Mobile TV should be more than a television

|The final report of Podracing project

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VTT

Abstract

This publication contains the results of the project "Intuitive and parallel media service platform to 3G, podcasting, and DVB-H" (Podracing). The aim of the project was to *compare* three different media formats (text, audio and video), and three delivery methods (broadcast, unicast and pre-download) from end user's perspective.

The primary study question was formulated as following: If a user had the possibility to watch the latest television news from the mobile phone, or listen to the news on the radio, or read text news with the mobile, what would he or she choose?

As a result, mobile terminals were used in such a variety of situations that no single media format and no delivery method was able to fulfil all needs.

Previous studies suggested that mobile television involves low commitment. This was contrary to the findings of Podracing: The users did not usually do anything else while watching. Furthermore, just surfing around or viewing an arbitrary program flow seems not be enough. Even though one of key motives of mobile television use is to kill time, people may want to kill boredom with special content, which is just suitable for that moment.

Tiivistelmä

Jos kuluttajalle annetaan mahdollisuus valita, katsooko hän kännykästään viimeisimmät televisiouutiset, kuunteleeko uusimmat radiouutiset vai lukeeko tuoreimmat tekstimuotoiset uutiset, minkä hän valitsee? Entä viihdesisällöstä? Tutkimus antoi vastauksia näihin kysymyksiin kenttäkokeen avulla. Kenttäkokeessa tutkittiin rinnakkain sekä eri media-muotoja että jakelutapoja, jotka olivat tasapuolisesti koekäyttäjien saatavilla. Myös erilaisiin sisältöihin liittyvät lisäarvopalvelut kuuluivat tutkimuksen aihepiiriin.

Tuloksena voitiin todeta, ettei mikään mediamuoto tai jakelutapa yksinään vastaa mobiili-käyttäjän tarpeisiin. Mobiilitelevision pitää olla enemmän kuin pelkkä televisio.

Lisäksi todettiin vastoin aiempia tutkimuksia, että mobiilitelevision käyttö on fokusoitu-nutta. Jopa lyhyisiin käyttöhetkiin tarkoitetun sisällön pitää olla kuluttajalle mielekästä.

Preface

This publication contains the results of the project "Intuitive and parallel media service platform to 3G, podcasting, and DVB-H" (Podracing). The two year project has been funded by Tekes – the Finnish Funding Agency for Technology and Innovation, VTT Technical Research Centre of Finland and several companies. The aim of the project was to *compare* three different media formats (text, audio and video), and three delivery methods (broadcast, unicast and pre-download) from end user's perspective.

The project had previously conducted two field trials, which have been reported in two publications. The first publication compiled the main findings of the first user trial which concentrated on news content in different media formats. The second publication compared different mobile TV technologies: DVB-H and 3G. In the third and last field trial the three media formats and three delivery methods were available in one integrated service.

In addition to Tekes and VTT, companies financing the project were represented in the project management group as well as the research partners. At the end of the project the group comprised chairman Vesa Erkkilä *(Digita)*, Jonas Kronlund *(Elisa)*, Juhani Reiman *(Lingsoft)*, Teemu Lehtonen *(MTV3)*, Jani Hätönen *(Radio Nova)*, Ari Pöyhtäri *(Sofia digital)*, Eskoensio Pipatti *(SWelcom)*, Jouni Siren *(YLE)*, Marko Heikkinen *(Tekes)* and Carlos Herrero *(TKK)*, Caj Södergård *(VTT)*, Esa Reunanen *(TAY)*, and Heli Paavola *(TAY)*. The group has made a great effort on behalf of the project.

The project was carried out by VTT Technical Research Centre (VTT), Helsinki University of Technology (TKK) and the University of Tampere (TAY). The project group consisted *[contributions to chapters of this publication in brackets]* of Ville Ollikainen *(VTT) [editor, 1, 4.2, 6]*, Elina Noppari *[4.3, 4.4, 4.5, 4.6, 6]*, Maarit Mäkinen, Esa Reunanen *[6]* and Jorma Riihikoski *(TAY) [2.2, 5, 6]*, Carlos Herrero *[1]* and Pia Ojanen *(TKK) [3.1, 3.3]*, Tero Hannula, Tuomo Kivinen *[2.1]*, Juha-Pekka Koivisto, Timo Kinnunen *[3.2]*, Virpi Oksman *[2.1, 4.1, 4.3]*, Chengyuan Peng, Antti Tammela *[1]* and Markus Ylikerälä *(VTT)*.

Different mobile television delivery methods are a new and very fast developing technology. Hopefully, this publication will give the readers some new information and guidance in this exciting field.

Espoo, March 10, 2008

> Ville Ollikainen
> Senior Research Scientist
> VTT Technical Research Centre of Finland

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List of acronyms and symbols

3G   The third generation of mobile phone standards and technology

DMB   Digital Multimedia Broadcasting

DVB-H   Digital Video Broadcasting – Handheld

DVB-HTML   Digital Video Broadcast HyperText Markup Language

HTML   Hypertext Markup Language

IP   Internet Protocol

ISO   International Organization for Standardization

J2ME   Java Platform, Micro Edition

MBMS   Multimedia Broadcast Multicast Service

MIDP   Mobile Information Device Profile

S-DMB   Satellite Digital Multimedia Broadcasting

SMS   Short Message Service

SW   Software

T-DMB   Terrestrial Digital Multimedia Broadcasting

UI   User Interface

WAP   Wireless Application Protocol

WI-FI   Wireless Fidelity

WLAN   Wireless Local Area Network

XHTML   Extensible HyperText Markup Language

XML   Extensible Markup Language

1. Introduction

Ville Ollikainen, Antti Tammela, Carlos Herrero

Mobile television has been commercially launched. Consumers in several countries, such as South Korea, Italy and Finland can receive broadcast material targeted to mobile terminals. In addition to mobile television broadcasts, third generation (3G) mobile networks are capable of carrying streaming videos as unicast services. And further, even without any network, consumers can buy media players, such as iPod, and enjoy content that has been downloaded to the player prior to leaving home or work.

The project studied these three delivery methods. Let's now have an overview on the topic.

Watching television on a small screen has been possible for decades, as already in 1960's portable televisions became available for consumers. Until these days, however, the delivery technology as well as content and programme schedules have been targeted to normal television, not at all for mobile use. More recent mobile TV technologies have potential to enable true mobile television services.

From a consumer perspective, integrating mobile television into mobile phones is intriguing; keeping in mind that mobile phone is one of the most personal devices, always following us wherever we are.

Watching TV from a phone is expected to gain interest in a variety of situations. Moving from one place to another – from home to school, to work, or to a hobby – or waiting in public place, can be considered as mobility in a strict sense. Not forgetting this, being at home is a potential context for watching mobile TV, too.

For broadcasters, mobile TV offers new audiences and new prime times, while mobile operators aim for business opportunities and reducing churn. As there is also business potential for terminal manufacturers, technology providers, content producers and advertisement agencies, just to name few, only one major question seems to remain: how will the consumer accept the idea of mobile television?

From technical point of view, mobile TV networks are considerably different from traditional TV. There are currently two approaches in delivering mobile TV: The first is via a 3G cellular network. The second is through a broadcast network – in Europe DVB-H, T-DMB or DAB-IP. Existing 3G infrastructures provide the easiest launch for delivering content to mobiles: For 3G consumers there is no need to get new handsets, since in practise all 3G phones are video enabled. However, when the number of users

increases, 3G streaming fails to scale up to a mass market of mobile TV services. Within a couple of years, 3G networks are expected to get a broadcast upgrade, MBMS (Mobile Broadcast for Multimedia Services) [Hartung et al. 2007]. In the future, IP-based wireless technologies like WiMax may play a substantial role as a competitor in mobile streaming.

In broadcast, the same content is delivered to all mobile handsets in a single transmission, which makes broadcast most scalable. However, new networks are needed, because traditional television networks are optimized for stationary reception and highly directional receiver antennas, thus not supporting mobility. Currently there are four major technologies for mobile broadcast: European DVB-H and DAB-IP, Korean DMB (T-DMB for terrestrial, S-DMB for satellite networks) [Kim 2003] and proprietary MediaFLO by the US-based company Qualcomm Inc [Qualcomm Incorporated 2005]. In addition, China has specified its own mobile TV standard.

In addition to broadcast technologies and streaming services, there is also a third method for delivering mobile TV content to mobile terminals: download to terminal memory. Downloading music to portable players are paving path for downloading mobile media in general: virtual radio stations, videos and user-generated content on the Internet can be downloaded to portable players like Apple iPods, hence the name "podcasting" used also in this publication.

Downloading content to terminal memory has also been enabled by rapid development in non-volatile memory technologies. Increased production volume, mainly caused by digital photography, has slashed the price of one gigabyte to a fraction within just a couple of years. A reasonably priced 2GB memory chip can store 15 hours of 300 Kbps video. Consequently, music players, such as the above-mentioned iPod, have turned into general media players, premium mobile phones such as the Nokia N93 have quality video record and playback capabilities, and portable game consoles such as Playstation Portable (PSP) can store hours of mobile quality video.

In order to study podcasting as a mobile TV delivery method, we developed a mobile media prototype called Podracing. The model of podcasting used in this project is a version of push technology, in that the information provider chooses which files to offer in a feed and the subscriber chooses among available feed channels. Stored locally on the handset, this content can then be watched even when there's no network connection. And a service provider can schedule the delivery to a suitable time, for example during the night.

We should keep in mind that mobile TV handset is capable of reproducing not only video, but also audio. Larger screens make even text and images more applicable.

The study aims of the whole Podracing project emerged from the integration of different media formats and delivery technologies (see Figure 1). Our primary study question has been formulated as following:

If a user had the possibility to watch the latest television news from the mobile phone, or listen to the news on the radio, or read text news with the mobile, what would he or she choose?
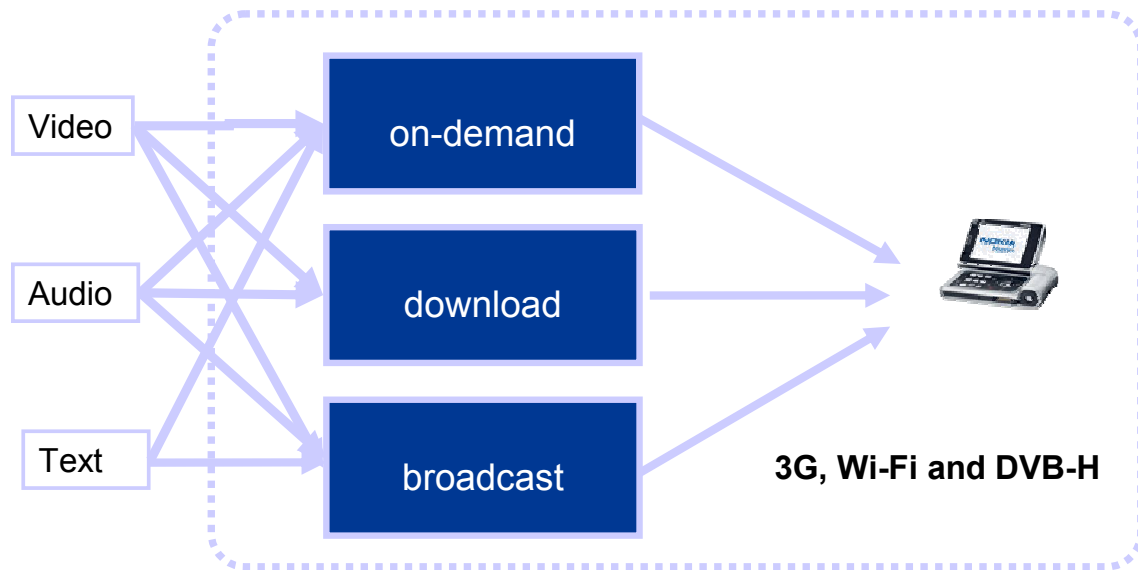
Figure 1. Podracing research framework.

2. Background for the research: The use of mobile media services

2.1 Previous Podracing trials

Virpi Oksman, Tuomo Kivinen

Previously two field trials were conducted in Podracing project. These trials have been reported separately, but a short summary is provided below.

2.1.1 First Podracing trial: Text vs. audio vs. video in news content

The first trial had a focus on different media format: video, audio and text. News content in these three formats was provided in an equal manner in a unified user interface.

The first field trial started in March 2006 with 10 users who used the service with 3G phones (Nokia 6630 and N70) for one month with an Elisa subscription. Before the test period, the users were interviewed and they received information concerning the test. Demographic data and media user profiles were gathered from the informants. The ages of the users ranged from 23 to 56. All of them worked at least part time and had used mobile services before. During the test period, the users reported their user experiences in a test diary. After the test, they were asked to fill in a usability evaluation form and they were interviewed again.

Mobility and real time effect were considered the most important characteristics in the first Podracing service. Being combined, these properties challenge all other media technologies. In the mobile news delivery, the users appreciated both continuously updated information and media formats carrying large amount of information. Having everything in real time was considered important, and as a consequence only the latest news had a high demand. From usability point of view, ease of use and quick launch and response times were also appreciated. Compared to earlier studies on mobile video content [Repo et al. 2003] there has been some changes in technology platform: Especially the use of earpieces with the mobile phone has became common since. This makes it more convenient to consume media content in privacy without disturbing others, for instance in public places.

When the users were able to receive news in different media formats in their mobile phones, text format were used most frequently (see Table 1). Typically, users considered text news format the most convenient for various kinds of situations. Text

was especially suitable for quick news headlines updates "on the go". Text based news format was also found less vulnerable for problems caused by disturbances in 3G reception. However, regarding the total amount of time, news in video format got longest viewing sessions. It seems that watching video news took place less frequently than reading text news, but at once, when the reception was good, people were watching on-demand news longer than having just at a glance.

Table 1. Text format was the most often used media type, but total usage time was longest for video.

	Number of sessions	Total amount of time
Text	**129**	**2 h 40' 13"**
Audio	**27**	**3 h 41' 39"**
Video	**80**	**10 h 59' 13"**

Text was considered the most reliable media form, sometimes associated with newspapers. On the other hand, when time was limited, video was considered being able to explain things in an understandable way. When watching mobile video, users were focused on it: One or both hands were needed to hold the mobile device, and users concentrated on watching the small screen and listening to the audio. Even at home users did not leave the mobile video on for "background noise" – the sound levels were considered very good, but users still held the phone in their hands and most often did not do anything else while watching. This finding was quite contrary to the low commitment expectation suggested by Knoche and McCarthy [2005].

The number of sessions when listening audio news was relatively low, but the average duration of the sessions was of the same magnitude as in watching video. This was a bit surprising, since the mobile phone in use (Nokia N70) had radio implemented in the phone, and the users preferred listening to it in real time instead of selecting news articles from the service. Monitoring radio usage and disabling radio from the phone had both technical obstacles, but the use of radio was taken into account in interviews.

2.1.2 Second Podracing trial: DVB-H vs. 3G streaming

The second trial compared mobile TV delivery methods: DVB-H broadcasting, 3G streaming and podcasting. Once again, the term "podcast" refers to downloading content in advance.

The field test started in October 2006 with ten families who used 3G TV and DVB-H with Nokia N92 phone for a period of one month with Elisa subscription. Before the test period, the users were interviewed and they received information concerning the test. Demographic data and media user profiles were gathered from the informants. The ages of the informants ranged from 12 to 56. During the test, the main informants carried the testing phone as their primary mobile, using it for both professional and personal communication. The testers used their company phone subscribtions for using the service. During the test period, the informants reported their user experiences in a test diary. After the test, users were asked to fill in a usability evaluation form and they were interviewed again. The informants had different kinds of hobbies, lifestyles, media profiles and interests. The tested mobile TV services consisted of a wide range of different kinds of contents: from main TV channels to sports news channels and from fashion TV to user generated contents.

It appears that the quality of reception is still one of the major technical problems perceived in mobile TV use.

