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Working Paper 02/2010
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Context Adoption in Mobile TV –
New Ways to Increase Customer Acceptance

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Abstract

Studies about Mobile TV show that this way of television generally meets with user interest. Disagreement about technical standards, discrepancies between the actors in the mobile TV sector and little user acceptance about the concrete Mobile TV offering are reasons for the failure of Mobile TV in Germany. This paper presents a concept which addresses the requirements of the relevant Mobile TV actors and uses context adoption to provide TV contents according to user needs.

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List of Abbreviations

BDSG	Bundesdatenschutzgesetz
DAB	Digital Audio Broadcasting
DMB	Digital Multimedia Broadcasting
DVB-H	Digital Video Broadcasting - Handhelds
DVB-T	Digital Video Broadcasting - Terrestrial
DXB	Digital Extended Broadcasting
eDAB	Enhanced Digital Audio Broadcasting
eDMB	Enhanced Digital Multimedia Broadcasting
EPG	Electronic Program Guide
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
HSDPA	High Speed Downlink Packet Access
IP	Internet Protocol
J2ME	Java 2 Micro Edition
JSR	Java Specification Request
MBMS	Multimedia Broadcast Multicast Service
PTM	Point to multipoint
TV	Television
UMTS	Universal Mobile Telecommunications System
VoD	Video on Demand
WiMax	Worldwide Interoperability for Microwave Access
WLAN	Wireless Local Area network
XML	Extensible Markup Language

1 Introduction

Various technologies have been developed for TV-content reception on mobile end devices (e.g. DVB-H and DMB). These are specially aimed at mobile use and promise mobile television consumption at speeds up to 150km/h (Byun, Bae & Kim, 2006, p. 215).

First studies into the acceptance and usage behaviour of mobile television users show that watching TV on mobile phones generally meets with user interest (Hanekop, 2007, p. 17). However, the reasons for mobile use, as well as usage situations and sequences differ very much from stationary TV use. Mobile TV is mainly used to bridge waiting times, and special emphasis is laid on up to date information. Therefore the use of mobile television is mainly restricted to short and spontaneous situations (Orgad, 2006, p.9f.). Consequently the classic television format with its sequential function, non-individualised time structure and comparatively long broadcasting formats is in conflict with short and spontaneous use (Hanekop, 2007, p. 29f.).

Nowadays, even traditional TV programs make it possible to take certain programs out of the linear course of broadcasting by making them available via the Internet on an IP-basis (Wilde & Hess, 2008). A delinearization of TV programs may therefore be expected. This kind of TV programs can in principle also be transmitted to mobile end devices.

As the commercialization of Mobile TV is still in its beginnings and commercial success strongly depends on user acceptance, usage situations of possible clients should be taken into consideration (InternetWorld, 2006; Hartz, 2006; Wilkens, 2006).

No Mobile TV system could establish itself in the German market so far due to a number of acceptance problems. This is the background for the personalization concept presented here. It aims at reducing the conflict mentioned and at enabling users to adapt the content of mass media to their personal preferences. The opportunities of this concept as well as its potential limitations will be presented.

Section 2 deals with technologies and previous Mobile TV applications. Demands towards Mobile TV applications will be discussed in section 3, whereas section 4 deals with the professional and technical organisation of the Mobile TV concept. The paper will be finalized by a discussion on the limits of the concept and a summary.

2 State of the Art

The idea of watching television while "on the move" did not develop just recently. It goes back to Sir Clive Sinclair in the 1960ies. In 1982 Sony undertook first steps to introduce a "pocket-television" (sold under the brand name "Watchman") ready for mass production (Funkschau, 1982, p. 16). These first attempts were unsuccessful due to technical weaknesses (image quality, battery life span), devices were not compact enough and thus unsuitable for mobile use (Günthör, 2008). Since then, there have been ground-breaking technical developments in the area of end devices and in broadcasting and mobile radio technologies which have turned the vision of watching TV on the move into reality.

The mobile-network-provider Debitel and „Mobiles Fernsehen Deutschland GmbH" (Mobile Television Germany Limited) already offered Mobile TV for the Soccer World Championship, under the name of "watcha". This special end device enabled the reception of four different programs in five major cities. Unlike the successful Digital Multimedia Broadcasting (DMB)-offer in South-Korea, this offer failed in Germany and was abandoned in May 2008. Surely, the business model was a reason for this failure (in Germany there was a user fee of 10-15 Euros per month, whereas the offer in South Korea was for free).

