kanssa b) Mob-TV palvelun kanssa? (*Korostetaan tässä ja läpi haastattelun, että meitä kiinnostaa nimenomaan Mob-TV palvelu, haastateltavat saattavat ajatella internetin käyttöä laitteella ei TV:n*)

3 Millaiseksi koit laitteen käytön pidemmän päälle? Sujuiko se helposti vai oliko asioita a) laitteessa b) palvelussa, jotka tuntuivat turhan monimutkaisilta ja hankalilta vielä käytettyäsi laitetta useamman kerran ? (*katso mitä vastannut seurantalomakkeeseen*)

4 Kuinka monipuolisesti käytit mobiilitelevisiota, käytitkö muita toimintoja kuin television katsomista?

5 Oliko eri valikoita mielestäsi helppo käyttää? Löysitkö helposti etsimäsi?

6 Millaista television katselusi Mob-TV:n kautta oli?
- katsoitko ohjelmia kokonaisuudessaan?
- Vain ohjelman pätkiä (ohjelmien alkuja, pätkiä valikosta)?
- Miksi et katsonut ohjelmia kokonaan?
  - Huono kuvan laatu
  - Kone meni jumiin
  - Ei halunnut katsella ulkona
  - Liian pitkä ohjelma
  - Ei jaksanut katsoa mainoksia tai edellisen ohjelman loppuja
  - Muu syy

7 Montako tyydyttäväksi kokemaasi katselutilannetta sinulla oli kokeilun aikana?

Käyttötilanteet

8 Kuinka usein kuljetit laitetta mukanasi?

9 Millaiseksi koit laitteen mukana kuljettamisen? Haittapuolia, millaisia? (*Vertailua ison ja pienen laitteen osalta!*)

10 Käytitkö Mob-TV:tä eri paikoissa? Oliko käyttösi erilaista eri paikoissa, katsoitko esim. eri ohjelmia eri paikoissa?

11 Ajatellaan, että tulevaisuudessa Mob-TV toimisi kännykän tapaan, ilman paikkaan liittyviä rajoituksia. Millaisissa paikoissa ja tilanteissa sinä käyttäisit Mobia? *(Vastaukseksi ei riitä esim. kaupungilla vaan täytyy tulla jotain konkreettista esim. kahvila, ostoskeskus.)*

12 Ajatellaan edelleen, että tulevaisuuden Mob-TV toimisi kännykän tapaan, ilman paikkaan liittyviä rajoituksia. Luuletko, että käyttösi oli erilaista eri paikoissa *(muistutus edellisessä kohdassa mainitsemistaan paikoista)*? Esim. riippuisiko valitut ohjelmat ja katsomiseen käytetty aika paikasta jossa katsot Mob-TV:tä?

13 Liittyivätkö kaikki Mob-TV:n katselutilanteesi kokeiluun vai tuliko aitoja katselutilanteita jolloin käytit laitetta muutenkin kuin kokeilumielessä? Millaisia nämä tilanteet olivat? (odotusaikojen käyttö, pienten taukojen pitäminen esim. työstä, opiskelusta…)

14 Havainnoitko sitä, miten muut ihmiset suhtautuivat Mob-TV:n katseluusi? Kuinka koit muiden ihmisten kiinnostuksen? Vaikuttiko se katseluusi? (kysytään jos havainnoinut)

15 Haittasiko sinua, että muut saattavat nähdä mitä katsot? Jos tällaista tilannetta ei nyt syntynyt, niin uskotko, että se haittaisi, mikäli käyttäisit Mob-TV:tä jatkossa?

16 Oliko kokeilun aikana ajankohtaista tapahtumaa jota seurasit Mob-TV:stä? Seurasitko jotakin ajankohtaista tapahtumaa muista medioista?

17 Vaikuttiko television katseluusi se, että ohjelmat olivat saatavilla koska tahansa? Jos vaikutti, niin kuinka se vaikutti?

18 Käytitkö Mob-TV:tä yhdessä muiden kanssa?
a) *millainen tilanne oli, tapahtuiko se näyttääksesi palvelua muille vai jostakin muusta syystä?*
b) *luuletko, että yhdessä katseleminen olisi luonteva tapa katsella mobiili televisiota?*

Jos vastaa, että on luonteva, voi vielä tarkentaa mitä tarkoittaa esim. missä sitä katsottaisiin yhdessä ja mitä?