The empirical research suggested that the users perceived a significant difference between different delivery methods, e.g. 3G and DVB-H and pre-downloading, and the difference is likely to affect on the length on watching sessions of mobile TV. During the test period especially 3G networks had some reliability and coverage problems. However, when technology gives the users more bandwidth and larger coverage areas, also the 3G TV viewing experience is likely to become better. Podcasting to the mobile phone was quite a new concept for the test users; however they thought that this delivery method would be useful for instance on long journeys, and in general in places with no 3G or DVB-H coverage. Obviously the advantage of podcasting is that watching the podcasted contents does not depend on the network connections – and thus can be done any time later, regardless of the location.

The findings of the test confirm many previous studies concerning the contexts of using mobile TV. Mobile television is mostly used in public sphere. The test users picked mainly the contents and channels which were already familiar. However since the test period was quite short, we were not able to see if the situations would have changed after a longer period of time. The interactive services were found interesting, and we could expect more innovative services developing in that area. Mobile TV alone caused a surprisingly high increase in estimated media consumption. It would be interesting to know if there would be a decrease in the time spent for reading free papers, since some contexts for consuming these media are similar (e.g. in commuting).

It was found that the price of using the mobile TV services, when they are finally finished products on the market, is also a significant factor that will affect the use. In the third trial of this project, reported in this document, the expectations on pricing models of mobile TV services are studied in detail.

2.2 Background of mobile TV business

Jorma Riihikoski

Since Podracing is related to mobile television in general, it is appropriate to have a look at mobile TV business today. Mobile TV broadcasting trials are taking place all over the world, and several commercial services are running:

- 4 million subscribers of cellular network based mobile TV worldwide
- 2 million subscribers of broadcast mobile TV in Korea (S-DMB 0.6 million, T-DMB 1.4 million)
- 600,000 subscribers of broadcast mobile TV in Italy (3 Italia's DVB-H network)
- a multitude of pilots and trials worldwide.

There are also recent or anticipated mobile broadcast network rollouts:

- Germany's MFD launched a DMB service in June [http://www.watcha.de; in German].

- TIM, Italy launched mobile TV service in Mediaset's DVB-H network 2006.

- Virgin UK to launched DAB-IP based service 2006 but it was not successful and it is closing down.

- Vietnam Multimedia Corporation has rolled out their DVB-H service at the end of year 2006.

- Japan's ISDB-T based transmissions are on air.

Case 3 Italia provides an interesting example of mobile TV Case in Italy. 3 Italia acquired an existing DTT network and license for 35 million € [http://www.tre.it (in Italian), http://www.dvb-h.org/Services/services-Italy-3Italia.htm]:

- The network covers 74% of Italian population.

- Its customer base was 100,000 one month after the launch on June 5th 2006, increasing to 400,000 by the end of December 2006. By May 2007, the company was reporting a customer base of 600,000. 3 Italia offers mobile TV as a part of an "all inclusive" proposition that combines a pay-TV subscription model with a daily bundle of voice and Internet. On the other hand there's a pay-per-view model that allows customers to pre-pay for access to the service from one day to 3 months.

- The channel line-up consists of 10 channels: RAI, Mediaset and Sky channels and two 3's own channels.

- The default channel is "La 3 Live", which contains low-cost programming (production costs 200 €/hour).

- Only one Samsung and one LG handset are supported (because of early implementation, the service is not fully compliant to DVB-H standards).

- Among pricing options for the TV service are e.g. daily charge of 3 € and monthly charge of 29 €.

Compared to Italy, Korea case sets a contrasting example in Korea. Case Korea: both networks are said to make big losses, the satellite-DMB service has 600,000 subscribers while it would need 5.5 million to reach break-even [Dermot Nolan, TBS].

Several estimations of mobile TV growth have been made. One of them, made by Informa Telecoms and Media, is presented in Table 2.

Table 2. Forecast for worldwide broadcast mobile TV users, by technology, 2006–2012. Source: Informa Telecoms & Media.

Users (million)	2006	2007	2008	2009	2010	2011	2012
DVB-H	0.3	1.4	6.1	20.3	51.0	102.6	182.2
DAB-IP	0.0	0.1	0.4	0.8	1.4	1.9	2.4
T-DMB	0.8	2.3	4.4	7.4	11.5	16.7	23.6
S-DMB	1.4	2.4	3.6	4.9	6.4	8.1	10.1
ISDB-T	2.0	5.7	10.6	16.7	24.7	35.0	47.2
MediaFLO	0.0	0.2	1.1	4.2	10.7	22.4	39.3
STiMi	0.0	0.0	1.3	3.5	7.6	14.8	27.2
DVB-SH	0.0	0.0	0.0	0.2	0.7	1.5	2.4
Cellular multicast	0.0	0.0	0.0	0.1	0.3	0.6	1.2
Total broadcast (exc cellular streaming)	4.6	12.1	27.5	58.1	114.2	203.7	335.6

In the early years of the forecast period, the most advanced networks will be S-DMB and T-DMB services, dominating broadcast TV handset sales worldwide from their stronghold of South Korea, and also from the early, less successful launches in Germany. However, their combined total is due to be overtaken by the Japanese ISDB-T standard in 2007. By 2012, there will be 23.6 million T-DMB subscribers and 10.14 million S-DMB users worldwide, as the former extends into the Middle Eastern markets and China (T-MMB). [Burk & McQueen 2006.]

There is also more optimistic estimation of faster growth of mobile users. According Gartner amount of users will reach 500 millions in four years time. Although in this amount are included all the people who are watching some kind of TV broadcast in their mobile devices, only 30% of users will order the services and the rest will get them with operator's package deal. Mobile networks TV turnover will grow from 100 million to

15 billion US dollars in 2010. Broadcast (meaning DVB-H-, MediaFLO- or DMB) turnover grows from 200 million to 10.8 billion USD.

Mobile TV appears to be expanding compared to traditional TV, but for the moment it is a marginal phenomenon. International examples portray business opportunities through expanding subscribers' case, but also losses and failures.

3. The Podracing prototype for third trial

3.1 System description

Pia Ojanen

The general aim of the Podracing project was to compare different media formats (e.g. text, audio and video), delivery methods, and mobile networks. The first trial concentrated on news service. The first prototype used on-demand delivery and 3G network. The second trial concentrated on comparing 3G and DVB-H, and gave some user opinions on podcasting. Third trial, presented in this publication, had podcasting integrated to the service. The prototype was evaluated in a field trial.

3.1.1 Service structure

Podracing terminal platform consists of browser-based client in a mobile phone, and content server. From user point of view the structure of the service is quite simple. User has browser installed to her phone and only Podracing application is available inside the browser. User interface is generated and media files are be available in the Content Server. (Figure 2.)
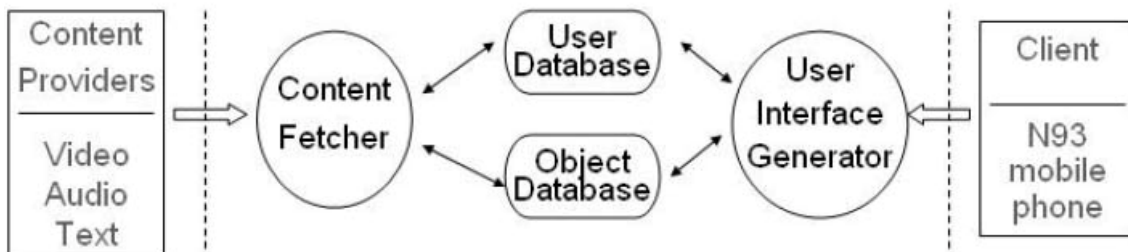
Figure 2. Structure of the service.

What a user actually sees is an xml-based user interface with links to video, audio and text files. Content is arranged by category and content provider. Special browser has to be installed to the phone in order to be able to access this service. Content is delivered via IP based 3G and WLAN using different delivery methods. Browser includes a built in tool for controlling podcasting specific downloads.

Application can be viewed by opening the browser application in the Mobile phone, which fulfils some minimum requirements. Having either WLAN or 3G connection available is essential, since the service cannot be viewed off-line.

User Interface consists of navigation and content areas (Figure 3). Graphical navigation elements were included, as the minimum requirements for the application already required graphical capabilities from the phone and adequate transmission speed. Thus also download times should be tolerable.

Automated content provisioning process was created for producing suitable material for mobile devices: After broadcasting a television program or publishing text based news, these items are sent to or retrieved by the Content Server, which modifies them to correct size and format. Content and available metadata is saved to the database. User interface presents available media content, podcast subscription status.

Figure 3. View of the User Interface on a mobile phone.

3.1.2 System requirements

Most handheld devices with network capabilities are Java-enabled and support some version of the Mobile Information Device Profile (MIDP). Java applications, called midlets, developed for a certain MIDP version, should be compatible with on all devices supporting that profile. Even though MIDP only supports only a few video and audio coding formats, it would be possible to develop a mobile video news service completely in Java code [Lee & Jayant 2006]. However, due to the MIDP constraints of playing audio and video files, it is recommended to use the native media player of the device.

Handheld devices share common characteristics, e.g., both memory and processor capacity are very limited, and J2ME applications are widely supported. However, different devices can provide different media frameworks and network capabilities. Hence, for the project J2ME-based SW development is preferred, while run-time memory should be kept minimal.

In the beginning, Podracing project had a plan to exclusively use Nokia N92 phone with DVB-H capability. The phone supports MIDP 2.0 standard, WLAN and 3G technologies can be used for data transfer. Display resolution is 240 x 320, which is adequate for presenting graphical user interface and video content; and the device supports memory

cards of up to 2 GBytes capacity. Models with quite similar capabilities, but without DVB-H, became available (Nokia N93 and Nokia N95) during the project. All these models were supported (Figure 4). DVB-H properties became later on less important, as it turned out that there were no programming interfaces available for integrating broadcast transmissions to the Podracing service.
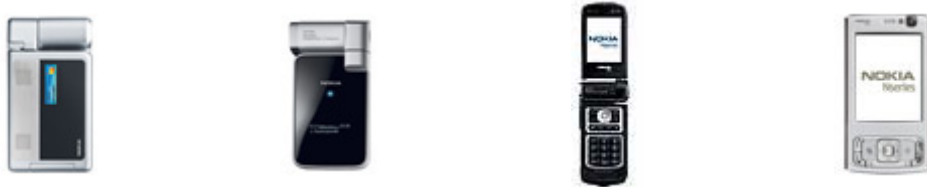

Figure 4. Supported phone models N92, N93i, N93 and N95.

3.1.3 Podracing architecture

The System architecture is based on the client/server model (Figure 5). In the third field test there were two servers running the service:
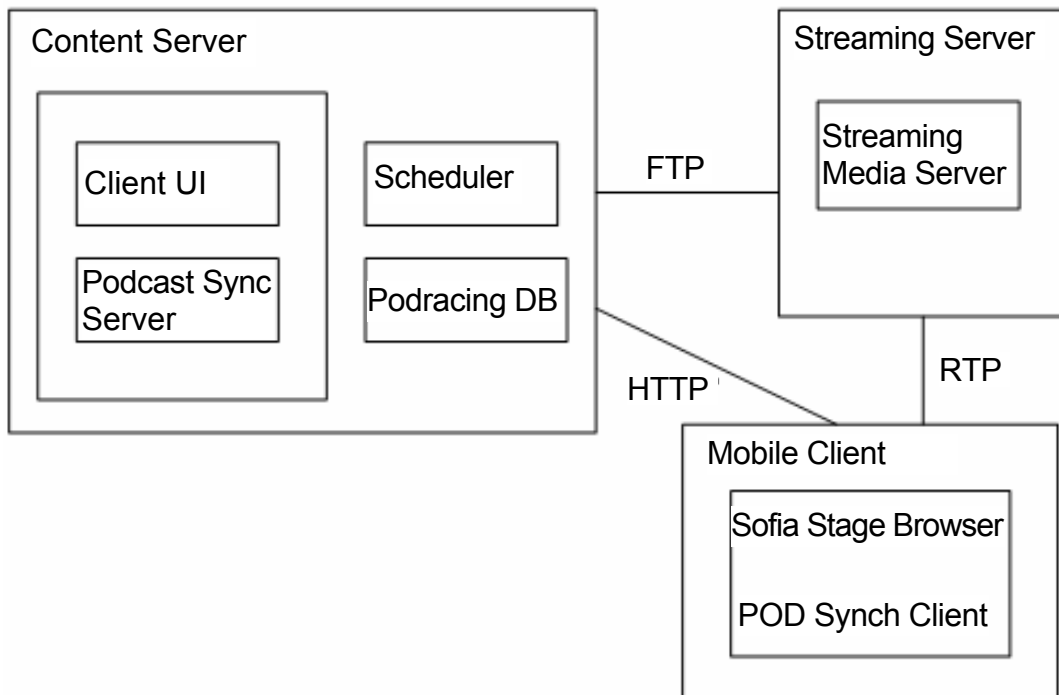
- Content Server
- Streaming Server.

Figure 5. Third field trial architecture.

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3.1.4 Server software

The Content Server software consists of three components: Content Fetcher, user and object databases and User Interface (UI) generator. The Content Fetcher receives and retrieves media files automatically from different sources, e.g., Finnish TV broadcasters, and adds the media files and corresponding metadata as Java objects into a Structured Query Language (SQL) based database system, the object database. In addition to that, a separate database, the user database, stores information about users' preferences and podcast subscriptions.

The UI generator was implemented using Java Server Pages (JSP) [http://www.jsp.com] and Spring Framework [http://www.springframework.org] to create the user interface for a declarative environment. The markup language interpreted by the browser was a reduced version of XHTML Mobile Profile, created by Sofia Digital.

Content Server contains most of application logic in the system. It contains following software components:

- Servlet Container
    - Hosts web applications
    - Technology: Apache Tomcat (http://tomcat.apache.org/)

- Scheduler
    - Triggers as scheduled tasks on timely basis

- Podracing Database
    - Provides persistence mechanism
    - Technology choices: MySQL (http://www.mysql.com/)

- Client UI
    - User Interface for browsing content at the server
    - Technology choices: JSP, Spring MVC

- Podcast Synchronization Server
    - Interface for retrieving podcasts from the server.

3.1.5 Client implementation

Client software consists of browser and synchronization application, which have been combined to one J2ME MIDP application. The Browser is Sofia Backstage® Mobile Digitext browser [http://www.sofiadigital.com]. The Podcast synchronization application, named Podsync, is used for retrieving Podcast files from the object database, requesting the list of new files to be downloaded from the user database. The Podsync application

can also delete files from the memory card and inform Content Server, through user database, about the files that are stored on local memory card at any moment. Sofia Backstage® Mobile Digitext Browser has been customized for Podracing UI, and Podsync was integrated into it.

Client side contains following software components:

- Sofia Stage Browser
  - Browser for viewing content at the server
  - Provided by Sofia Digital Oy

- Podcast Synchronization Client
  - Retrieves Podcast content from the server.

3.1.5.1 Sofia Backstage® Mobile Digitext Browser

Sofia Digital Backstage browser can serve as an example as XML based Client, which is not a normal web browser. It has quite similar features with Mobile web browsers and couple of extra features provided only by this browser. One main advantage was possibility to close co-operation with Sofia digital, in order to implement project specific extra features to the browser.

A special limited version of XHTML Mobile Profile was used as a markup language for second version of the browser. One of the major improvements in the second version is the absence of transcoding, which reduces response times significantly. Fonts and pictures are clearer, because the view is not being scaled from TV resolution to fit the screen. Figure 6 illustrates some sample screen shots.

Figure 6. Sofia Digital Browser in Podracing service.

3.2 Podracing content

Timo Kinnunen

3.2.1 Overview of content acquisition

Three types of content, text, audio and video, from three broadcasting companies, Nelonen, MTV and YLE, is fetched, processed and stored by Podracing servers. The text material is basically news articles in tagged XML-files, which can be parsed with Java Xerces XML-parser. The XML also includes some metadata used by the project. A new fresh set of news articles is fetched once every hour. The audio material is a static set of clips, fetched and transcoded into 3GPP audio-only clips. There has been no update for audio material. The selected video material is automatically transferred every day from broadcasters.