In the meantime, MFD has established a consortium together with the publishing houses Holtzbrinck and Burda. It is called "Mobile 3.0", and MFD was awarded a contract for DVB-H (Opitz & Hansen, 2008). There were several delays due to repeated disputes between private and public television stations about channel assignments until the end of the year. Only nine of the originally planned sixteen channels were available at the beginning. For a long time the launching at the occasion of the Euro Cup 2008 was jeopardized. During this "Soft-Launch", phase, many viewers were not able to receive DVB-H, as suitable end devices were not available on the market and suitable distributive channels were also missing. The media even talks about a "Mobile-TV-stillbirth" (Stöcker, 2008), because no end devices are on the market and some TV-channels (for example RTL, VOX, SAT.1) refuse to provide their program via DVB-H for free. Furthermore, the offer could only be used in a few cities. Another obstacle is the fact that mobile phones are mainly sold by network operators and that these barely give DVB-H television a chance as it is (Stöcker, 2008). Furthermore, the Mobile 3.0 consortium is asked to give back its DVB-H licenses and it is likely that investors will back out of this consortium (Heise, 2008).

Meanwhile, network operators and resellers offer end devices for the widespread DVB-T-standard where no further costs need to be considered. By now, nearly all mobile phone providers offer TV-content based on mobile radio technologies (e.g. t-zones by T-Mobile, O2 mobile and Vodafone mobile). The content is transmitted via streaming and downloading. UMTS is used exclusively during Streaming (for example of live-content or videos), whereas downloading can be carried out via GSM or GPRS (Roth, 2005, p. 387).

When using TV-services based on mobile radio, one has to bear in mind that in addition to possible user fees, data transmission fees for UMTS, GPRS or GSM have to be paid directly to the mobile network operator. Furthermore, the image quality of TV content is significantly lower in the case of streaming, as when using DMB, DVB-H or DVB-T (Opitz & Han-sen, 2008). A graphic classification of all broadcasting technologies presented is shown in Figure 1.