19 Käytitkö internettiä laitteen kautta?

20 Kumpaa käytit enemmän, varsinaista TV- palvelua vai internettiä?

21 Mihin muuhun käytit laitetta edellisten lisäksi?

22 Peliin liittyvät kysymykset:
- Millaisia pelitilanteet olivat?

- Pelissä oli opetuspyrkimys. Käytettiinkö sitä siihen, oliko helppo/ymmärrettävä?
- Pitäisikö pelin liittyä suoraan televisio-ohjelmaan vai olla irrallinen huvitus ohjelmien ohella?
- Millaisia pelejä olisi kiva pelata mob-TV -laitteella?

Hyödyllisyys

23 Millaista ohjelmaa toivoisit mobiili-TV:n tarjoavan?
- samat ohjelmat, vähemmän ohjelmia, Mob-TV:lle räätälöityjä ohjelmia
- mikä ei sovi Mob-TV:lle

24 Yhdistyivätkö kotona olevan TV:n ja Mob-TV:n käyttö jollakin tapaa? Esim. katsoitko ohjelmatiedot Mob-TV:stä ja jatkoit tavallisella telkkarilla.

25 Kuvitellaan, että Mob-TV toimisi nykyistä laajemmalla alueella kännykän tapaan, mitään rajoituksia ei olisi. Mitä ohjelmia katsoisit tavalliselta, mitä Mob-TV:ltä? Eli luuletko, että sellainen tilanne on mahdollinen, että tapanasi olisi katsoa eri ohjelmia eri televisioista?

26 Luuletko, että hyvin ja moitteettomasti toimiva Mob-TV, jonka käyttö ei olisi paikkaan sidottua, voisi joskus korvata kotitelevisiosi? Miksi ei voisi/ mitä odotat Mob-Tvltä, millä ehdoin tämä olisi mahdollista?

Liiketoiminta

Maksullisuudesta puhuttaessa korostetaan sitä, että kyseessä olisi ongelmitta, laajalla alueella toimiva palvelu.

27 Millaisia ajatuksia mobiili-TV:n maksullisuus sinussa herättää?

28 Kuinka mieluiten maksaisit Mob-TV:n katselusta? *(kuukausimaksu, ohjelmakohtainen maksu, aikaan perustuva…)*

29 Minkä verran olisit valmis maksamaan Mob-TV:n käytöstä? Ohjelmasta? Kuukaudessa?

30 Jos kielteinen/varovainen maksamisen suhteen, tiedustellaan miksi ei ole valmis maksamaan?

31 Seurasitko Mob-TV tiliä? Jos seurasi, niin kysytään miltä hinta vaikutti. Jos ei, niin kerrotaan kertynyt saldo, ja kysytään mitä mieltä siitä on.

32 Tuleeko mieleesi vielä muita asioita joita olisit toivonut Mob-TV:ssä olevan tai haluaisitko vielä sanoa jotain Mob-TV:stä?

Appendix Q: Field test's background information questionare (chapter 6.3)

1. Kuinka kokenut olet tietokoneen käyttäjänä?

Seuraavassa on esitetty tietokoneen käyttöä kuvaavia vaihtoehtoja. Valitse vaihtoehdoista se, joka kuvaa parhaiten tietokoneen käyttöäsi tällä hetkellä.

Merkitse vastaus vetämällä poikkiviiva pystysuoralle mittari-janalle.

ERITTÄIN KOKENUT	Käytän tietokonetta erilaisiin tarkoituksiin erittäin monipuolisesti. Olen tietokoneen käsittelyn ammattilainen. Tunnen myös tietokoneen teknisen toiminnan oikein hyvin.
	Käytän tietokonetta hyvin monipuolisesti. Käsittelen tekstiä, kuvia, pidän yhteyttä ihmisiin tai haen tietoa internetistä. Olen lähes tietokoneen käsittelyn ammattilainen.
KOKENUT	Käytän tietokonetta monipuolisesti. Käytän myös Internetiä, sähköpostia, multimediaohjelmia tms. Laajennan koko ajan osaamistani. Olen harrastaja.
	Käytän tietokonetta melko monipuolisesti. Kirjoitan, piirrän, käytän Internetiä tai teen jotain muuta. Osaamiseni laajenee melko usein uusilla asioilla.
KOHTALAISEN KOKENUT	Käytän tietokonetta kohtalaisen monipuolisesti. Minulla on muutamia asioita, joita teen useimmiten tietokoneella, esim. kirjoitan, selaan www:tä, piirrän tai pelaan. Osaamiseni on laaja-alaistumassa.
	Tietokoneen käyttöni ei ole kovin monipuolista. Käytän useimmin tietokonetta silloin, kun se helpottaa joidenkin tehtävien hoidossa tai viihdyttää minua. Aika ajoin opin uusia asioita.
KOHTALAISEN KOKEMATON	Käytän tietokonetta muutamiin tehtäviin. Opin melko usein jotain täysin uutta. Lähinnä käytän tekstinkäsittelyä, sähköpostia, tai jotain muuta kevyttä.