In video processing, Windows Media Format (MTV3 and Nelonen) is first resized with AVISynth and then encoded into 3GPPv5 (MPEG-4 SP) format with Helix Mobile Producer Standard. A speech-to-text analysis tool from Lingsoft is used to extract keywords from MTV3 and Nelonen tv-news broadcasts. YLE provides video files in 3GPP format, so no encoding is needed in YLE content. Finally Darwin Streaming Server is used to stream 3GPP files to Real Player clients in mobile devices. Figure 7 below illustrates content acquisition processes used in the project.
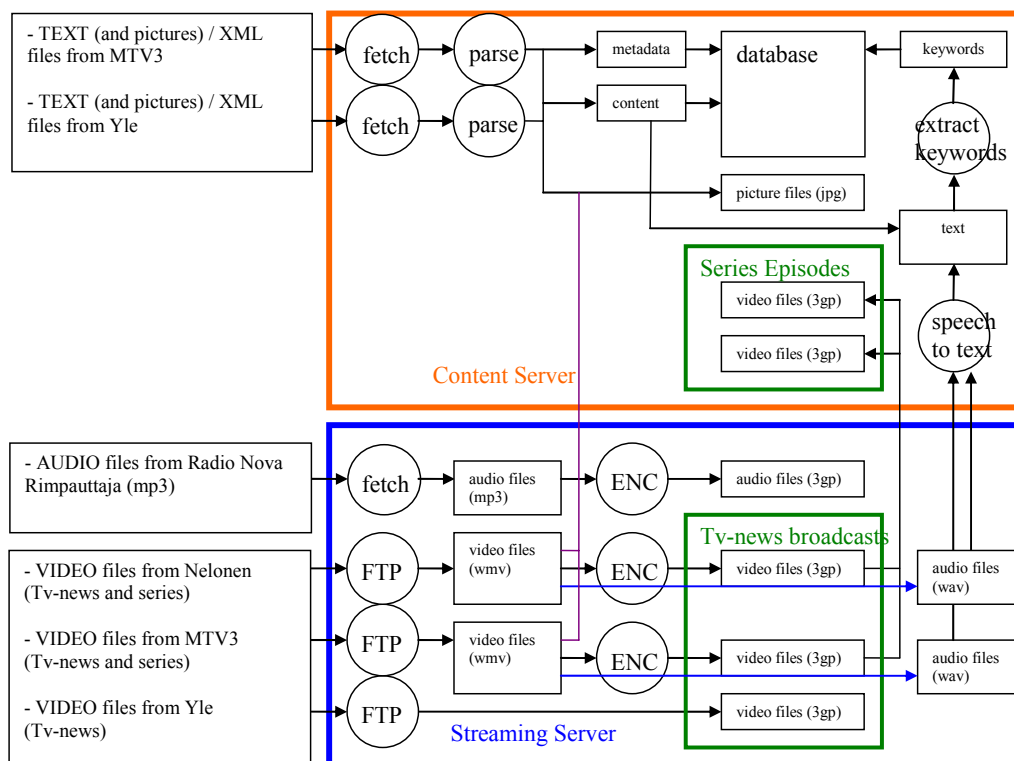
Figure 7. Podracing content acquisition.

3.2.2 On-demand content

On-demand content contains tv-news broadcasts from YLE, MTV3 and Nelonen, Rimpauttaja audio clips from Radio Nova and text-news articles from YLE and MTV3.

3.2.3 Podcast content

Podcasted content contains series episodes from MTV3 ("Salatut elämät") and Nelonen ("Bella", "Inno", "Ota tai jätä", "Pop-ikoni", "Retro" and "Start!").

3.2.4 Broadcast content

Five 24/7 broadcast simulation channels are generated as five different Darwin Streaming Server Playlists: Nelonen series, Nelonen news, MTV3 series, MTV3 news and YLE news. Using predefined playlist filenames it was possible to update playlist dynamically and automatically as new material arrived to our server. All news channels rotated latest news broadcasts from one day. MTV3 series channel rotated six latest episodes of one series ("Salatut elämät") whereas Nelonen series channel rotated six different series ("Bella", "Inno", "Ota tai jätä", "Pop-ikoni", "Retro" and "Start!") using one episode of each, until all episodes were played, each series then started again from the first episode.

3.3 User Interface

Pia Ojanen

3.3.1 Podracing User Interface implementation

3.3.1.1 Mark-up languages

Brand new version of the Sofia Browser was available for the third trial. The XHTML style markup language used for the browser is targeted to low end devices and is thus considerably limited. The lack of up-to-date documentation, as well as continuous development gave a challenge for the implementation. On the other hand the browser had gone through major enhancements after trial 2, so for instance the performance had improved significantly.

3.3.1.2 Programming languages

The server-side of the system was implemented using Java programming language. User Interface was build using Thin Client Approach. This approach saves development costs, since no application specific custom client is needed.

Spring Framework (http://www.springframework.org) was chosen for the implementation of the User Interface, together with Web MVC framework. Spring Framework is lighter and considered more suitable for this kind of small project than Struts, which was originally suggested.

3.3.1.3 Real Player as a player for video/audio content

Real Player is used for playing all video and audio files (Figure 8). It is a default application in most of Series 60 Nokia Mobile Phones and as such a familiar application to more advanced users.

Current version of Real Player is quite limited when it comes to controlling videos and video streams. User is not able to stop the clip and then start over again, or jump from one part of the video to another, but it has to be watched from the beginning to end. More advance versions became available during the project.

Figure 8. On the left on-demand video, Nelonen news, opened with Real Player. On the right Podcasted video, episode of the series "Mothers and daughters", opened from phone memory with Real Player.

3.3.1.4 Navigation structure

The user navigates through the pages and links by using the directional pad of the mobile phone. The two menu buttons of the phone (located under the screen or next to it depending on the screen orientation) are also used to open Podracing menu and as a back-button.

In studies related to mobile browsing, text based navigation is often recommended. Nevertheless, images were selected as navigation elements in this project, mainly because they are well supported in second generation phones, such as the models in question. Display is considerably larger than in the previous models and faster network connection is available for downloading and streaming videos. It is thus reasonable to expect that device is able to render small images at reasonable speed. This kind of navigation model is often used in PC world.

On the other hand it was not considered during the design that some of the users would be using only text based parts of the service (news feed). Browsing only text material would benefit from the lighter text based navigation: The user might want to access news content and already downloaded podcasting content also when available network connection is very limited.

Browser supports paging model, so content was divided in three separate "frames" (Figure 9), even though frame does not have the same meaning in this context as in normal web development. It can be considered as one page element instead.
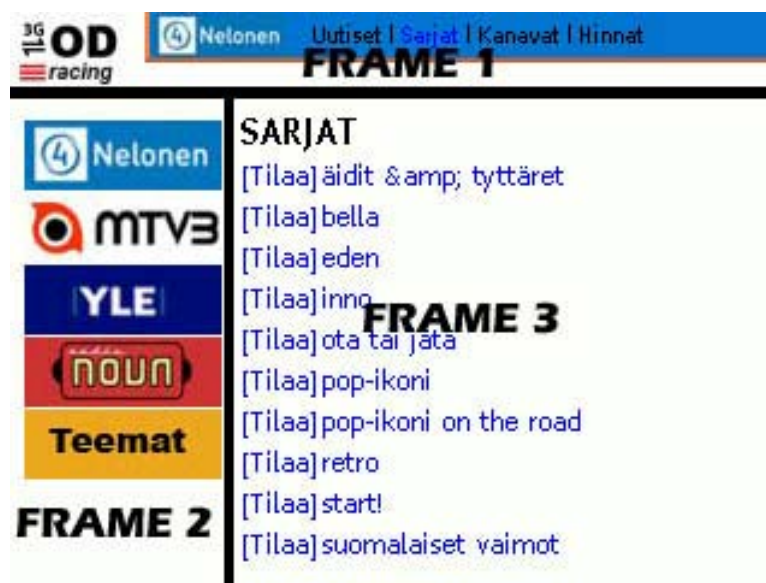

Figure 9. Screen area is divided into three frames.

Frame 1	Logo of the service is located on the left side. It could be easily changed, if the service model would be different.
	Brand colours and logo are displayed on the left side. Brand logo will function also as a link to brand main page.
	Available content categories belonging to the selected brand, current category is highlighted. This way user is always aware of her location on the service.
Frame 2	Navigation elements are located in this frame. Depending of the level it will be either brand logos or text. Brand logos are already familiar concepts to users.
Frame 3	Content is always in this frame. Only videos will open in separate window.
	If content does not fit into one view if will be divided to separate pages. Paging model is already familiar from text TV. Arrow keys will move user forward or backward.

3.3.1.5 Icons and graphic elements

Graphical icons for media types were added, so that user would always be aware which media type, as illustrated in Table 3.

Table 3. Graphical icons for media types.

	Audio file	Headphones
	Text file	Letter T
	Video file	Icon of a television set

3.3.1.6 On-demand News

First entity in the content view was news. First view displayed 8 most recent articles from the channel. User was able to select All News, if he was interested in a wider selection.

News feed was automatically generated. The content came from the broadcasting companies, which also provided metadata about news articles and video clips. In this way news were categorized and sorted using different criteria.

At this point all news items were either text articles or video clips. They could as well be audio clips, if they would have been available. Icon on the left indicated file type of an item (Figure 10).

Figure 10. Main view of the service (left). Most recent news (right).

News main view	News main view contains 8 most recent news article or video clip from the selected brand. Link to ALL NEWS is available in the bottom and it leads to news category view, if available.
Category view	Left side of the view contains navigation, containing pre-defined news categories. Every link will open news set of this particular category to right side of the view: Main Local Foreign Economy Media and IT Sports Entertainment Others Right side of the view contains list of articles, which are part of the selected category.

Text articles had their own template, which contained article name, publication date, timestamp and actual text. Version in the second trial had a possibility to display a picture, if available, but it was removed from version 3, because image scaling was not supported in new version of the browser. Related articles were displayed at the end of each article. (Figure 11.) They were automatically fetched from the database using keywords in the metadata of the article.

Figure 11. Individual News article (left) and Related articles (right).

News article	News article consists of following information: Headline Release time Article text It is always followed by list of related articles.
Related articles	A list of articles which have same keywords than the available article itself. Links will lead to similar article pages with an article and related articles.

3.3.1.7 Podcasted series

Series view contained list of available series. On the left side user was able to see the state of the series. (Figure 12.) There were two possible options for the state: series has been already ordered, or user is able to order the series.

When the user selected a series and clicked the link, the series navigation view was displayed. On the left side all available episodes were listed.

If user ordered the series, only three most recent episodes were downloaded. It was found out before the trial that if all episodes were available when user starts to use the service it would take too much time to download them at once.

Figure 12. List of available series and status if they are ordered or not (left) and Episode list and information for series. Episode is not yet downloaded (right).

Series	Left side of the content area contains state of the order, options [order] and [ordered]. User can change the state by clicking the link.
	Right side of the content area contains names of the series, which are also links to episode view.
Episode	Left side contains a list of available series. It contains name of the series and navigation, which contains all available episodes of this series. User can browse all episodes using this navigation.
	Right side Contains title of the episode, release time and status, whether the episode has been ordered or not and is it available in the device or if it still needs to be downloaded.

3.3.1.8 Downloading podcasted episodes

In the second trial Podcasting downloads were triggered by separate application, called Podsync. The user had to open a standalone Java application in order to update new series to his phone. The implementation was separated from the User Interface. If the user ordered a series he was supposed to open Podsync application and launch the downloading process. After all downloads were completed the user was able to see the episodes from the User Interface.

In the third trial user was able to view status of all downloads active during the session. This functionality was ported from the Podsync to the browser application.

After the episode was downloaded to the terminal, a link "[view]" appeared to the screen. (Figure 13.) This link opened the video, now existing in the memory of the phone.

Figure 13. Progress bar for downloading series to the phone memory (left) and Episode is available for watching behind the link (right).

Podsync view	All downloads are visible in the Podsync status view. User can access this view from phone menu. This functionality is integrated to the browser.
Episode view	After episode has been downloaded by Podsync it will be available for viewing in the User Interface. [View] -link will open the episode in Real Player.

3.3.1.9 Broadcasted news and series

Broadcasting channels were available as links in their own view. Channel name and short description were available as static content. The content was the same as offered for Podcasting. DVB-H was not available, so broadcast was emulated with 3G streaming. Content quality was a bit lower in streaming, but otherwise the service was the same.

When the user selects a link to the content, Real Player becomes launched. (Figure 14.) In the Content server there was a pre-defined set of programs which loop over and over. When administrator wanted to change the episodes it was done in the server and the change became effective immediately.

This was the most unreliable of the three different delivery methods. The phones used it was not possible to use any other connection for video streaming, except 3G. Thus, even if the user would have had a WLAN connection available and would have used it for browsing and downloading podcasted series, as well as text based news, the streaming with Real Player was operational over a 3G connection only.

Figure 14. Broadcasting view, available broadcasts and short descriptions (left). News broadcast is playing after user has selected the link (right).

Broadcasting view	Most recent news clips and entertainment clips are available from Broadcasting view.
Broadcast loop	Loop consists of most recent news or entertainment clip from the brand. It will be updated frequently, as new content is published. Loop will be opened in Real Player, using 3G network connection.

3.3.1.10 Theme Channels

The concept of Theme Channels was introduced in the third trial. It was a concept combining content from all Channels/Brands, even though this was not completely in line with the original brand based approach. In the actual implementation there were pre-defined theme categories and themes, which were always related to a category (Table 4).

Table 4. Theme categories named after their keywords.

People	Regions	Politics	Economy	Sports	Free-time
M. Schumacher	Europe	Prime	Fortum	Formula	Garden
Tarja Halonen	Russia	Minister	Sampo	Yleisurheilu	Summer
M. Vanhanen	China	Government	Nokia	Pesäpallo	Art
J. Katainen	United States	Foreign	Maailmanpankki	Golf	Theater
Tanja Saarela	North Korea	minister	Raakaöljy	Tennis	Music
Madonna	Iran	Security	Forest Industry	Olympics	Culture
Hanna Pakarinen	Finland	Eduskunta	Yrittäjyys	Rebound	Children
Ari Koivunen	Helsinki	Nato	Mortage	Uefa-Cup	Weekend
	Tampere	EU		MM-rally	Band
		Party		Boxing	

"Themes" were current topics, which were selected so that they would produce enough hits in the database. Themes were kept constant throughout the field trials.

Lingsoft speech recognizer software, which was used for keyword retrieval from video and audio files was not optimized for analyzing whole sentences, but rather it should recognize individual words, for example dictations that have been defined in advance. As the project had also engaged with this product the pre-defined theme set was used.

3.3.1.11 Prices

Price lists were added to the User Interface in the third trial of the project. There was no actual functionality on these views, they were like reminders to users, giving an idea how much the service would cost in real life. (Figure 15.)

Figure 15. Imaginative price list for available content types.

4. Field test results

4.1 Podracing study aims and research methods

Virpi Oksman

The purpose of the field study in the third trial was to explore users' mobile TV choices in different everyday situations. Qualitative and quantitative methods were combined to make sure that adequate data was collected. Semi-structured interviews, questionnaires and media diaries helped to disclose users' media habits and how they present their expectations and preferences. We also asked the users to take some photos with the camera phone about the situations in which they might use the mobile TV service, and of other places, things or contexts that are important for them. This helped us gain an understanding about the role of media in the users' everyday lives.