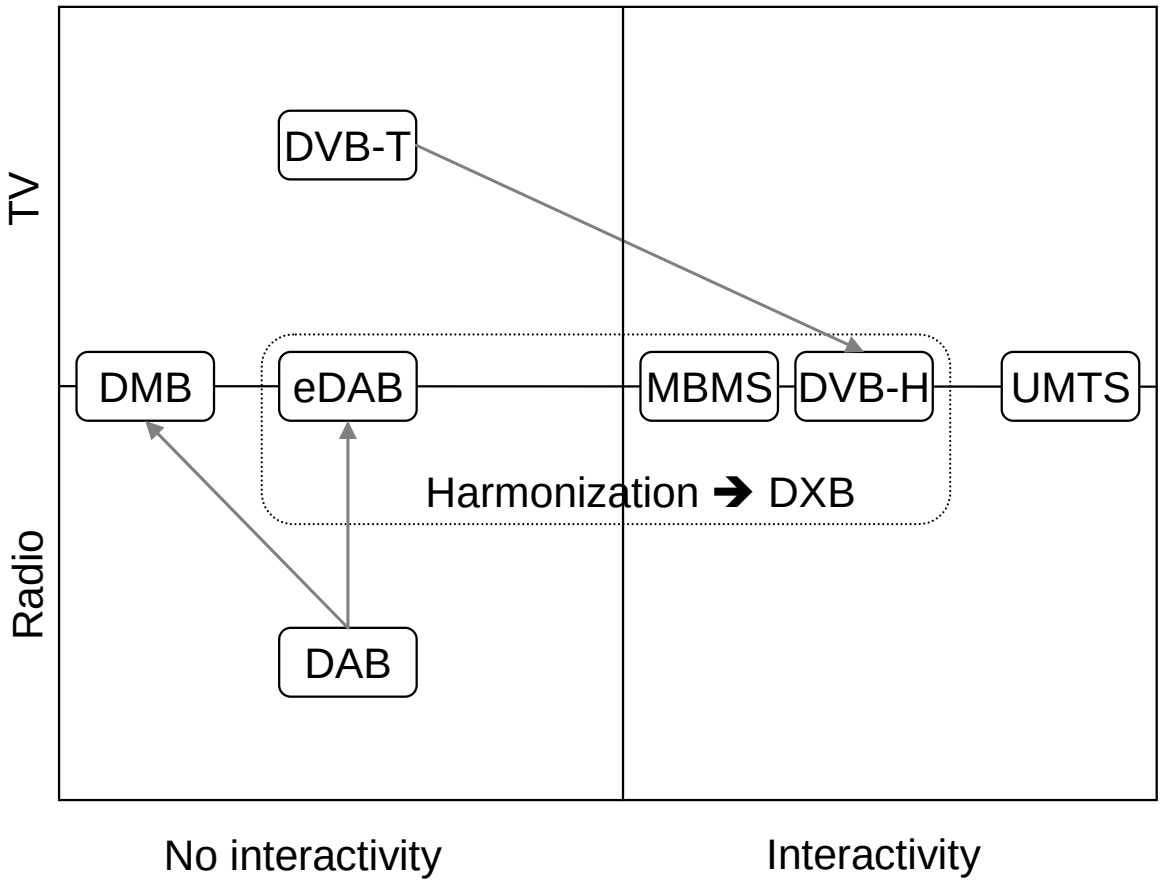

Figure 1: Overview of Mobile TV transmission technologies[1]

[1] The arrows show the direction of development (for example: it can be seen that eDAB is based on DAB).

3 Usage Situations and Demands towards Mobile TV Appliances

This section deals with usage situations and demands made by the three actors involved (user, mobile phone providers and producers of end devices) of mobile-TV use.

3.1 Usage Situations and Implications of Mobile TV use

In order to examine the situations in which the use of Mobile TV is profitable for the user, various user studies will be consulted (DMB-user study in context of the research project “mifriends” of the Bavarian Federal State Centre for new media in Munich; DVB-H user study in Helsinki and Berlin of Nokia) (Hanekop, 2007). The five most important usage situations according to the most recent survey (mifriends study) are presented in Figure 2. According to this, Mobile TV is interesting to customers (1) while using public transport, (2) at the bus or train station, (3) to bridge extended waiting times, (4) to inform during leisure time and (5) to watch TV at home.

		Frequency of usage	Spontaneity of usage	Duration of usage
(1) While using public transport	Mobile TV was most frequently used on buses and trains to bridge waiting times during transport. The usage duration depends, among other factors, on the travel time and typically lasts between one and 25 minutes. Mobile TV may replace or complement reading the morning newspaper on the way (Hanekop 2007, p. 30). Most users do not aim at bridging waiting time by random content but look for specific topics, e.g. news.	very often	spontaneous but sheduled also	1 to 25 min.
(2) At the bus or train station	Mobile TV may also be used to bridge time spent waiting for buses or trains (Orgad 2006, p. 10; Hanekop 2007, p. 54ff.). Waiting times may occur very suddenly and surprisingly, e.g. when it comes to delays. The viewing time is often limited to a few minutes. Mobile TV is especially used in unplanned waiting situations as it is integrated into the mobile phone and therefore available any time (Orgad 2006, p. 6).	often	spontaneous	1 to 5 min.
(3) Extended waiting times	Waiting times of 30 minutes and more occur e.g. when consulting a doctor. Usually, the time spent waiting in the waiting-room is bridged by reading printed media. Users may recur to Mobile TV as a substitute for the formerly used media in this situation. The dominant usage motivation is identical with the two situations described earlier: waiting time is filled by a useful occupation. Although the viewing time available is possibly longer in this case, it does not necessarily lead to a longer usage time because the small screen of a mobile end device makes watching TV more tiring than on a normal TV screen (Hanekop 2007, p. 52ff.).	often	spontaneous but sheduled also	about 30 min.
(4) During leisure time	During leisure time, Mobile TV may, for example, be used while being at a swimming pool, in a park or at a lake in order to keep informed on current events, for amusement or to watch programs that would otherwise be missed (Södergard 2003, p. 226f.).	often	spontaneous	1 to 10 min.
(5) At home	Using Mobile TV at home occurs much less often than in the other situations described. Mobile TV is only used when the normal TV is, for example, used by other family members. It is then used as an emergency solution, because watching TV on the small display, as already noted, requires a certain amount of concentration and may become strenuous after a short period of time (Hanekop 2007, p. 87ff.). These results seem to differ between countries. Austrian studies indicate that the usage "at home" was the most popular (ORF 2007).	sometimes	spontaneous	5 to 30 min.