	Minulla on vielä paljon oppimista tässä.
	Tietokoneen käyttöni on aika kapea-alaista. Käytän kyllä jos tulee sopiva tilaisuus. Perusohjelmien käyttö minulta sujuu jotenkuten, mutta ongelmatilanteissa tarvitsen apua.
KOKEMATON	Käytän tietokonetta harvoihin tehtäviin. Olen hiukan opetellut käytön perustaitoja. Olen kyllä kiinnostunut enemmästäkin käytöstä.
	Käytän tietokonetta hyvin vähän. En osaa käyttää tekstinkäsittelyä, enkä ole juuri tutustunut Internetiin tai pelannut tietokonepelejä.
ERITTÄIN KOKEMATON	En käytä tietokonetta oikeastaan lainkaan. En osaakaan vielä käyttää niitä, mutta opettelen ehkä joskus.

2. Montako tuntia käytät tietokonetta keskimäärin viikossa?
(merkkaa rasti sopivien vaihtoehtojen kohdille)

Työpaikalla tai opiskellessa ☐ **0 – 1 h** ☐ **1 – 4 h** ☐ **4 – 7 h** ☐ **7 – 10 h** ☐ **10 – 20 h** ☐ **>20h**

Vapaa-aikana ☐ **0 – 1 h** ☐ **1 – 4 h** ☐ **4 – 7 h** ☐ **7 – 10 h** ☐ **10 – 20 h** ☐ **>20h**

3. Mitä seuraavista laitteista käytät säännöllisesti?
(valitse sopivat vaihtoehdot)

- Televisio
- Videonauhuri
- Teksti-TV
- Radio
- CD-soitin
- DVD-soitin
- Matkapuhelin
- Tietokone
- Kämmentietokone (PDA)
- Elektroninen kalenteri

4. Kuinka usein kuljetat matkapuhelinta mukanasi?
(valitse yksi vaihtoehto)

- Lähes koko ajan
- Satunnaisesti
- En ollenkaan

5. Mihin käytät matkapuhelinta säännöllisesti?
(valitse sopivat vaihtoehdot)

- En käytä matkapuhelinta
- Puhelut
- Tekstiviestit
- WAP
- Internet
- Pelit
- Kalenteri
- Laskin
- Kuvien lähettäminen
- Muuhun, mihin?_____

6. Kuinka paljon olet valmis käyttämään matkapuhelinlaskuusi kuukaudessa:

n. _____ euroa

7. Jos käytät kämmenmikroa mitkä ovat pääasialliset käyttökohteesi?
(mainitse korkeintaan kolme tärkeintä)

-
-
-

8. Mitä seuraavista viestintävälineistä seuraat ja kuinka usein?
(merkkaa rasti sopivien vaihtoehtojen kohdille)

	Joka tai lähes joka päivä	Kerran viikossa	Satunnaisesti	En lainkaan
Tilattu päivälehti	☐	☐	☐	☐
Iltapäivälehti	☐	☐	☐	☐
Aikakauslehti	☐	☐	☐	☐
Teksti-TV	☐	☐	☐	☐
Videonauhuri	☐	☐	☐	☐
Radio	☐	☐	☐	☐
Internet WWW	☐	☐	☐	☐

9. a) Paljonko käytät keskimäärin aikaa WWW:n selailuun viikossa?
(valitse yksi vaihtoehto)

- En selaile lainkaan www-sivuja
- 0 – 1 tuntia viikossa
- 1 – 4 tuntia viikossa
- 4 – 7 tuntia viikossa
- 7 – 10 tuntia viikossa
- 10 - 20 tuntia viikossa
- Yli 20 tuntia viikossa
- Netti auki koko työpäivän, käytän pitkin päivää

b) Jos käytät Internetiä, nimeä kolme *eniten käyttämääsi* www-sivustoa.
(älä nimeä hakupalveluita kuten Google, AltaVista, Yahoo tms.)