The field test started in May 2007 with eleven households who used Podracing service with Nokia N92, N93 or N95 phone for a period of three months with Elisa subscription. Before the test period, the users were interviewed and they received information and instructions concerning the test. Demographic data and media user profiles were gathered from the informants. The ages of the informants ranged from 24 to 56. During the test, the main informants carried the testing phone as their primary mobile, using it for both professional on personal communication. During the test period, the informants reported their user experiences in a test diary. After the test, users were asked to fill in an evaluation form and they were interviewed again. The informants had different kinds of hobbies, lifestyles, media profiles and interests.

The test period was overlapping with summer holidays of most of the test users. A typical summer holiday in Finland is four weeks.

4.2 Statistical analysis

Ville Ollikainen

Total of ten users were logged in the trial. Five of them had the service available about three months, two approximately 2.5 months, one about 2 months, one 1 month, and one 3 weeks. One user took part in interviews after using the service.

An average user was accessing the Podracing service during 22 days within the trial period, which means that in general the service was not used on daily basis. Additionally, a holiday season affected the usage, which made it less feasible to analyse

how the usage changed over the test period. Furthermore, any analysis comparing weekdays would also have been affected by the holiday season.

Keeping these restrictions in mind, Figure 16 presents the usage over the entire test period: The first users got the service in mid May and the second wave in June. The end of the trial was not fixed, and the number of users got lower towards the end. The figure indicates that the holiday season (typically in July, but may vary) did not have and significant quantitative influence on the usage.
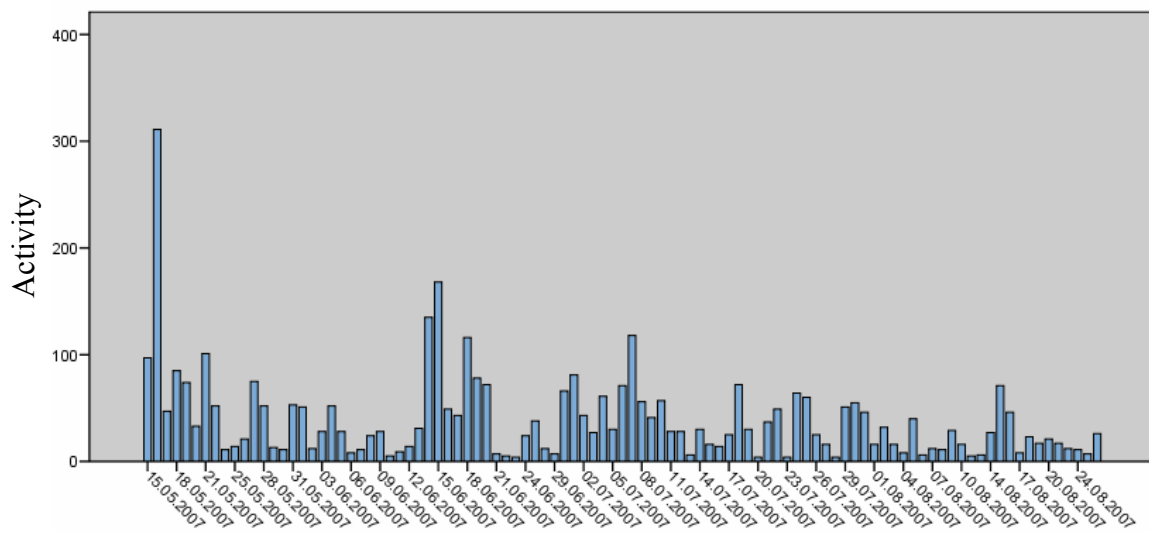
Figure 16. User activity throughout the trial.

A typical user was trying out different functionalities in the beginning of the test period, and the use of the service became more consistent after the first week. This is why the first week is excluded from all analysis unless otherwise mentioned, and discussed separately.

4.2.1 Log files

There were two different log files: log file of the Podracing service and log file of the streaming server. The streaming server logged all activities concerning streaming on-demand video services and broadcast emulating video loop services. On-demand events were seen in both logs, whereas statistics of loop services were available only in streaming log.

In the streaming log the users were not identified. Most of the on-demand requests were found from streaming log by comparing time stamps between the logs. Information about the success of on-demand content requests was available in the streaming log:

According to log files six users were able to view streaming on-demand content successfully. Two users had attempts, but without success, and for two users there was not a single attempt for on-demand video in the service log.

Because the loops used the same technical implementation we can assume the same six users were able to access loop content, whereas four did not.

Eight users were successfully viewing downloaded Podcast content through the service. It should be noted that easy of download was depending on the individual configuration: In most cases there was Wi-Fi available for quick download, but 3G made the download sluggish.

All ten users were able to browse text articles. When comparing media formats, all comparisons, if not otherwise mentioned, were scaled to the amount of usage per user: The number of users was 10 for text based services, 8 for downloaded content and 6 for on-demand and video loop services.

Compared to other media formats, the amount of audio content was minimal, and it did not change over time. Only four users were listening to audio and the number of audio accesses was only 8, so audio is excluded from further analysis.

In some cases it was difficult to determine, if there had been success in watching an on-demand streaming video. Consequently there was a small difference between service log and streaming log results, which is corrected to the figures.

Since loop video accesses were not logged to the service log, no individual analysis for the loops can be made. However, since we were able to calculate success rate of on-demand services and we were able to see the amount of loop service accesses, we can estimate the number of attempts to access loop services in a comparable manner.

4.2.2 Comparing different media formats

In Table 5, text, on-demand streaming, downloaded podcast and broadcast emulating loops are compared.

Table 5. Comparing media formats.

	Text	On-demand	Podcasting	Loops (est.)	Other Podracing use
Percentage of sessions	29%	21%	7%	35%	-
Average duration of a session	2'02"	3'02"	12'57"	1'56"	-
Average total duration of media consumed	12'50"	14'10"	19'25"	14'57"	1 h 08'

Broadcast emulating loops got highest click rate, but the duration of a session was shortest. Downloaded content got fewest clicks, but when it was used, the sessions had by far longest durations. Average amount how much each one of these media formats was used, was surprisingly equal.

As we see from the figures, the use of Podracing service alone, without accessing any specific media content seemed to be most popular.

4.2.3 Session durations

Figure 17 illustrates session durations when browsing text based content. An average text article was fairly quick to read through, average 1'18", but typically several text articles were read one after another. Sometimes the end of the last article was not found from the log, since opening a text article may had been the last action from the user in that session. For these cases the duration of reading last article is considered being the average duration.
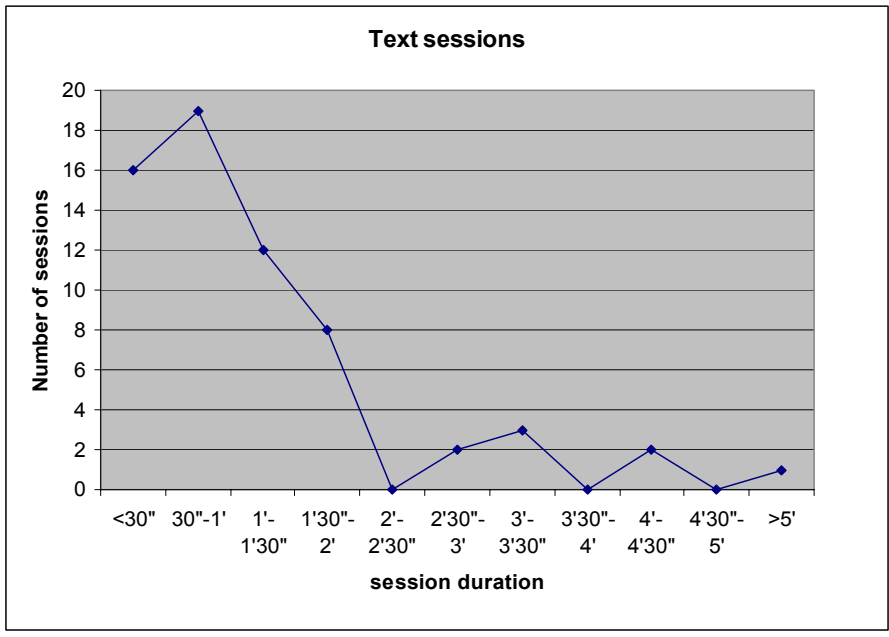
Figure 17. Duration of text sessions.

No on-demand streaming content was watched more than 10 minutes in a row. Short durations dominate the usage, as illustrated in Figure 18.
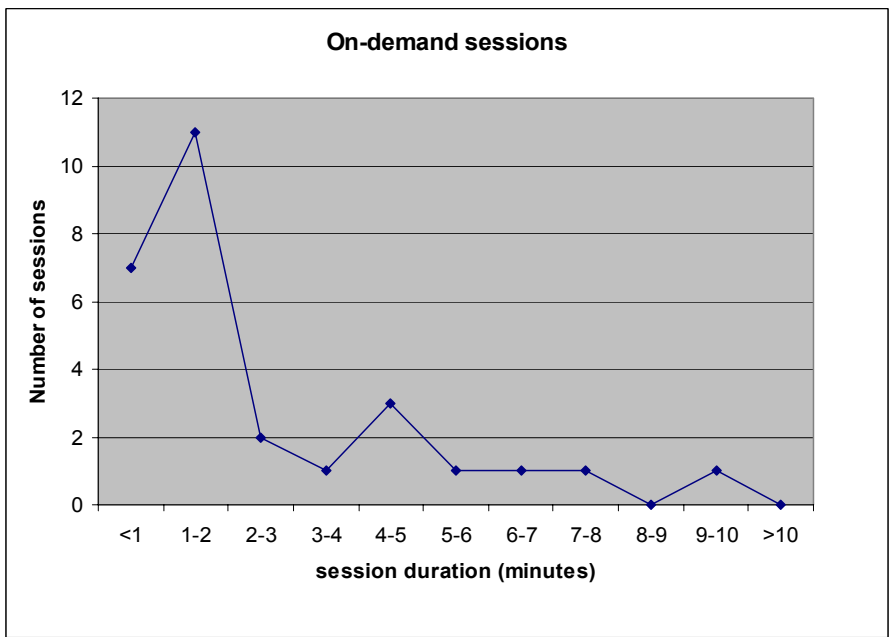
Figure 18. Duration of on-demand streaming sessions.

Downloaded podcast videos, on the other hand were watched either as a quick preview or as the whole episode from the beginning to the end (Figure 19).
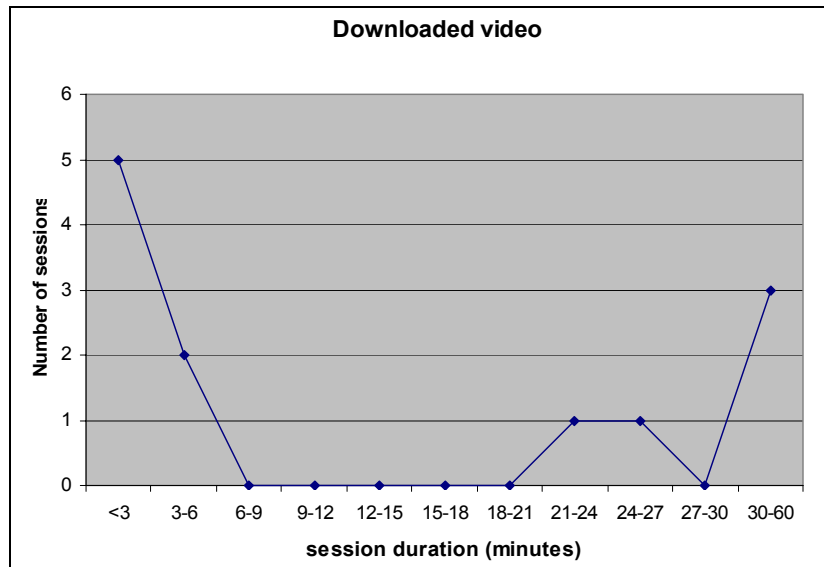
Figure 19. Duration of watching downloaded podcast content.

4.2.4 Prime time

According to the log data people were using the service mainly in the early morning and late night (Figure 20). Despite of higher activity, a typical night time session was shorter than average.
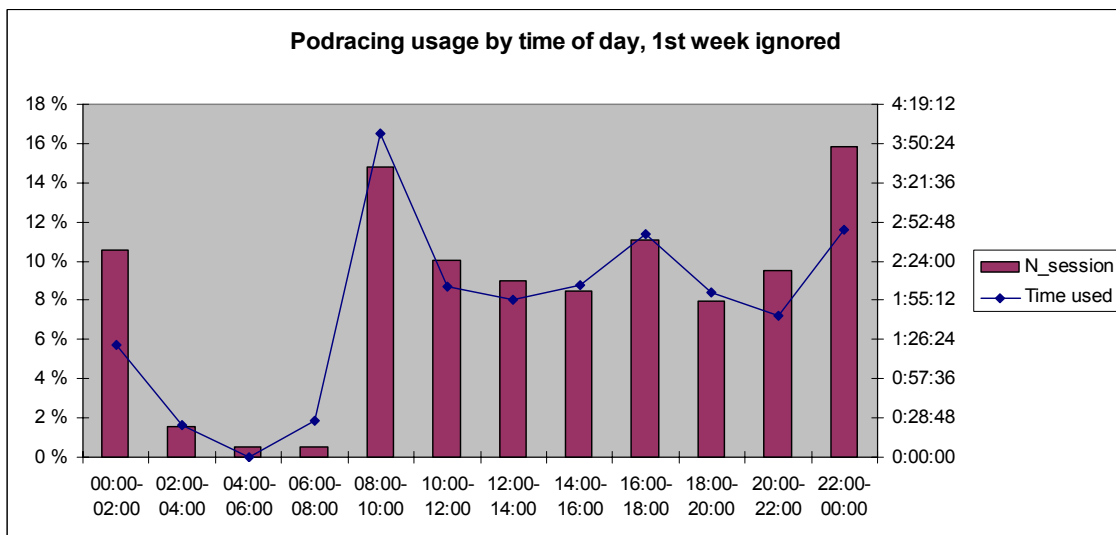
Figure 20. Prime time of Podracing service. Bars present percentage of sessions in two-hour slots, while line shows total time of usage.

As mentioned, the holiday season affected the results, so the analysis over weekdays did not show significant differences. Some of test users estimated that they might have used the service in later hours because of the holiday season.

4.2.5 First week use

It can be reasoned, that while the first week represents time of trying our different functionalities provided by Podracing service, it also represents time of using the service as it is assumed to be. In this view the first week may show, what would be the wishes from the user, whereas the rest of the period shows the use in everyday life. The first week means the first week of each individual test user.

First of all, let's have a look at media format comparison (Table 6).

Table 6. Comparing media formats, first week only (rest if the trial in parenthesis).

|	**Text**	**On-demand**	**Podcasting**	**Loops (est.)**	**Other Podracing use**
Percentage of sessions	24% (29%)	27% (21%)	6% (7%)	45% (35%)	-
Average duration of a session	2'04" (2'02")	3'37" (3'02")	30'37" (12'57")	2'19" (1'56")	-
Average total duration of media consumed	3'19"	6'38"	11'29"	7'01"	44'

There were no significant changes in the proportion of each media format between the first week and the rest of the trial. Downloaded podcast episodes were viewed considerably longer time. The short duration of using on-demand services can be explained by technical difficulties in the beginning.