Figure 2: Usage situations and implications of Mobile TV use

It has been established that the viewing time in Mobile TV is much shorter than in stationary TV. Most usage sequences are not longer than five minutes (Hanekop, 2007, p. 18). Usage occurs mostly during the day in spontaneously developing situations. The usage of Mobile TV depends on gaps occurring in the daily routine, mostly while on the way. The use of stationary TV is oriented towards the programs offered. Besides the differences in viewing time, there is also a difference of motives. Mobile TV is used to fill waiting times with a useful occupation, while relaxation and entertainment are most important when using stationary TV. Traditional TV broadcasting formats do not correspond to this kind of usage because they are not made for short and spontaneous consumption. As programs last between 45 and 120 minutes on average, it is hardly possible to grasp a relevant section within a Mobile TV viewing time of five minutes or to recognize plots or background information.

3.2 Requirements for Mobile TV Applications

The usage situations described in section 3.1, the specificities of Mobile TV usage and the problems of current solutions (see section 2) lead to requirements for Mobile TV applications from the point of view of the players involved (B1 - B12), the providers of mobile services (M1 - M3) and the producers (H1 - H4). These will be elaborated in the following chapter.
The user's point of view

Due to the great variety of possible usage motivations and the corresponding advantages and disadvantages of modes of transmission, mobile TV applications should be able to provide two ways of content provision: (1) on demand content if there is a specific need for information and (2) broadcasted content in case there is just time to be filled without deciding on a specific topic beforehand (B1).

The very short average viewing time of Mobile TV applications requires the fast and uncomplicated provision of content (B2). The handling of the application has to be straightforward (B3) (Södergard, 2003, p. 84f.) in order to enable the user to retrieve the content required and to switch channels as fast as possible .

In this context it is helpful to have an electronic overview of the programs (EPG, Electronic Program Guide) of the available broadcasting and on-demand programs (Loebbecke, 2004, p. 4ff.). When switching to a new channel, information on the current program should be displayed (e.g. title and genre) in order to facilitate a quick orientation of the programs provided (B4) (Hanekop, 2007, p. 19f.). The Mobile TV application should also enable the user

to retrieve additional information on a program selected, for example to satisfy a need for information faster or in greater detail.

Mobile TV applications should allow a time-independent use of content (B5), especially in order to provide the user with up-to-date information during unforeseen waiting times (Trefzger, 2005, p.13ff.; Södergard, 2003, p. 193f.). This can, for example, be achieved by storing content on the end device.

Being able to access content independent of place is as important for the user as being time-independent (Trefzger, 2005, p. 18). However, accessibility independent of place requires the availability of transmission technologies everywhere. This is not always the case (e.g. in subways or in buildings). Therefore the application should adapt to the network resources available and provide alternative ways of access and use. If there is no radio connectivity (e.g. in subways) it should automatically provide stored content (B6).
If viewing times are very short (e.g. three minutes), most of the time will easily be spent searching, even if the features described above are used. Therefore Mobile TV applications should have functions to minimize the time the user has to spend searching (B7). Here a personalized system of entertainment recommendations, based on stored preferences, is imaginable.

Mobile TV applications should grant certain adequate security standards (B8) when processing personal data. The technical limitations of mobile end devices also have to be considered (small displays, limited energy supply, more limited hardware resources) (B9). User studies show that Mobile TV should not impinge on other functions of the end device (B 10) as this is unacceptable for users as well as for mobile network providers (Hanekop, 2007, p. 20ff.; Wilkens, 2008). The use of a homogenous transmission concept by the providers to transmit the required content is another requirement (B11). Access to the content should not be limited to one transmission technology in order to make the application run on the greatest possible number of end devices. The economic use of the resources should also be secured by using cost-efficient modes of transmission (B12). Finally an attractive business model is important for the user, as already explained in section 3.1. Mobile TV applications financed through advertising seem to be more popular with users and more successful in the market (e.g. DVB-H-TV in Austria and DMB in Korea). Therefore, a free basic program should be available for the first access to Mobile TV.

3.2.1 The mobile network providers' point of view

Mobile network providers expect that Mobile TV does not interfere with the use of other, potentially profitable, function of mobile phones (Wilkens, 2008). They are interested in business models that provide income for them through communication fees (M2), and they are interested in providing as little new infrastructure as possible for these services (M3). This is, for example, the reason why mobile network providers supported DVB-H as opposed to DMB, because DMB would have been connected with infrastructure investments in spite of being receivable basically for free.