-
-
-

10. Miten usein käytät seuraavia Internet-palveluita?
(merkkaa rasti sopivien vaihtoehtojen kohdille)

	En koskaan	Satunnaisesti	Usein
Keskusteluryhmät	☐	☐	☐
Chat-palvelut	☐	☐	☐

11. a) Oletko käyttänyt Internetissä maksullisia palveluja?
(valitse yksi vaihtoehto)

- Kyllä
- En

b) Jos kyllä, niin mitä palveluja tai tuotteita olet seuraavista käyttänyt tai ostanut?
(valitse sopivat vaihtoehdot)

- Uutispalvelu
- Lipunvaraus
- Digitaaliset kuvat
- Pelit
- Postimerkit
- Kirjat
- CD-levyt
- Vaatteet

- Tietotekniikkatuotteet
- Aikuisviihde
- Kodin elektroniikka
- Muuta, mitä? _____

12. Kuinka monta tuntia katselet keskimäärin viikossa televisiota: _____ tuntia

13. Mikä on television katselusi päätehtävä:
(valitse yksi vaihtoehto)

- Tiedon hankkiminen
- Rentoutuminen ja viihde
- Keskustelun herättäminen
- Yhdessäolo
- Muu, mikä? _____

14. Mitä muita asiota teet television välityksellä, paitsi katsot ohjelmia
(esim. teksti-tv:n katsominen tai pelien pelaaminen)?
(mainitse korkeintaan kolme tärkeintä)

-
-
-

15. Kuinka paljon tiedät digitaalisesta televisiosta?
(valitse yksi vaihtoehto)

- En mitään
- Ymmärrän perusasiat
- Asiantuntija

16. Kuinka innostunut/kiinnostunut olet digitaalisesta televisiosta**?**
(valitse yksi vaihtoehto)

- En yhtään
- Olen kiinnostunut sen verran, että tiedän mistä puhutaan
- Olen erittäin innostunut/kiinnostunut

17. Oletko tilannut kotiisi maksullisia kanavapaketteja?
(valitse yksi vaihtoehto)

- Kyllä
- En

18.Mitä harrastat?_____

19. Kotitaloutenne kokonaistulot vuodessa:
(valitse yksi vaihtoehto)

- Alle 16 800 euroa (n. 100 000 mk)
- 16 800 – 33 600 euroa (n. 100 - 200 000 mk)
- 33 600 – 50 500 euroa (n. 200 - 300 000 mk)
- 50 500 – 67 300 euroa (n. 300 - 400 000 mk)
- yli 67 300 euroa (yli 400 000 mk)

Kiitos vastauksistasi ja tervetuloa mukaan tutkimukseen!

Appendix R: questionaire about usability, satisfaction and watching habbits (chapter 6.3)

Hyvä koekäyttäjä,

Ennen loppuhaastattelua pyydämme sinua vastaamaan alla oleviin väitteisiin oman kokemuksesi pohjalta. Väitteet liittyvät Mobiilitelevision käyttöön. Lomake palautetaan loppuhaastattelun yhteydessä. Kiitos!

OLETKO SAMAA VAI ERI MIELTÄ seuraavien väittämien kanssa (ympyröi yksi vaihtoehto 1-5 asteikolla)

1 2 3 4 5

(Täysin eri mieltä) (En osaa sanoa) (Täysin samaa mieltä)

Mobiilitelevisio toimii teknisesti moitteettomasti 1 2 3 4 5

Mobiilitelevisiota on helppo käyttää 1 2 3 4 5

Minulla on usein vaikeuksia päästä käsiksi haluamaani ohjelmaan tai lisätietoihin 1 2 3 4 5

Mobiilitelevisio toimii liian hitaasti 1 2 3 4 5

Jaksan hyvin odottaa, kun mobiilitelevisio avaa haluamaani ohjelmaa tai lisätietoja 1 2 3 4 5

Opin nopeasti käyttämään mobiilitelevisiota 1 2 3 4 5

Muistan helposti miten mobiilitelevisiota käytetään 1 2 3 4 5

Mobiilitelevisiossa on lähes kaikki ne ominaisuudet, joita tarvitsen 1 2 3 4 5

En pidä mobiilitelevisiota kovinkaan hyödyllisenä 1 2 3 4 5

Olen kaiken kaikkiaan tyytyväinen mobiilitelevision käyttöön 1 2 3 4 5

Nykyiset televisio-ohjelmat soveltuvat mielestäni hyvin mobiilitelevisioon 1 2 3 4 5

Katson mobiilitelevisiosta eri ohjelmia kuin normaalista televisiosta 1 2 3 4 5

Katson mobiilitelevisiosta vain lyhyitä ohjelmia tai ohjelman pätkiä 1 2 3 4 5

Katselupaikka (esim. koti, tori, bussi) vaikuttaa siihen, millaista ohjelmaa katson 1 2 3 4 5

Olen tyytyväinen mobiilitelevision kuvan laatuun..... 1 2 3 4 5

Olen tyytyväinen mobiiilitelevision äänen laatuun..... 1 2 3 4 5

Olen tyytyväinen akun kestoaikaan..... 1 2 3 4 5

Olen tyytyväinen mobiilitelevision näyttöön..... 1 2 3 4 5

Pidän mobiilitelevisiota itselleni tärkeänä informaation lähteenä..... 1 2 3 4 5

Mitä muuta haluaisit tuoda esille mobiilitelevision käytöstä?