Prime time during the first week (Figure 21) shows most activity taking place during late afternoon and early evening. This is in contrast to the rest of the trial, in which early morning and late evening were dominating.
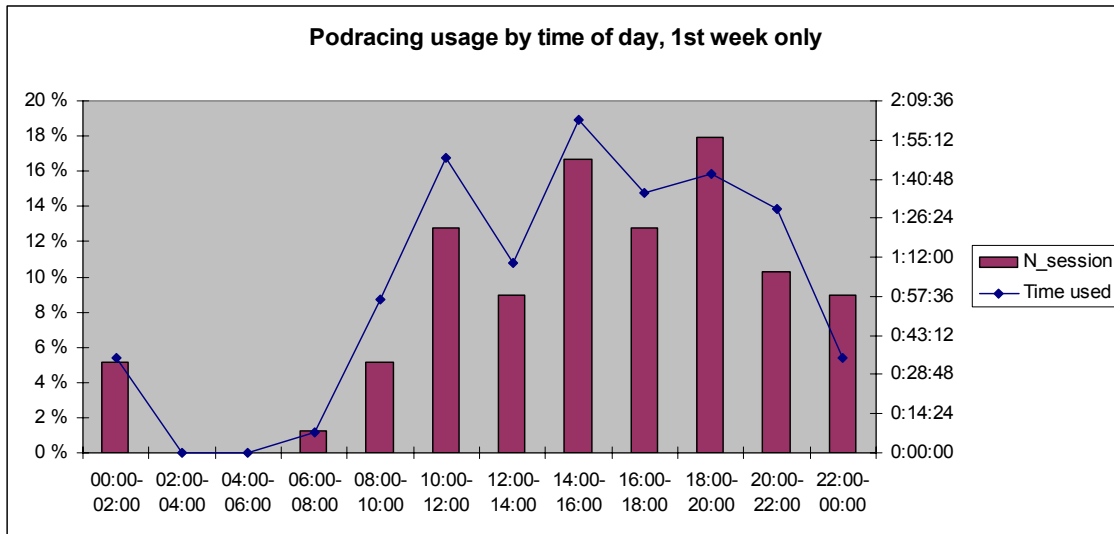
Figure 21. Prime time of Podracing service during the first week.

Other analysis did not show substantial differences in the usage between the first week and the rest of the trial period.

4.3 General findings

Elina Noppari, Virpi Oksman

The idea of Podcasting was liked; it was perceived especially handy during holiday trips.

Podracing was independent from time and place. It allowed users to watch content in privacy according to personal preferences. It also turned out to be convenient during trips. The test users estimated that it increased TV watching in general, as expected.

> *"I liked the Podcasting concept very much. I used it mainly through 3G. But it was very slow. It was very handy during summer holidays, especially during our trips by car. But when I left outside Helsinki it was much slower without 3G networks."* (Woman, 26 years)

Certain challenges were reported, concerning 3G networks, limited battery life and lacks in usability.

Podracing prototype was used over both WLAN and 3G connections. The test users tried to use WLAN in public places as much as possible, but often they had to find out for their disappointment that the mobile phones did not always connect to the WLAN networks when it was supposed to do so. 3G networks had lack of coverage even within cities.

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"Only in Lasipalatsi I was able to connect to [3G] network." (Woman, 51 years)

"In the bus 3G switches to 2G and then become the hiccups." (Man, 27 years)

Battery life was another concern. Most of the test users were satisfied with mobile phone battery life, if they loaded the battery once a day (the test users with N92 and N93), and the use of Podracing and other media services was quite light during the day. Yet, with increased media use, the battery life became obviously a problem (the test users with N95).

"If I forgot to close some programs, I found very soon that the battery was dead. Then if I did not use Podracing at all, I didn't need to do anything for it. Phone itself does not consume the battery too much, but all the other media use discharges it quickly. Let's say that if the battery was full in the morning then, by the end of the afternoon, the battery ran out again. It was enough only for just opening and closing Podracing." (Man, 44 years)

Some users considered navigation cumbersome; it would have been easier to move directly to right or left. There were also a number of popups and confirmation dialogs, which were reported annoying. Some users were accessing downloaded content by accessing them from mobile phone file explorers instead of Podracing service. In this case the file names were not self-evident.

"You have to browse through one page before getting to the next. Of course it was annoying when you have to go sort of round and round. Could not just go to left and right." (Man, 44 years)

"When upgrading to the latest version it began to nag if it can use the information in the phone, it sometimes interrupted the download and began the nag every minute. Had to press buttons all the time." (Woman, 27 years)

"When I was on a train I had to guess, because I was not able to figure out from the series of numbers, which episode was which." (Woman, 35 years)

4.4 Use contexts and times

Elina Noppari

As stated in previous trials of the Podracing project, the usage of mobile services usually occurs in three user areas: home, work and public. These were also the main use environments during the third field trial. People were using the service in many different locations from bathroom to bed. Mobile television was viewed when they were commuting and travelling abroad, as well as in the bar or on the summer holiday. For some users mobile television was clearly a private medium, while others sometimes shared their viewing experiences and the usage had more social elements.

In this third, but also in the second field trial of Podracing project the users were asked to take pictures, when they are using the service. Figure 22 shows a couple of them.
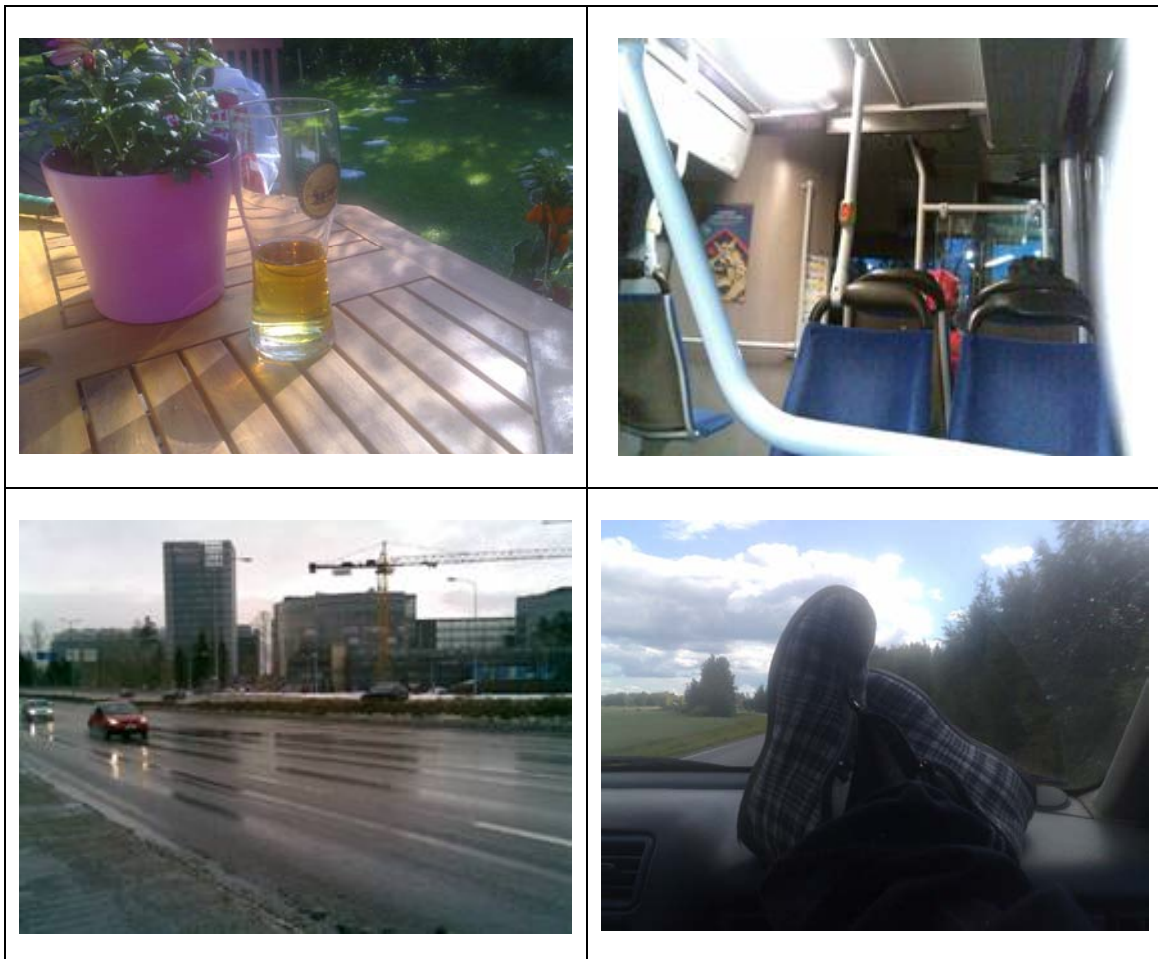

Figure 22. Pictures taken from where the service was used.

"I tested this all the way in Norway. During my one week holiday I watched Elisa [YLE] news recordings. I did not mind one day delay. And then I was sailing and travelling across Finland. The service did not work at the summer cottage, which was annoying. I did like the idea though, that you could like record with this. It is very good when you are travelling – you just have to chase down WLAN spots."

"You are able to watch it any time any place. It is good recreation during long trips and nice playing, what series to watch this time. I usually don't watch much TV. It was possible to watch something at the end of the day at work. It was not so much a social happening, but more like a private thing. Although I also watched it with my friends mainly to show how it works."

"I used Podracing mostly at work. During the nights I left it download programs. Watching series in turn was quite haphazard; I did not do it in any specific time of the day."

"I watched it in different places and downloaded the programs in different places with WLAN. I used WLAN because it was faster. I did not watch all the programs which I downloaded. I did not schedule my watching, but watched randomly some clips."

"I checked out the service with my wife in bed. It was nice."

When asked more closely which content types they preferred in different use environments and situations, test users said that the use of the service was more versatile at home, than it was for example while commuting or travelling. Different content types were tested more often at home than in public area.

To some degree this result may ascribe to 3G network problems and battery endurance. The coverage of 3G was not flawless and interrupted viewing every now and then, also in the city area. The users also had problems with WLAN: mobile phones did not connect to WLAN in many places where the wireless network worked well with portable computers.

"The only time I was able to get wireless connection was in Pärnu, on the beach. Not even once I managed to do that in the city."

Some interviewees stated that loading podcasts consumed the battery, so it was usually done when the telephone was plugged. Usage problems probably channelled the use conventions and it is hard to say how the testers would have used different content types

if the technical limitations had not been there. Some users criticized this emphasizing that battery problems damaged the whole idea of mobile television.

> *"Couple of hours is the maximum. If you are transferring the data, battery endurance is really weak. So in practise you have to keep the phone plugged all the time. So is this television anywhere and anytime, as it is marketed? You have to find the electric wall socket, if you really want to use this."*

However, most interviewees did not seem to mind very much that they had to plan their use beforehand. Although typical mobile use is spontaneous, most users did not consider it inconvenient to subscribe and download podcasts at home for later watching elsewhere.

Four users said that they loaded and viewed podcasts regularly in different locations. Loading was usually done in the evening at home and viewing the content was spontaneous. According to the testers, Nelonen podcasts were the content they used most when they were away from home.

The number of the test users was limited, but it became quite clear, that each and every one of them had their own daily routines and habits, which affected their use of mobile television services. Some quite simple choices, like commuting with a private car or in public transportation, effects the way mobile services are used. People who regularly use public transportation have plenty of empty moments in their day to watch mobile TV, while private car users view mobile television at home, sporadically at work, in special occasions or do not find so much need for it. But interviews showed that mobile television is not solely a public place medium, but is used in many different places in the private area. It is presumable that the use of mobile television will become even more versatile as people get used to the service and absorb it in their everyday routines.

4.5 Podracing contents

Elina Noppari

Podracing concept offered viewers broadcast, podcast and on-demand content. Broadcasting was simulated with news and entertainment loops. There were media formats of audio, video and text, both entertainment and news programs produced by different channels.

As Figure 23 presents, test users found broadcasted news and podcasted entertainment series most interesting. In the figure not only the content, but also the transfer mode and channel brand is present and all these factors effect the interestedness of content to some degree.

This result is similar to some earlier mobile television studies, saying that news is very often the most popular mobile television content, and news viewers prefer to have live feeds. And entertainment again might be popular podcasted or loaded content.
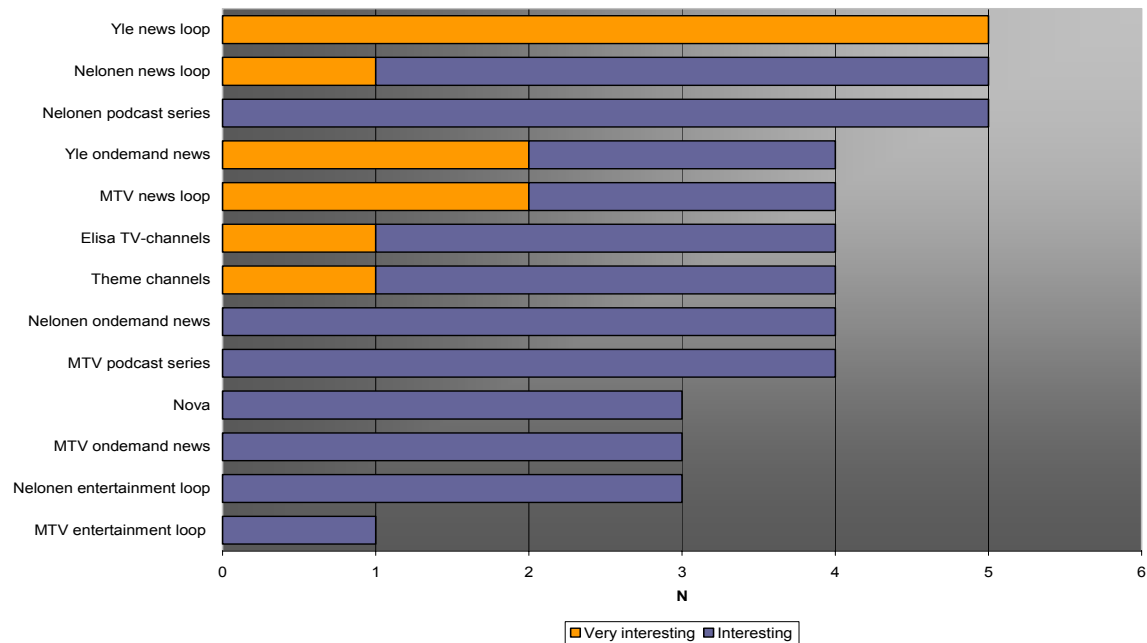
Figure 23. Content types that test users considered interesting or very interesting (N = 11).

As one notices, users did not like entertainment loops as much, saying that they want to see the series from the beginning, even though mobile viewing is often short-term and fragmentary. Some users stated that Finnish entertainment content is too rational for loops: trash entertainment might work better; there is no need to see the whole show. **The irritation of not seeing the beginning of the show can be generalized to apply also to broadcast entertainment in mobile television.**

> *"Loops do not fit into a mobile phone. It is irritating to start viewing in the middle of the program."*

Although the users preferred news loops, podcasted series of Nelonen came off well. Only one user had tested podcasts before the trial. After the trial, all of them considered the possibility of podcasting or subscribing programs as a major addition to a mobile television. It makes the viewing even more flexible.

Most users did not view all the podcasts they have ordered during the field trial. Anyhow, seven of them said that the podcast series of Nelonen were the content they used most during the field test. Actual viewing of podcasts might have been even more active if there weren't problems with battery endurance and loading.

> *"It was really nice to watch the recordings. It was nice to watch them when resting."*

> *"I'm interested in subscribing because TV does not always show programs you want to watch."*

Six users stated that also the channel brand effects on their viewing choices. Above all this came up when talking about news and documentary content. Especially Finnish Broadcasting Company YLE was considered a reliable news brand. Brands were not as important when talking about entertainment. And naturally there were also those who did not mind the brand as much at all. Some users simply chose the brand which was first in the menu.

> *"I'm not any YLE-fan, but if they can do something, it is news."*

> *"I don't care about who produces the news. The entertainment news of MTV and Nelonen could have been in same heap."*

One has to remember, that also actual programs had a strong effect on users opinions. Six of the test users did not find available content for their own preferences. Channel Nelonen was evaluated more interesting as MTV, but this hasn't so much to do with the channel brand, but program supply. The pilot carried only two MTV entertainment programs: a soap opera "Salatut elämät" and cooking program "Ruokala". Nelonen with its various entertainment programs had more to choose.

It is obvious that users do not view regularly a program they do not find interesting. They might do it once or twice for testing purposes and leave it there. It is also presumable that user preferences might have been different in a younger user group. In that case, the entertainment content would probably have been more popular.