3.2.2 The end device manufacturers' point of view

The disagreement on Mobile TV standards among manufacturers is a drawback, as they shy back from producing end devices for a Mobile TV standard whose success is not foreseeable. Therefore the establishment of a standard (E1) is of especial importance for this player. He is also interested in the simple and cost-efficient production (E2) of this technology and in its having clear product advantages (E3) for the mobile phone user in order to ensure a sustainable interest in adequate end devices. Mobile network providers are the most important customers of end device manufacturers and have therefore a decisive influence on the realization of adequate end devices (E4).

Figure 3 provides a summary of the requirements of users, mobile network providers and end device manufacturers. It shows that there are tensions between the spontaneous use of Mobile TV and the inflexible time structure of the program formats (S1). There are also conflicts between the requirements of the three players, which can work against the establishment of Mobile TV. Mobile network providers want to earn money from the transmission of data, while users are in favor of the most cost efficient transmission (S2). A successful Mobile TV concept has to come up with solutions for these tensions and conflicts.

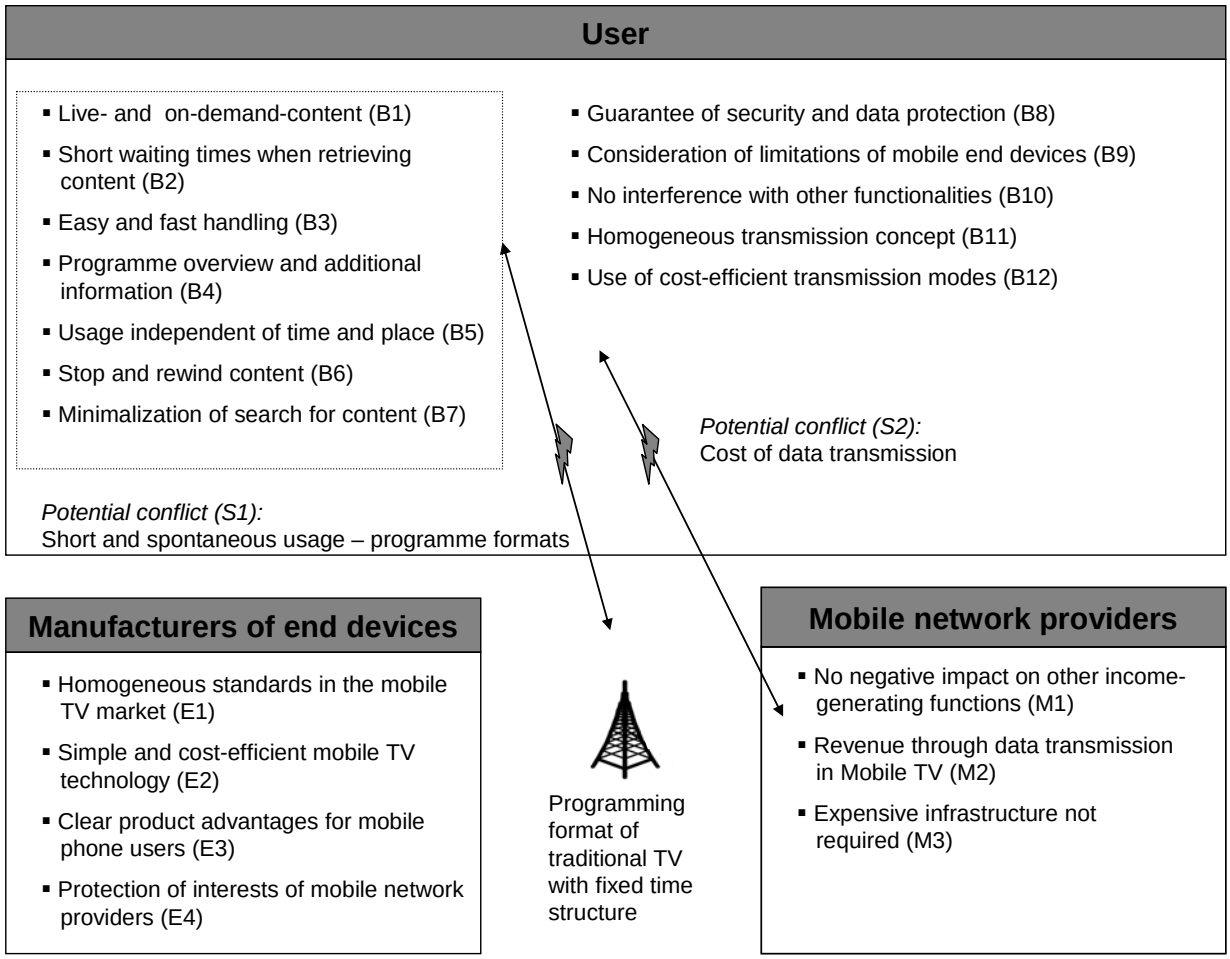

Figure 3: Requirements of users, mobile network providers and manufacturers of end devices

4 Concept for a context-adaptive Mobile TV application

This chapter will present a concept for the reduction of mentioned acceptance problems in chapter 2, which also takes account of the requirements explained in chapter 3 and is therefore able to raise the acceptance of Mobile TV for mobile network providers, end device manufacturers and users.