_____

_____

_____

Appendix S: Field trial's background information form for children

TAUSTATIETOLOMAKE

1. Montako tuntia käytät tietokonetta keskimäärin viikossa?
(merkkaa rasti sopivan vaihtoehdon kohdalle)

☐ **0 – 1 h** ☐ **1 – 4 h** ☐ **4 – 7 h** ☐ **7 – 10 h** ☐ **10 – 20 h** ☐ **>20h**

2. Mitä seuraavista laitteista käytät säännöllisesti?
(valitse sopivat vaihtoehdot)

- Televisio
- Videonauhuri
- Teksti-TV
- Radio
- CD-soitin
- DVD-soitin
- Matkapuhelin
- Tietokone
- Kämmentietokone (PDA)
- Elektroninen kalenteri

3. Kuinka usein kuljetat matkapuhelinta mukanasi?
(valitse yksi vaihtoehto)

- Lähes koko ajan
- Satunnaisesti
- En ollenkaan

4. Mihin käytät matkapuhelinta säännöllisesti?
(Valitse sopivat vaihtoehdot. Lisää vaihtoehtoja toisella sivulla.)

- En käytä matkapuhelinta
- Puhelut
- Tekstiviestit
- WAP
- Internet
- Pelit
- Kalenteri
- Laskin
- Kuvien lähettäminen
- Muuhun, mihin?_____

5. Kuinka paljon saat käyttää matkapuhelinlaskuusi kuukaudessa tai minkä suuruinen saldorajoituksesi on? n. _____ euroa

6. Jos käytät kämmenmikroa mitkä ovat pääasialliset käyttökohteesi?

(mainitse korkeintaan kolme tärkeintä)

-
-
-

7. Mitä seuraavista viestintävälineistä seuraat ja kuinka usein?
(merkkaa rasti sopivien vaihtoehtojen kohdille)

	Joka tai lähes joka päivä	Silloin tällöin	En lainkaan
Lehti (Esim. Aamu-) Lehti, Aku Ankka)	☐	☐	☐
Televisio	☐	☐	☐
Teksti-TV	☐	☐	☐
Videonauhuri	☐	☐	☐
Radio	☐	☐	☐
Internet WWW	☐	☐	☐

8. a) Kuinka monta tuntia kerrallaan viivyt Internetissä?_____tuntia
b) Jos käytät Internetiä, nimeä kolme *eniten käyttämääsi* www-sivustoa.
(älä nimeä hakupalveluita kuten Google, AltaVista, Yahoo tms.)

-
-
-

9. Miten usein käytät seuraavia Internet-palveluita?
(merkkaa rasti sopivien vaihtoehtojen kohdille)

	En koskaan	Satunnaisesti	Usein
Keskusteluryhmät	☐	☐	☐
Chat-palvelut	☐	☐	☐

10. a) Oletko käyttänyt Internetissä maksullisia palveluja? Mitä? (Esim. Pelit, lipunvaraus. Valitse yksi vaihtoehto.)

- Kyllä
- En

b) Jos kyllä, niin mitä palveluja tai tuotteita olet seuraavista käyttänyt tai ostanut?
(valitse sopivat vaihtoehdot)

- Uutispalvelu
- Lipunvaraus
- Pelit

- Digitaaliset kuvat
- Postimerkit
- Kirjat
- CD-levyt
- Vaatteet
- Tietotekniikkatuotteet
- Kodin elektroniikka
- Muuta, mitä? _____

11. Kuinka monta tuntia katselet keskimäärin viikossa televisiota: _____ tuntia

12. Mitä muita asiota teet television välityksellä, paitsi katsot ohjelmia (esim. teksti-tv:n katsominen tai pelien pelaaminen)?
(mainitse korkeintaan kolme tärkeintä)

-
-
-

13. Mitä harrastat?_____
_____

Kiitos vastauksistasi ja tervetuloa mukaan tutkimukseen!