The length of the programs limited the use of entertainment content. Most test users considered conventional TV series much too long for mobile viewing. According to them, mobile television programs should be impulsive and short. The desirable length could be 5 to 15 minutes. This result is also very similar to previous mobile television studies saying that average mobile television use lasts less than 10 minutes. Use might last a little longer when a special event is followed on mobile television. Mobile television pilot done during the FIFA World cup showed that majority of testers viewed mobile television 15 to 30 minutes, and there were those whose viewing lasted more than an hour. But also in this trial use time reduced quickly after the event.[1]

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[1] http://www.sofi.unigoettingen.de/index.php?id=584&no_cache=1&tx_drblob_pi1%5BdownloadUid%5D=670.

Since the use situations are often very short, some users valued the text format as the most suitable media type for mobile terminal. It is easy to flick through text headlines and skip over uninteresting topics. Users emphasized that not all the news are interesting and especially in mobile viewing situation it is frustrating to wait the compelling topic.

> *"An opportunity of loading is interesting as such. But the programs were too long. Half-hour long series are too long for mobile devices."*

> *"I was not inspired to view longer series. You suddenly have a tiny moment for viewing, and viewing the series is always interrupted. – I watched short humour pieces on Elisa-TV and news, and I may have put music on at the same time. You have to follow longer series all the time to stay with them. If there had been shorter podcast pieces, I probably would have subscribed them."*

> *"I watched Channel Nelonen, because it was first on the menu. I did not watch the series, because I do not normally watch them and they are too long to be watched in mobile phone."*

Some users hoped for a mobile service, where text news would have been complemented with short video clips, like it is done in several web pages. They also considered news links, offering similar news topics as the original one, as useful.

Test users were also asked about the interactivity of mobile television: do they expect mobile television to be more interactive than conventional television, and if so, what interaction they consider as interesting. Three out of eleven users said they expect mobile television to carry interactive elements. What those elements should be was even more difficult question to answer.

> *"I would definitely expect mobile TV to offer more interactive services than regular TV. For instance buying some theatre tickets. But I would not buy a washing machine through a mobile TV so there should be different options."*

None of testers were interested in chat, where users could discuss about the programs with each others. Three of them stated that they might be interested in user-generated content and even be willing to take part in content production (e.g. sending pictures or videos to the program with mobile television). Four testers said that they would like to give feedback, if only this possibility is implemented in a simple way.

"I don't usually participate anything using my mobile phone. Nor do I participate on chats. I would probably take a picture if I was on the scene, and I would send it to somewhere. The genre could be whatever from news to entertainment. But I wouldn't necessarily watch that kind of a program."

Even though the test users were not so much into an interactive mobile television, their interviews revealed that somehow user's expectations of mobile television have increased. Some users stated that Podracing pilot got positive attention in their circle of friends and still has a certain status of novelty, but the others said that a mobile terminal showing moving picture is no longer exceptional or interesting as such.

The users stated that a mobile television service should be able to give a feeling that a user actually knows and gets more than others. Producing that kind of a real-time service is challenging, especially in present media environment where everything is in internet in the delay of ten minutes. If a person is leaving from home to work and opens up his mobile television in the bus, he expects to find something extra that he wasn't able to get from the newspaper, morning TV show or internet at home.

"(There should be) some new stuff that I could show to my colleagues, hey look what is going on."

Users hoped that a mobile service would match up to their real needs and use situations. Whilst the use of mobile television is usually very spontaneous and low commitment, it seems that some people expect to have niche content even for those short moments of viewing. Just surfing around and viewing meaningless program flow is not necessarily enough. Even one of key motives of mobile television use is killing time people may want to kill boredom with special content, which is just suitable for that moment.

"You have a minute to use the mobile phone. The service must have an answer for that moment."

As people's daily routines and needs are very different, there is a demand for feature rich mobile television with customized elements. Some users stated that they would like to have tailored services and the idea of theme channel got positive attention. In this pilot the theme channel key words were written in advance and they were not adjustable. This naturally cut down the actual use of the channels. However, the concept of theme channel got understood and seven out of eleven users liked the idea.

"I wasn't interested in theme channel key words, otherwise I might have used that. The idea was good. Functional concept, but the content was wrong for me."

"Opinions and preferences change, so you have to be able to change the content, too."

To summarize this up it seems that news are still the most interesting content in mobile television, even though people also appreciate the possibility of subscribing the podcasts. However, conventional entertainment TV shows are considered too long for mobile television. Many people prefer short and even niche content for their brief moments of mobile viewing. Their expectations have increased: many of them hope for customized services, which could give them a feeling that they actually get more than others, thanks to a mobile television.

4.6 Mobile TV use profiles

Elina Noppari

To demonstrate the variety of needs mobile television users may have, we created four user profiles based on the test user interviews. To some degree all the users can be described as early adopters, because they voluntarily took part in this kind of a study and were interested in new technology. However, their motives and preferences were different, as were their every day routines and habits. These profiles are more like ideal types: they are based on real characters, but generalised and blended. These fictional user ideal types authenticate that people have many different expectations for mobile television and all these needs should be taken into account in concept designing.

The profiles are:

A. Independent content seeker

An independent content seeker is a twenty something male, who is commuting with his private car, is socially active, interested in new technology and is a very experienced media consumer. Independent content seeker makes the most of peer to peer networks, his internet use is versatile and he is neither dependent on television program schedules nor the recording devices. He is an individual user, who finds the most content he is interested in, in the internet.

> *"I don't watch so much television, mostly DVDs and loaded internet series. Actually I watch only Formulas as live. I prefer to watch series at my own pace, not when the channel says so. The programs I'm interested in, I find in the internet. I've been using the net so long, I know what you can find there. MTV3 is charging one Euro of Salatut elämät previews, but you can easily reach those episodes in peer to peer networks for free."*

The independent content seeker does not use public transportation, and this affects his mobile television use. Mobile services are often used for killing time when waiting, but this kind of a user does not have so many idle moments in his day. When he is at home or at work, the internet is available, and he does not feel he needs mobile terminal so much for up-dating or leisure. He is a selective user, who does not listen to the radio in his car, but his favourite CDs. His mobile television use does not take place in public sphere, but sporadically at work and at home.

At home he mostly consumes entertainment content and his computer is on 24/7. Sometimes he uses television and internet simultaneously. Time for mobile television comes late at night when an independent content seeker user goes to bed.

> *"I use mobile services regularly at home. Every night before I go to sleep, I flick through news headlines to wear me down. I don't read books in bed, for some reason I have to play with my mobile phone. I don't know why. If I have found a good mobile game, I play before I go to sleep."*

As he is used to get quickly what he wants, his expectations of mobile television are relatively high. He wants it to run smoothly and he is not willing to wait. An independent user might choose the text as a mobile media format, because uninteresting topics are easily skipped over. Because he is a selective television user and arranges special movie nights, he finds regular programs, let alone the films, much too long for mobile television. Formula race kind of an event might be an exception, if there wouldn't be conventional television at hand.

Content seeker is an experienced media consumer and does not mind so much about the brands. He trusts that he is able to interpret and evaluate current content, no matter who has produced it.

> *"I am interested in entertainment and other news. I am a heavy-user of news. I prefer the sites where different news sources are integrated. But I do not care about who produces the news."*

B. Socially orientated user

Socially oriented user is a thirty something female, who often shares her mobile television use experience with other people. Even though mobile terminals are usually considered as private devices, this user likes to show clips of her favourite content to her friends. When she goes visiting her grandmother to the hospital she wants to cheer her up with mobile television.

> *"My friends are still interested in mobile television. It is fun to watch this with friends. I showed this to my 80 year old grandmother, who has senile dementia and who seldom responses to any impulses. She said "Television!". It was a touching moment."*

Occasionally she uses mobile television at home and wants to share this experience with other family members. For this user, mobile television has same kind of characteristics as conventional television. But unlike the normal television, she is able to take the mobile device with her. Viewing situations may occur when she is lying with her husband in bed, side by side.

> *"I was watching this with my significant other. We were in bed and it was nice."*

As mobile television still has some novelty value for her, she often asks her son for tips and counselling. Not only the technical advice, but also hints about interesting programs and content. Mobile television works as a good conversation topic with a teenager. Her son has introduced her to some alternative content, like user generated programs. She even finds it possible to participate in content production – at least if she would get some compensation out of it.

> *"If I were on the scene, I could take a picture and even send it. Especially, if I get some benefit out of it – price reduction for example."*

Sometimes socially active user views mobile television in public places. She does not want to miss a common viewing experience of big, once in the life time events. However, when watching Eurovision song contest in a bar, she was a bit embarrassed. Even though she wants to share her mobile television experiences, she does not want to attract too much attention.

> *"I noticed that when I tried this during the Eurovision song contest, I got some... people had this attitude; is she bragging or what. An adult playing with her telephone..."*

C. Rational time killer

A rational time killer is a forty something male, who uses mobile television quite traditionally when he is commuting or is travelling for business purposes. Mobile phones are often considered as devices used primarily in public area.

Every morning rational time killer takes a bus to work and during his 25 minutes trip to town, he wants to reach fresh and new content. He is also pretty selective. Even though the mobile television is used for killing time, he is not interested in trivial content. He wants a mobile television to give him a feeling that he actually knows more than others. This "knowing more" has a social aspect: he likes his role as a source of information and wants to present new conversation topics to his colleagues when he gets to work.

> *"I'm interested in current topics. This service should give me a feeling that I know more than others. If I get same information from other media, why I should follow this? If I have a mobile terminal and I'm on the move, I'm interested in topics that are relevant in that mobile situation."*

As he expects mobile television to give him something extra he did not get from the morning newspaper or morning TV show, he is interested in customized and personified content. For that reason he values the theme channels in Podracing.

> *"This (mobile phone) is my private thing. Today you expect to have more tailored features. Theme channels with updated keywords would probably have been the service I used most. It was customized. If I have 50 news headlines and I have to hunt for interesting topics. If someone is classifying those for me, I read them. And I'm ready to pay for them."*

Rational time killer does not use his mobile television in private area, and he does not even understand how the device could be used at home. He is not interested in mobile entertainment and uses his mobile television in short sequences.

> *"No one would watch programs on mobile device at home! And if I were hooked on some TV-series, I would record them, instead of watching them on small screen outside of home. I'm too old; I'm not attracted to watch 40 minutes long series on this. This is far too small and the programs are too long."*

Channel brands have some relevance for this user. Even though he seeks also for alternative sources, he thinks that for example Finnish Broadcasting Company YLE is a very reliable news brand. Because he is first and foremost interested in fresh perspectives, he hopes for mobile services where short video clips from different sources are put together with text news. Even though he is a bit traditionalist, he is willing to view and even to produce user-generated content – if only he would witness some newsworthy situations.

Rational time killer is also a bit of a techno freak. He expects the service to make good use of all technical features.

> *"One generation has passed, but the content has not developed as well as the device. The clarity was not as good as the terminal would have enabled. If you think about mobile device with multi media features, you expect the service to be consonant with it."*

D. Entertainment enthusiast

Entertainment enthusiast is a thirty something female, who finds the entertainment most interesting mobile television content. She is hooked on many TV series, and does not want to miss an episode while she does not have a chance to watch conventional television. Even she has recording equipment she finds mobile television more convenient way to stay updated in courses of her favourite shows.

> *"I am not into news. You are usually surrounded by them. I am most interested in series. I could be ready to even pay for previews of my favourite series."*

Especially she likes the possibility of podcasting. Subscribing podcasts makes mobile television even more flexible. She values the TV anytime and anywhere experience.

> *"It was possible to watch whenever you wanted to watch something. You had that chance. And it was possible to watch programs you liked. The idea was great and amplified my television viewing."*

As entertainment enthusiast regularly follows several television series, her life is pretty much in routines. Her week scheme is strongly affected by media, and following it makes her feel secure and gives her the feeling of life control. Because of that she even wants to follow domestic programs when she is abroad. Even though she is not normally into mobile news, any domestic program will do when she is travelling.

> *"I was using this in Norway. It was really great to watch recorded YLE news in Norway! I also tested this in Tallinn. I liked the concept. It was great when you had a summer holiday."*

These four ideal types were based on eleven test user interviews. Because of small number of users, no wide generalizations can be drawn, but even this amount of users embodied several use routines and needs. If there were more test users from different age groups and social classes, the spectrum of user profiles would have been even more diverse.

5. Mobile TV pricing and business models

Jorma Riihikoski

5.1 Mobile TV revenue streams

Mobile broadcasting can generate revenues from three sources, namely from

- customers
- advertising
- broadcast network access fees.

Customer revenues are based on the additional value of mobile TV services. There are several charging mechanisms to be used: A monthly subscription fee is considered the most acceptable according to nearly all pilot market research, but pay-per-view or time-based charging are other options. Mobile broadcasting provides a new distribution channel for TV content, including advertising. Thus, selling air time to advertisers can be considered as an additional income source for broadcasters. [Sattler 2006.]

At this moment in Finland mobile TV audience and markets are so small that the advertising revenue streams don't play any significant role. There are also different ways for revenue:

a) One time revenue which is created when device is sold or bundled to the operator's service.

b) Monthly access fee which is paid with telephone bill.

c) Pay-per-view or time-based charging for other extra options and services which user selects personally. All these revenues will be shared to some extent between all players in mobile TV value chain.

Companies get profit already from some mobile services like mobile votes, ring tones and interactive TV, but the mobile TV's value capture models and roadmaps are still under the construction. One question is if the value is captured from user's payments or from advertisement incomes. One possibility is that it could come from pay-TV package which's one attribute is to have mobile TV in same contract. The investments are going to be at low level because of a) waiting for more clear business model, b) higher equipment penetration c) and better knowledge about what the users really want to watch.

5.2 Mobile TV cost streams

Cost streams are related to

- infrastructure
- content
- device subsidies (possibly), but also
- marketing and sales expenditures.

The largest part of infrastructure costs attains to broadcast network rollout and operation. Mobile broadcast networks are expected to have good indoor coverage, because pilots have shown a high usage even indoors. So coverage and quality of reception are heavy cost drivers. Infrastructure costs also depend on the planed coverage.

The main content costs relate to content creation and provision, the adaptation of content formats to the requirements of mobile reception, but also the acquisition of content rights and licenses. [Sattler 2006.]

5.3 Roles and players of the value chain

In most of the studies on mobile broadcast business models, the following main roles of the value chain have been identified [Sattler 2006]:

- Broadcaster: aggregating content into channels based on a broadcast license if necessary.

- Mobile broadcast service provider: providing the mobile broadcast service based on a platform license if necessary.

- Mobile network operator: operating the mobile network and mobile services.

- Broadcast network operator, operating the broadcast network based on a frequency license.

- Users.

In the most cases the revenue is split between evenly between content provider, mobile operator and broadcast service provider.

Financial design criteria in this context relate to the costs of the network build-out, the revenue sharing agreements, and the business-to-consumer billing formulas.

5.4 Business model

Mobile network operator led model (Figure 24) seems to be quite near the situation in Finnish mobile TV trials.