Appendix T: Most watched programs before 22.11.2002 sorted by user-group (chapter 6.6.2)

Spare-time users before 22.11.2002	Students before 22.11.2002	Workers before 22.11.2002	Family, adults before 22.11.2002	Family, children before 22.11.2002
1. News broadcasts 71 (TV-uutiset 33)	1. News broadcasts 11 (TV-uutiset 7)	1. News broadcasts 6 (TV-uutiset 2)	1. News broadcasts 15 (TV-uutiset 6)	1. Pikku Kakkonen 16
2. Ajankohtainen kakkonen 9			2. Palmu 9	2.Sätkyjä ja tärinöitä 12
3. Hot Sport 9			3. Itsevaltiaat 7	3. Koulu-tv 12
4. Ykkösen aamu-tv 8			4. Todella upeeta 6	4 Muumilaakson tarinoita 7
5. Merilinja 7			5. Kypsymättömät 5	5. BUU-klubben 6
6. Se on siinä 6			6. Saviset ja Vahaset 5	6. Jalka & Lamppu 6
7. Urheiluruutu 6			7. Urheiluruutu 5	7. Hot Sport 5
8. Itse valtiaat 5				8. Risto Räppääjä 5
9. Kakkosen syyssää 5				
10. Muumilaakson tarinoita 5				
11. Tää on seksii!! 5				

Appendix U: Most watched programs after 22.11.2002 sorted by user-group (chapter 6.6.2)

Spare-time users after 22.11. 2002	Students after 22.11. 2002	Workers after 22.11. 2002	Family, adults after 22.11. 2002	Family, children after 22.11. 2002
1. News broadcasts 5 (TV-uutiset 1)	1. News broadcasts 13 (TV-uutiset 9)	1. News broadcasts 7 (TV-uutiset 4)	1. News broadcasts 56 (tv-uutiset 18)	1. Pikku Kakkonen 27
	2. Itsevaltiaat 5	2. Joka kodin asuntomarkkinat 5	2. Huomenta Suomi 12	2. Arttu 17
		3. Karpolla on asiaa 5	3. Kuningaskuluttaja 12	3. Koulu-tv 17
			4. Kova laki 11	4. Richard Scarryn touhukas maailma 15
			5. Ihana aamu 10	5. Sätkyjä ja tärinöitä 14
			6. Kotikatu 9	6. Angela Anakonda 13
			7. Ykkösen aamu-TV 8	7. Vaaleanpunainen pantteri 13
			8. Inhimillinen tekijä 7	8. Franklin 10
			9. 45 minuuttia 7	9. Itse valtiaat 10
			10. Poliisi-tv 6	10. Joulukalenteri 10
			11. Tulosruutu 6	11. Muumilaakson tarinoita 10
			12. Ajankohtainen kakkonen 5	12. News broadcasts 9 (TV-uutiset 3)
			13. Estradilla 5	13. JUU EI 7
			14. Itse Valtiaat 5	14. Agrippina 6
			15. Itsenäisyyspäivän vastaanotto 5	15. Tilt.tv 6
			16. Joonas Hytönen show 5	16. Suuri Kupla 5
			17. Jos sais kerran 5	
			18. Koulu-tv 5	
			19. Lööpin takana 5	
			20. Sinun tähtesi 5	
			21. Tilt.tv 5	
			22. Ulkolinja 5	
			23. Remontti 5	
			24. Pikku kakkonen 5	

Appendix V: Most watched programs before 22.11.2002 sorted by age group (chapter 6.6.2)

Age group 0-12 before 22.11.2002	Age group 13-20 before 22.11.2002	Age group 21-30 before 22.11.2002	Age group 31-40 before 22.11.2002	Age group 41-50 before 22.11.2002	Age group 51-60 before 22.11.2002	Age group 61- before 22.11.2002
1. Pikku Kakkonen 16 2. Koulu-tv 12 3. Sätkyjä ja tärinöitä 7 4. BUU-klubben 6 5. Muumilaakson tarinoita 6 6. Jalka & Lamppu 6	1. News broadcasts 7 (TV-uutiset 4) 2. Hot Sport 9 3. Sätkyjä ja tärinöitä 5	1. News broadcasts 22 (TV-uutiset 11) 2. Se on siinä 6 3. Vaaleanpunainen pantteri 5	1. News broadcasts 19 (TV-uutiset 11)	1. News broadcasts 27 (TV-uutiset 11) 2. Palmu 9 3. Itse-valtiaat 7 4. Urheiluruutu 6 5. Koulu-TV 5 6. Kypsymättömät 5 7. Saviset ja Vahaset 5 8. Ykkösen aamu-tv 5 9. Todella upeeta 5	1. TV-uutiset 2 2. Frasier 1 3. Meri-linja 1	1. News broadcasts 26 (TV-uutiset 9) 2. Ajankohtainen kakkonen 6

Appendix W: Most watched programs after 22.11.2002 sorted by age group (chapter 6.6.2)

Age group 0-12 after 22.11. 2002	Age group 13-20 after 22.11. 2002	Age group 21-30 after 22.11. 2002	Age group 31-40 after 22.11. 2002	Age group 41-50 after 22.11. 2002	Age group 51-60 after 22.11. 2002	Age group 61- after 22.11. 2002
1. Pikku Kakkonen 27 2. Arttu 17 3. Koulu-tv 17 4. Sätkyjä ja tärinöitä 14 5. Richard Scarryn touhukas maailma 13 6. Vaaleanpunainen pantteri 13 7. Angela Anakonda 12 8. Joulukalenteri 11 9. Franklin 10 10. Itse valtiaat 10 11. Muumilaakson tarinoita 10 12. News broadcasts 7 (TV-uutiset 2, TV-uutiset ja sää 2) 13. JUU EI 7 14. Agrippina 6	1. News broadcasts 8 (TV-uutiset 7)	1. News broadcasts 13 (TV-uutiset 4) 2. Karpolla on asiaa 6 3. Itsevaltiaat 5 4. Joka kodin asuntomarkkinat 5	1. News broadcasts 12 (TV-uutiset, sää ja urheilu 2)	1. News broadcasts 38 (TV-uutiset 21) 2. Huomenta Suomi 7 3. Kuningaskuluttaja 7 4. Poliisi-TV 6 5. Ykkösen aamu-TV 6 6. Inhimillinen tekijä 5	1 News broadcasts 13 (Seitsemän uutiset 3)	-

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Mobile television – technology and user experiences

Report on the Mobile-TV project

Abstract

Watching television from a wireless pocket-sized terminal or phone is interesting in many situations. Public and private transportation vehicles and public places are potential environments for mobile television services. Even in homes, mobile television handsets are interesting, both as a personal television set and as a tool to establish a closer interaction with the television programs. In addition to these possibilities for enriching viewer experience, mobile television offers the broadcaster new audiences, the teleoperators a new distribution channel and the equipment manufacturer new receiver product possibilities. In fact, television is the only major media missing from today´s mobile phones.

In this study we empirically investigated people´s *real* interest in mobile television by interviewing a large population and by building and trialling a prototype system. The system combines several types of wireless networks in a 4G fashion. It takes digital terrestrial television broadcasts from the air and delivers them over the Internet to mobile terminals in hot-spot areas covered by Wireless Local Area Networks (WLAN). Content is also delivered over the GPRS cellular network. Two types of terminals are used – a pocket-sized PDA and an A5-sized tablet PC. The digital television signal is transcoded down to a bit rate suiting these terminals. In the field trial the user could watch almost the complete program content of the three leading Finnish TV channels. The user could also access all programs transmitted during the previous week from the media server (TV-Anytime feature).

Ordinary families, leisure users, workers and students participated in the trial. Each user tried the service at WLAN hot-spots during one month. The users clearly considered the service to be television, not wireless multimedia. This underlines that new services should be rooted in known user interfaces. The most liked feature was the ability to watch programs from the archive whenever the individual wanted. Typically, the user surfed through the program lists and checked what had passed unnoticed. The users normally watched short programs or pieces from longer programs. Children in particular – even preschoolers - liked the service; in some cases even so much that it replaced the ordinary television. News programs were most popular among the adults. Additional information was seldom retrieved and searches were even more rare. Typical use would be when waiting for something or when killing time or more generally in the same situations, where one would normally read an evening newspaper. The users were prepared to pay about the price of a newspaper for the service.

This study clearly indicated that the mobile device is, in many respects, better suited to interactive applications than normal television. This notion is the starting point for a follow-up project. Another topic for future research is how to remake television content so that it optimally suits mobile devices.

Keywords

User interface, portable terminals, mobile terminals, visualisation tests, interactive television, TV-Anytime, mobile digital television

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Mobile television – technology and user experiences

Report on the Mobile-TV project

Tiivistelmä

Television katselu langattomalta taskukokoiselta laitteelta tai matkapuhelimelta on kiinnostavaa monessa tilanteessa. Julkiset ja yksityiset kulkuvälineet ja julkiset tilat ovat mobiilitelevision potentiaalisia käyttöympäristöjä. Myös kodeissa ovat pienikokoiset mukana kulkevat TV-päätteet kiinnostavia sekä henkilökohtaisena televisiona että välineenä läheisempään vuorovaikutukseen televisio-ohjelmien kanssa. Paitsi että mobiilitelevisio tarjoaa mahdollisuuksia rikkaampaan katselukokemukseen, se tarjoaa televisioyhtiölle uusia katseluryhmiä, teleoperaattorille uuden jakelutien ja päätelaitevalmistajalle potentiaalisia tuotteita. Televisiohan on ainoa päämedia, joka vielä puuttuu nykyajan puhelimista.