In the mobile network operator-led model, the mobile network operator handles the role of mobile broadcast service provider, manages the end-relationship with customers and is responsible for service provision, marketing and customer care. For the service, the mobile network operator will need to purchase content from broadcasters and other content providers.
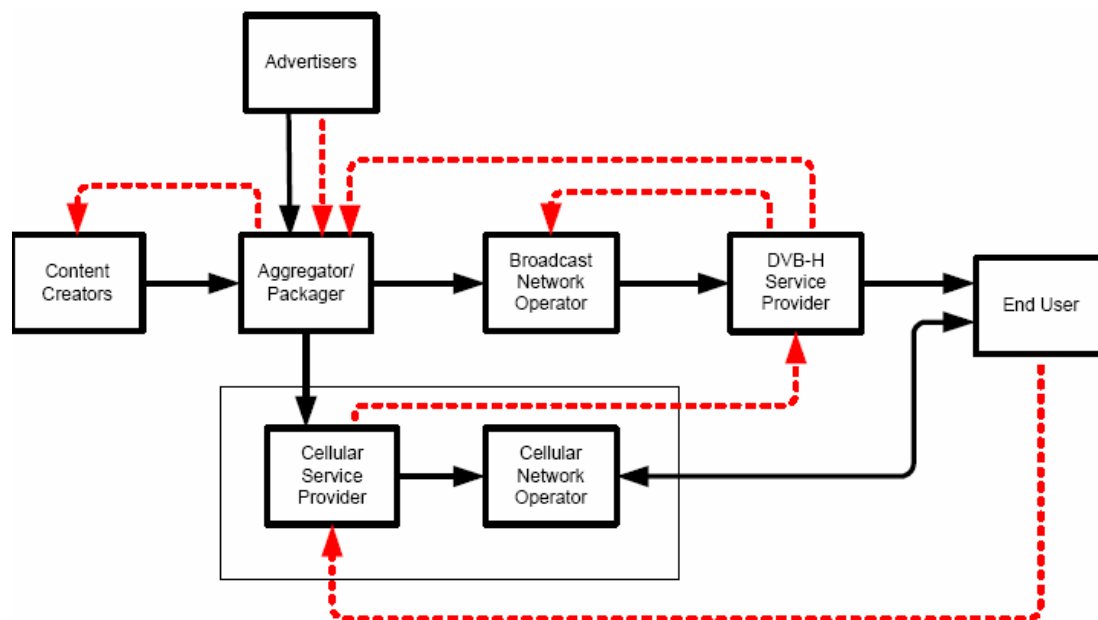

Figure 24. Mobile network operator led model [Sattler 2006].

There are also several decisions to be made by operators, broadcasters and consumers. The following criteria were used to describe the financial design decisions [Braet & Ballon, 2008]:

(a) Cost sharing agreements. This first financial criterion describes how different actors carry the costs of the service rollout. Three cost categories are taken into account. First, the device cost refers to the primary purchase cost of the handsets and to what degree the consumer has to pay the entire cost of the handset, or whether device subsidies are allowed. Second, the network infrastructure costs refer to the cost of building the transmission infrastructure. Third, the content

and application costs refer to which partner carries what part of the content and/or application development cost.

(b) End-user billing. This criterion describes the ways in which the user pays for the services provided. The billing formula will depend on the kinds of product bundles offered, but does not follow directly from that criterion.

(c) Revenue sharing agreements. The last criterion describes the ways in which the service supplier(s) agree on how the revenues generated through end-user billing are distributed throughout the value network, including the broadcasters, other content providers, and the mobile network operators.

Braet and Ballon [2008] also found out that no clear business case can be made before one knows in what ways the collected revenues will be redistributed from the 'customer owner' to the broadcast network operator and the content aggregators. From the little information they obtained during interviews with the executives, it appeared that the broadcast network owner and the customer owner will divide the lion's share of revenues. Content aggregators that do not own spectrum do not build and operate the network or do not have a direct customer relationship, have expressed fears that revenue share agreements may turn out to be suboptimal for them.

5.5 Mobile TV and value added services

This section is based on interviewing mobile TV content and service providers: Teemu Lehtonen / MTV Oy, Marcus Wiklund / SWelcom Oy, Timo Argillander / Digital Media Oy, Jonas Kronlund / Elisa Corporation and Ari Pöyhtäri / Sofia Digital Oy.

5.5.1 Content and content providers

There will be all kinds of possible contents mixed up in Podracing service and it doesn't matter who owns them. That was the original plan when the project started. Aim was also create best possible and useful platform and interface for users (customers).

Content should be available divided to different media formats and brands such as MTV3, Radio Nova or Nelonen. Fundamental aspect is that everybody should be in control for their own media and be able to sell advertisement for their own brand. Example of that is Google news which aggregates services from different providers, which is good for them but is not thought very satisfied model by the service producers. While it may be beneficial from customers, the model for value capturing is prone to become complicated. There should always be an aggregating host who is taking care of

all services and business activities. In this respect the model presented in Podracing, where content is accessed through media brands, could be a successful compromise.

The content providers are key players when we are thinking about different sectors of users and their models for watching the mobile TV. The service could be also produced only by one media company in co-operation with the operator. Relevant question is that if Podracing is very wide national service it could take long time to get it together and meanwhile there could be other technologies like IPTV where people could customize their own media- and web-services by RSS-feeds. Getting together services and contents from different content providers and selling them to right user segments may turn out to be a very hard task for company which is acting as an aggregator. So it is easier to come to the conclusion that services are in future produced by companies or their brands and not collected as wider spectrum service. It is possible that users in the future can filter their contents through web's search pages.

Media companies' portfolios are today already in internet. Their usability and commission gives the roadmap for future development. There are also services in IPTV which are very near mobile TV business and benefiting of mobile connections. For example UK satellite TV company BSkyB is taking a clear benefit of broadband by complementing the satellite service with IP based TV transmissions:

- Currently their broadband service availability covers 70% of UK households as a part of premium service package BSkyB provides consumers DVR-set-top-boxes.

- The storage of these DVR devices is divided in two: one half for consumers' own recordings, the other half for push-vod-content (push-vod: operator decides which content is transmitted to DVRs, consumers can choose from this offering what to watch).

- BSkyB service allows consumers also to program their DVRs remotely with a mobile phone.

- In addition to broadband service, BSkyB is "not currently looking out for being a mobile operator" [Justin Fielder, BSkyB].

[Report from IBC 2007
http://www.digitalmedia.fi/main.site?action=news/view&id=34&ngid=2.]

Still several major questions remain unsolved: Are the operator's content portals the places where customers start to seek the service contents they prefer or are they willing to go straight to the origins of the contents which means in this case the content providers and broadcasters portfolios or portals? Which is the menu that customers use to order the services for their mobile phones? It is also often the question of promoting, marketing and training the customers to use the portal and services. Customers want to

choose the services from the menu, but there always have to be someone who is able to create this supply. In many cases supplier is content provider or broadcaster. It could also be the operators. But it raises the question why operators, because the broadcasters could have direct relationship with customers. On the other hand, the operator is billing the mobile users and they have direct customer relationship with the operator.

5.5.2 Business models and value added services created for users

The most popular services at Mobile TV at that moment are text news, videos and simulated broadcasting. These services must offer so much added value that the price level to pay is lowered and at the same time one must keep the promise given to customers. Consumers are eager to pay just for the exact services that they feel will suit them. The level to pay for whole portal is high, because the average watching time is short. One solution might be a package agreement with the customer so that he gets more services and that the ones he is interested in are included in the package.

One business model is so called 360 degree model which includes broadcast, radio, net TV, mobile broadcast as a cross media. The mobile services are not spearhead services when launching the business. In this model all players work in co-operation. Mobile services are an extra business which gives added value to the users while they are related to the mainstream services already available. The key idea is to provide the same services to the different media so that they support each other. Individual mobile content creates added value to the other existing media services. That way the product is more planned and linked to the services in other medias. The model is built around the traditional linear TV. Most popular shows will be popular also in mobile TV and web-tv. The main channels should be included to attract the majority of potential users, but there is also long tail thinking that opens mobile TV markets for different subcultures. What is available in the web is sooner or later usable also in mobile phones. Interactivities are going to be personified services and multimedia experience with radio channel (+audio information about music) with simulcasted broadcast.

Another model is to keep the brands independent and choose suitable contents for the right audience and sell ads to enhance revenue. Part of these contents are free and other part are payable. That is model for straight business wise thinking. Operator have no role in this model all the income is coming in from advertisement and pay-TV from niche services which give exact added value to user. Though this model requires limitless data transfer agreement with operator.

Gaining income from advertisement is very questionable solution especially concerning bulk advertisement. There are going to be some other ways to produce income such as

pay-TV channels. It seems that the end users of the services have to pay in future otherwise the schema doesn't work. Capturing the value through advertisement income seems not to be enough to make Mobile TV activities in Finland profitable.

At this moment the role of Mobile TV is very small in business. The turnover is a very small proportion of the revenue if compared to the one from web services. However development in this sector is encouraging. Mobile internet is coming on strong in future. What will be the new medias for using mobile web is to be seen. Short video material is going to increase. Content for mobiles is multimedia: news, messages search services and moving pics (short cuts). Customers definitely are attracted to live happenings as Formula racing and other sport events. Longer movie cuts which are watched from phone's HD in special occasions as during travel will be common. Even now people use PSP consoles in planes and trains to play and watch movies.

Social media is already in web and in that way those contents like FaceBook will be available in mobile phones. They are also free to use. Mobile versions for these applications are under construction. Mobile is no distant island, but is part of the systems that are used to share services in different media, such as computers, game consoles, laptops and TV sets. The real challenge for media companies is to create compact mobile TV service aggregate for users. Media companies might try to create new shorter mixes from their TV and internet services for mobile phones, which will suit better mobile TV and its user's needs and habits. Fitting example of this is Formula One highlight news mixes specially made for mobile TV and music videos. The step to make content which is only aimed for mobile TV use is very high. Media companies already make Web-only Content and it seems logical that this development will reach the mobile TV in future. The border between Mobile TV and Internet is slowly disappearing which makes only mobile TV aimed content production problematic.

Mobisodes *[Short cuts]* and highlights from news and different series are probably the most wanted content in mobile TV. Channels collect and recommend their TV-favourites this way to the user. Chatting, playing and voting are part of interactive TV. Mobile phone is the best device for that, because it is more personified than TV. Social media in mobile TV as a format might be the other favourite. Market is too insignificant in Finland for large scale mobile TV business and it is not going be real profitable business in few years time. But it is definitely going to follow the stronger and faster development happening in larger international markets.

5.6 Results of field test: Mobile TV and value added services

The test users were asked about their willingness to buy different kind of mobile TV services and products. The field test users were most eager to watch live happenings like concerts as Figure 25 presents.
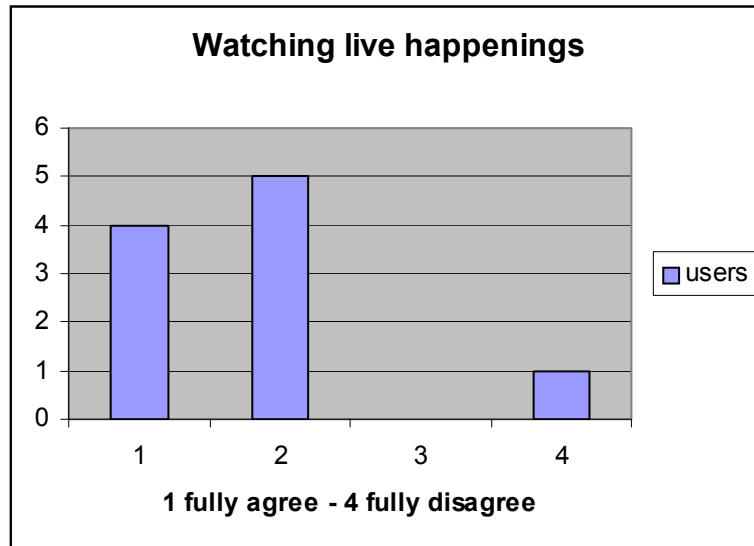
Watching live happenings

Figure 25. Users were interested in watching live happenings.

Nine users out on ten agreed on that issue. Test users were also willing to buy episodes of old favourite series or collections of them from some kind retro-TV shop as Figure 26 shows.
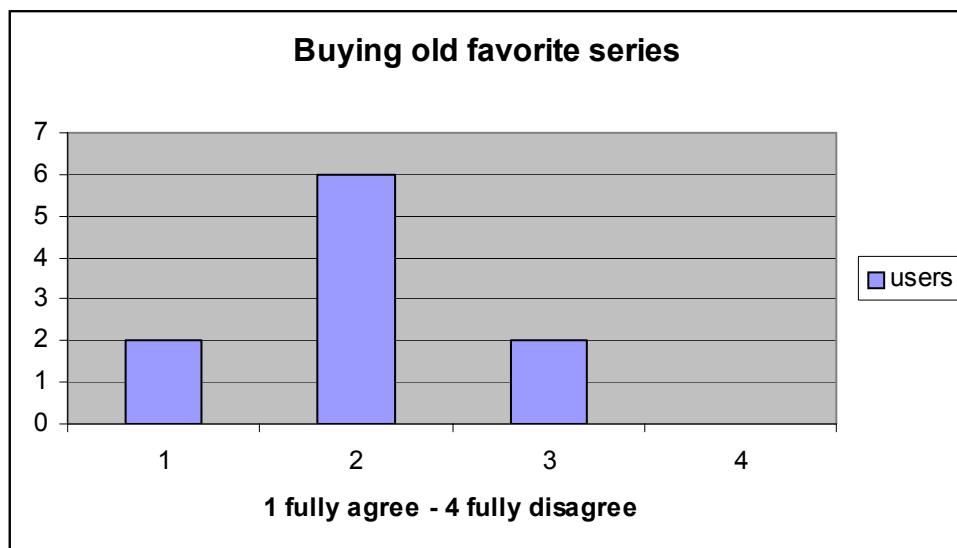
Buying old favorite series

Figure 26. Users were interested in retro-TV shop.

Buying and watching movies were not so popular, as Figure 27 demonstrates: only three users out of ten showed interest in it. It seemed that size of the mobile screen and the longer length of the movies prevented the watching.
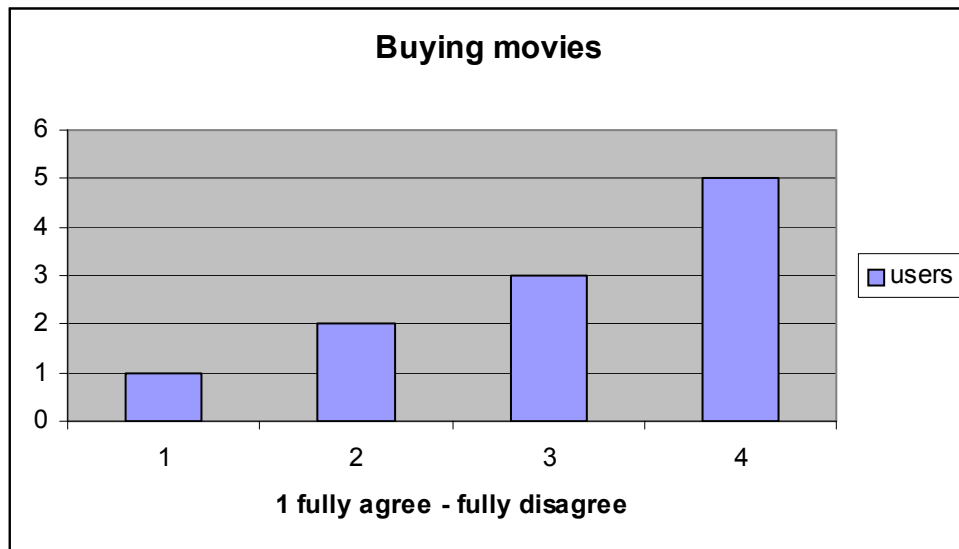

Figure 27. Users were not interested in buying movies.

Test users were not so interested buying TV series supplementary products like DVD-boxes with mobile devices, but they were more interested in buying supplementary services like ringtones etc. which have connections to TV series. Half of the test users were ready to subscribe or podcast the unseen episodes of TV series beforehand and paying extra for that.

5.7 Results of field tests: Mobile TV pricing models

Test users preferred paying for mobile TV with the operator's bill. It was also asked if users would like the pay with different bill, but only two test users agreed on that issue and eight wanted to pay for the mobile TV with operator's mobile phone bill.

Most users thought that best principle for pricing is to have fixed package price for one month (Figure 28).
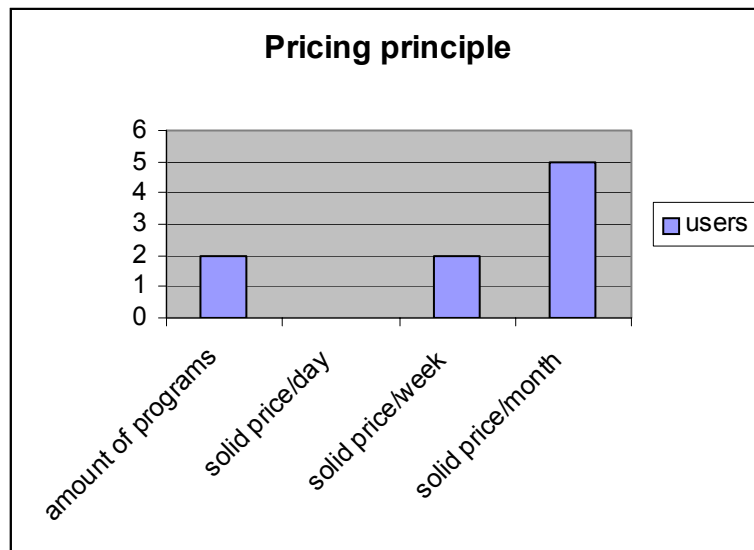
Figure 28. Fixed price per month was the most acceptable pricing model.

Table 7 present test users answers to the questions how much they were willing to pay for mobile TV content.

Table 7. Willingness to pay for different content types.

Content	Average price € per program or episode	Minimum/maximum €
Live happenings like concerts	3.45	1/5
Unseen episodes of TV series	1.05	0/3
Episodes of old favourite TV-series	0.95	0/3
Movies	1.2	0/3,5
Documents	1.45	0/5
News and reports	0.6 per day 4.7 per month	0/1 0/10

Some of the users compared the price of the concert and movie to the price of a ticket. Result was that highest price they were willing to pay was about 10–20% of the ticket price. Some of the users were not willing to pay anything for the mobile TV products or services.

Most of the test users would like to have mobile package which includes mobile TV services for certain amount of money as Figure 29 shows.
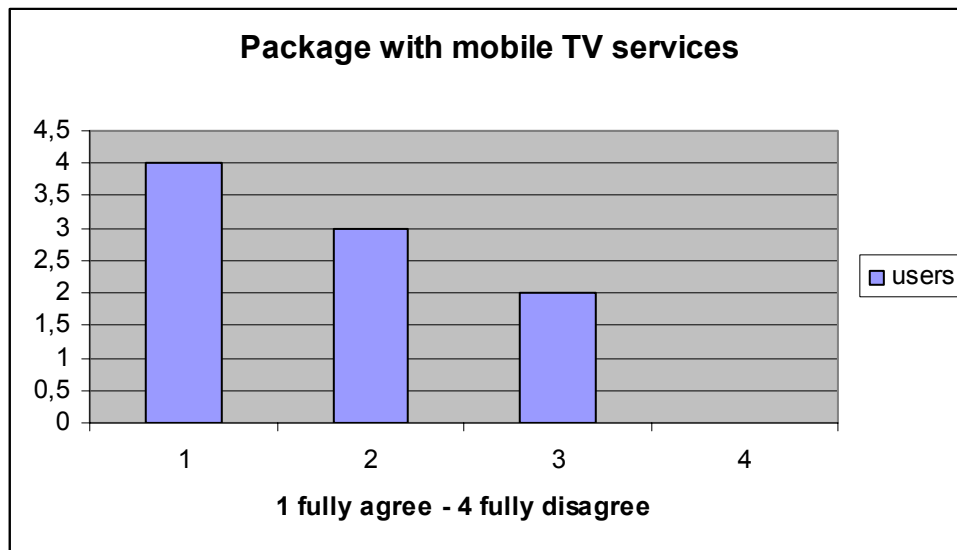
Package with mobile TV services

Figure 29. Mobile TV packages were preferred.

Test users were also asked the open question what would be suitable contents to be tailored for the mobile TV. Presented as an open question, answering turned out to be difficult, but following contents and services were mentioned:

- music and videos
- snowboarding for the kids
- news and weathercasts
- sports
- news and reports (economy and stock markets)
- series podcasted so that you can start in same spot where you stopped earlier (pause-button)
- short news during daytime collected from different broadcasters (max. 15 minutes).

6. Conclusions

Ville Ollikainen, Elina Noppari, Esa Reunanen, Jorma Riihikoski

The aim of Podracing project was to *compare* three different media formats (text, audio and video), and three delivery methods (broadcast, unicast and pre-download) from end user's perspective.

In field trials there were no winners and no losers: Although the number of participants in the trials was limited, mobile terminals were used in such a variety of situations that no single media format and no delivery method was able to fulfil all needs. When interviewed, the users presented a wish that a mobile service, such as mobile television, should match up to their real needs and use situations. Whilst the use of mobile television is usually spontaneous, it seems that some people expect to have niche content even for those short moments of viewing.

Podracing had a unified user interface for all content and all delivery methods. The users appreciated having similar logic in user interface. Furthermore, it was presented that right content should be found within 30 seconds from launching the service. Keeping in mind that a media brand is important, the model presented in Podracing could be a successful compromise: the content was accessed through selecting media brand first.

Previous studies suggested that mobile television involves low commitment. This was contrary to the findings of Podracing: The users did not usually do anything else while watching. Furthermore, just surfing around or viewing an arbitrary program flow seems not be enough. Even though one of key motives of mobile television use is to kill time, people may want to kill boredom with special content, which is just suitable for that moment.

Just as mobile television, the Podracing service was not solely a public place medium. It was used in many different places in the private area. It is presumable that the use of mobile television will become even more versatile as people get used to the service and absorb it into their everyday routines, thus increasing the complexity required.

Recent mobile television development has been focusing on broadcast. Mobile user does not choose time to watch television. In Podracing, broadcast was emulated using programme loops. Users did not like entertainment loops, saying that they want to see the series from the beginning, even though mobile viewing is often short-term and fragmentary. Some users also stated that Finnish entertainment content is too rational for loops: trash entertainment might work better, as there is no need to see the whole

show. The irritation of not seeing the beginning of the show can be expected to apply also to broadcast entertainment in mobile television in general.

Another trend has been to include video playback capabilities to MP3 devices, mobile phones and even GPS navigators. Although typical mobile use is spontaneous, most users did not consider it inconvenient to subscribe and download podcasts at home for later watching. This lacks real time effect, which is not as important for entertainment.

Although mobile streaming could be advantageous over both broadcasting and podcasting, it suffered from gaps in coverage and from reduced technical quality. It is also a widely accepted opinion that mobile networks can not cope with increasing amount of users accessing to streaming media at the same time.

Text and streaming video got almost equal amount of usage. Some users hoped for a mobile service, where text news would have been complemented with short video clips, like it is done in several web pages. In news services they also appreciated recommendation links to similar news articles.

From business point of view, one prominent business model is so called 360 degree model which includes broadcast, radio, net TV, mobile broadcast as a cross media.

Test users preferred paying for mobile TV with the operator's bill. It was also asked if users would like the pay with different bill, but only two test users agreed on that issue and eight wanted to pay for the mobile TV with operator's mobile phone bill. Most users thought that best principle for pricing is to have fixed package price for one month.

Even though the testers were not so much into an interactive mobile television, their interviews revealed that somehow user's expectations of mobile television have increased. Some users stated that Podracing pilot got positive attention in their circle of friends and still has a certain status of novelty, but the others said that a mobile terminal showing moving picture is no longer exceptional or interesting as such.

The preferences and motives of different users were different, as were their every day routines and habits. It was possible to create four user ideal types: independent content seeker, socially oriented user, rational time killer and entertainment enthusiast. Because of small number of test users, no wide generalizations can be drawn, but even this amount of users embodied several use routines and needs. If there were more test users from different age groups and social classes, the spectrum of user profiles would have been even more diverse.

Acknowledgements

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Appendix A: End user questionnaire

1. Arvioi Podracingin helppokäyttöisyyttä ja käyttömukavuutta seuraavien väittämien valossa.

Ympyröi numero, joka vastaa lähinnä sopivaa vaihtoehtoa:	Täysin samaa mieltä	Jokseenkin samaa mieltä	Ei samaa eikä eri mieltä	Jokseen-kin eri mieltä	Täysin eri mieltä	*Kommentoi halutessasi:*
Podracingin löytäminen puhelimesta oli helppoa.	1	2	3	4	5	_____
Podracing oli helppo avata.	1	2	3	4	5	_____
Opin nopeasti käyttämään Podracingia.	1	2	3	4	5	_____
Navigoiminen Podracingissa oli helppoa.	1	2	3	4	5	_____
Teemakanavien käyttäminen oli helppoa.	1	2	3	4	5	_____
Podcasting- ja ondemand-palvelun käyttö oli minulle helppoa.	1	2	3	4	5	_____
Broadcast-kanavien käyttö oli helppoa.	1	2	3	4	4	_____
Podracingin käyttö oli nopeaa.	1	2	3	4	5	_____
Pystyin itse ratkomaan Podracingissa esiintyneet käyttöongelmat.	1	2	3	4	5	_____
Tekniset ongelmat häiritsivät käyttöä.	1	2	3	4	5	_____
Podracingissa oli tarpeeksi kiinnostavaa sisältöä.	1	2	3	4	5	_____

2. Kerro käyttökokemuksesi pohjalta kolme hyvää asiaa Podracing-palvelusta.

1. _____
2. _____
3. _____

3. Kerro käyttökokemuksesi pohjalta kolme huonoa asiaa Podracing-palvelusta. Oliko sinulla käyttöön liittyviä ongelmia?

1. _____
2. _____
3. _____

4. Missä paikoissa ja tilanteissa useimmin käytit Podracing-palvelun eri osioita?

Kerro myös vuorokauden aika, sisältötyyppi ja käytön kesto.
Muistele käyttöaikoja ja tilanteita.

Ympyröi numero, joka vastaa lähinnä sopivaa vaihtoehtoa:	Logi:	Kotona	Töissä	Harrastuksissa	Liikennevälineissä	Matkalla	Mökillä	Muualla, missä? _____	1. Miksi valitsit ko. tilanteessa kyseisen brändin/palvelumuodon? 2. Mitä sisältöjä silloin kuuntelit/luit/katsoit?
Nelonen entertainment loop		1	2	3	4	5	6	7	_____
Nelonen news loop		1	2	3	4	5	6	7	_____
MTV entertainment loop		1	2	3	4	5	6	7	_____
MTV news loop		1	2	3	4	5	6	7	_____
Yle news loop		1	2	3	4	5	6	7	_____
Elisa TV channels		1	2	3	4	5	6	7	_____
Nelonen podcasting sarjat		1	2	3	4	5	6	7	_____
Nelonen podcasting uutiset		1	2	3	4	5	6	7	_____
MTV podcasting sarjat		1	2	3	4	5	6	7	_____
MTV podcasting uutiset		1	2	3	4	5	6	7	_____
Nelonen ondemand sarja		1	2	3	4	5	6	7	_____
Nelonen ondemand uutiset		1	2	3	4	5	6	7	_____
MTV ondemand sarja		1	2	3	4	5	6	7	_____
MTV ondemand uutiset		1	2	3	4	5	6	7	_____
Nova ondemand puheohjelmat		1	2	3	4	5	6	7	_____
Yle ondemand uutiset		1	2	3	4	5	6	7	_____
Teemakanavat		1	2	3	4	5	6	7	_____

A2

5. Mobiili-tv, sosiaalisuus ja interaktiivisuus

Ympyröi numero, joka vastaa lähinnä sopivaa vaihtoehtoa:	Täysin samaa mieltä	Jokseenkin samaa mieltä	Jokseenkin eri mieltä	Ei lainkaan samaa mieltä	En osaa sanoa	Perustele miksi?
Mobiili-tv:n katsomista julkisella paikalla pidetään brassailemisena.	1	2	3	4	5	_____
Mobiili-tv:tä on hauska katsoa kavereiden/perheen kanssa.	1	2	3	4	5	_____
Mobiili-tv:stä voin katsoa ohjelmia omassa rauhassani keskittyen kotioloissa.	1	2	3	4	5	_____
Mobiili-tv:n katsominen on minulle sosiaalista toimintaa.	1	2	3	4	5	_____
Kuluttaisin mobiili-tv:n katsomiseen enemmän kuin 20 min vuorokaudessa.	1	2	3	4	5	_____
Paras mobiili-tv:n katsomisaika on iltapäivällä esim. kotimatkalla töistä.	1	2	3	4	5	_____
Odotan mobiili-tv-palvelujen olevan interaktiivisempia kuin tavallisten TV-ohjelmien.	1	2	3	4	5	_____
Haluaisin keskustella tv-ohjelmista kännykällä muiden kanssa chat-tyylisesti.	1	2	3	4	5	_____
Haluaisin mobiili-tv:n kautta osallistua interaktiivisesti ohjelman tuottamiseen (esim. lähettämällä kuvia/videoita ohjelmaan).	1	2	3	4	5	_____
Haluaisin antaa mobiili-tv:n kautta palautetta ohjelmista.	1	2	3	4	5	_____

A3

Appendix B: Business studies questionnary

Mikä olisi mielestäsi paras laskutusmuoto:

1. Puhelinlaskun yhteydessä
2. Erillinen laskutus

Mikä olisi paras hinnoitteluperiaate

1. Katseltujen ohjelmien määrän mukaan
2. Pakettihinta €/pv
3. Pakettihinta €/vk
4. Pakettihinta €/kk

Olisin valmis maksamaan mobiili-tv:n kautta nähtävistä live-tapahtumista (esim. konserteista, urheilukilpailuista) _____ euroa/tapahtuma.

Olisin valmis maksamaan mobiili-tv:n kautta tilattavista sarjojen ennakkojaksoista _____ euroa/jakso.

Olisin valmis maksamaan mobiili-tv:n kautta tilattavista vanhojen suosikkisarjojen (esim. Kummeli, Pulttibois jne.) jaksoista _____ euroa/jakso.

Olisin valmis maksamaan mobiili-tv:llä katsottavista elokuvista lisähintaa ____ €/kpl.

Olisin valmis maksamaan dokumenttiohjelmista _____ euroa/ohjelma.

Olisin valmis maksamaan uutis- ja ajankohtaisohjelmista _____ €/vrk tai ____€/kk.

Minkälaiset sisällöt olisivat sopivia räätälöitäviksi erikseen vain mobiili-tv:tä varten:

_____

Author(s)
Ollikainen, Ville (Ed.)

Title
Mobile TV should be more than a television
The final report of Podracing project

Abstract

This publication contains the results of the project "Intuitive and parallel media service platform to 3G, podcasting, and DVB-H" (Podracing). The aim of the project was to *compare* three different media formats (text, audio and video), and three delivery methods (broadcast, unicast and pre-download) from end user's perspective.

The primary study question was formulated as following: If a user had the possibility to watch the latest television news from the mobile phone, or listen to the news on the radio, or read text news with the mobile, what would he or she choose?

As a result, mobile terminals were used in such a variety of situations that no single media format and no delivery method was able to fulfil all needs.

Previous studies suggested that mobile television involves low commitment. This was contrary to the findings of Podracing: The users did not usually do anything else while watching. Furthermore, just surfing around or viewing an arbitrary program flow seems not be enough. Even though one of key motives of mobile television use is to kill time, people may want to kill boredom with special content, which is just suitable for that moment.

Watching television on a small screen has been possible for decades, as already in 1960's portable televisions became available for consumers. Until these days, however, the delivery technology as well as content and programme schedules have been targeted to normal television, not at all for mobile use. More recent mobile TV technologies have potential to enable true mobile television services.

This publication contains the results of the project "Intuitive and parallel media service platform to 3G, podcasting, and DVBH" (Podracing). The two year project was funded by Tekes – the Finnish Funding Agency for Technology and Innovation, VTT Technical Research Centre of Finland and several companies. The aim of the project was to compare three different media formats (text, audio and video), and three delivery methods (broadcast, unicast and predownload) from end user's perspective.

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