Tässä työssä on kokeellisesti tutkittu ihmisten *todellista* kiinnostusta mobiilitelevisiota kohtaan haastattelemalla iso määrä ihmisiä, sekä rakentamalla ja kokeilemalla prototyppijärjestelmää. Järjestelmä yhdistää useantyyppisiä langattomia verkkoja 4G-tapaisesti. Se poimii digitaaliset maanpäälliset lähetykset ilmasta ja jakelee niitä eteenpäin Internetissä yli mobiilipäätteille langattomien lähiverkkojen (WLAN) kattamilla alueilla. Sisältöjä voidaan myös siirtää GPRS-solukkoverkon yli käyttäjille. Kahdentyyppiset päätelaitteet ovat käytössä – taskukokoinen kämmentietokone (PDA) ja A5-kokoinen Tablet-PC. Digitaaliset televisiosignaalit transkoodataan bittinopeuteen, joka sopii näille päätteille. Kenttäkokeessa käyttäjä pystyi katsomaan melkein kaikkea, mitä Suomen johtavat kolme TV-kanavaa lähettivät. Käyttäjä pystyi myös hakemaan arkistosta katsottavaksi kaikki ohjelmat, jotka oli lähetetty viime viikon aikana (TV-Anytime piirre).

Normaalit perheet, vapaalla olevat, työntekijät ja opiskelijat osallistuivat kenttäkokeeseen. Jokainen käyttäjä kokeili palvelua WLAN-hot spotien alueilla kuukauden ajan. Käyttäjät olivat yksiselitteisesti sitä mieltä, että palvelu oli televisiota, ei langatonta multimediaa. Tämä tukee näkemystä, että uusien palvelujen olisi perustuttava vanhoihin tuttuihin käyttöliittymiin. Eniten pidetty piirre oli mahdollisuus katsoa ohjelmia arkistosta milloin tahansa. Tyypillisesti käyttäjä selaili ohjelmalistoja läpi ja tarkisti, mitkä ohjelmat olivat menneet ohi huomioitta. Käyttäjät katsoivat yleensä lyhyitä ohjelmia tai osia pidemmistä ohjelmista. Erityisesti lapset – jopa esikoululaiset – pitivät palvelusta; joissain tapauksissa jopa niin paljon, että se korvasi normaalin television. Uutisohjelmat olivat suostuimmat aikuisten keskuudessa. Lisätietoja haettiin harvoin, ja hakuja tehtiin vielä harvemmin. Tyypillinen käyttö oli odotellessa tai kuluttaessa aikaa, yleisemmin tilanteissa, joissa normaalisti luetaan iltapäivälehteä. Käyttäjät olivat valmiita maksamaan palvelusta saman verran kuin sanomalehdestä.

Tämä tutkimus antoi selvän osviitan, että mobiilipääte sopii monessa mielessä paremmin vuorovaikutteisiin sovelluksiin kuin normaali televisio. Tämä havainto on lähtökohta jatkoprojektille. Toinen aihe jatkotutkimuksiin on, kuinka televisiosisältöjä voidaan muokata siten, että ne sopivat mahdollisimman hyvin mobiililaitteille.

Avainsanat

User interface, portable terminals, mobile terminals, visualisation tests, interactive television, TV-Anytime, mobile digital television

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Watching television from a wireless pen tablet or pocket-sized terminal is interesting in many situations. Public and private transportation vehicles, and public places are potential environments for mobile television services. Even in homes, mobile television handsets are interesting, both as a personal television set and as a tool for establishing closer interaction with the television programs.

This publication presents results about people´s real interest in mobile television. The results come from interviewing a large number of persons and from building and trialing a prototype system. A total of 293 people took part in the interviews and the trial. The trial system combined several types of wireless networks in a 4G fashion. It took digital terrestrial television broadcasts from the air and delivered them over the Internet to mobile terminals in hot-spot areas covered by Wireless Local Area Networks (WLAN). Two kinds of terminals were used - a pocket-sized PDA and an A5-sized tablet PC. In the field trial the user could watch almost the entire program content of the three leading Finnish TV channels. The user was also able to access all programs transmitted during the previous week from the media server (TV-Anytime feature).

This publication is intended for producers and distributors of television content, as well as for people in the handset device industry; it is also useful for students and people who are generally interested in the future of television.

The publication starts with a review of television usage patterns and early experiences of digital television and mobile television trials around the world. Thereafter, mobile television is placed in a broader media landscape and social context, and the design and implementation of the prototype is described. At the end, the user experiences of the prototype system are given. Finally, perspectives for developing mobile television services are drawn up.

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