4.1 Technical concept

Due to the requirements (B1, B6, B9) and tensions (S1) on-demand content should be available via a VoD portal in addition to live content. The question is which transmission technologies are suitable to transmit the content to the user: On-demand access to content is only possible based on mobile phone technologies as the request of information requires bi-directional communication (see section 3.1). The transmission of live content requires only one-sided communication and can be done via mobile radio and broadcasting technologies. It has already been described in the requirements that the mode of transmission should be as cost-efficient as possible (B1). Therefore the radio technologies presented in section 2, which also facilitate mass media access to content, shall be used while accessing live content. In addition, the broadcasted live content is supposed to be available for a certain period of time via the VoD portal in order to facilitate the use of content independent of time (B5).

Due to the various modes of access on the provider's side, content has to be stored in a single format (B11, B9). Therefore a uniform standard is to be used for the encoding of content, which also allows showing additional information with the respective content (B4, E1). The transmission concept on the provider's side shall also allow for a uniform communication via radio technologies mentioned above (B11). There should also be a possibility to integrate broadband wireless communication standards (B2, B12).

To display information on the current content or to realize the automatic filtering of content on the end device, meta information about the broadcasted content also has to be transmitted (B3, B4, B7). Meta information for each element of content shall therefore be stored on the provider side and integrated into the data flow when transmitted (e.g. characteristics for unambiguous identification, genre, duration and title of the content element).

Each content element is to be divided into exactly timed sequences and allocated a consecutive sequence number. The sequence number is integrated into the data flow at the start of the sequence. This division makes it possible to reload content sequences in case they were incorrectly transmitted (B9). In addition to general information on the various elements the generation of an overview of the live program as well as of the VoD program must be supported (EPG). Detailed descriptions and additional information on each content element shall be stored and be accessible by the user (B4).

Based on the concept presented here, software components are needed to fulfill the functions identified. There must be a player for playing video content, a browser for displaying and navigating the program overview, a recorder for recording content and a personalization component to administer user data, submit program proposals and take account of the user's context when searching for and displaying content. These components will be explained in the following paragraphs.

4.1.1 Player

The player must be able to play video content via mobile radio and broadcasting technologies and to read and display the meta information contained. Information on e.g. title, duration or genre of the content played are displayed briefly when transmission starts and then hidden again. Live content must not only be displayed, but it must also be possible to navigate the available program channels. It follows from the requirements that the user must be able to interrupt the playing of content (B5). For live programs (broadcasting) the player has to temporarily store the content received after the interruption on the end device. Thus it becomes possible to resume the content from the point of interruption. Nevertheless, the temporary storage of on-demand content (streaming) shall also be possible in order to compensate for short transmission delays. To this avail each content element received when starting the player needs to be automatically buffered and temporarily stored. If there is an interruption, the transmission technology could be changed or the faulty parts could be reloaded.

4.1.2 Browser

The browser is another basic component, providing a uniform environment for the display of non-video based content. It enables the retrieval of program overviews, the retrieval and display of additional information, the navigation in the VoD portal and the display and overview

of content stored on the end device. Program overviews shall be downloaded via mobile radio and broadcasting technologies and stored on the end device in order to enable the retrieval of this information independent of place and time.

4.1.3 Recorder

In order to be able to postpone the viewing of TV programs to an individually chosen point of time (Ortelbach, Seidenfaden, Hagenhoff & Schumann, 2005, p. 16; chapter 3.1) or to view programs without a mobile connection, TV content shall be stored on the end device. The scheduled reception and storage of live content and on-demand content shall be possible. Besides the video information, meta data should also be stored in order to be able to display them during playback.

4.1.4 Personalisation

The Mobile TV application shall be adaptable to the individual user's context in order to provide interesting content independent of time and place, and to support the individual user in selecting content.

The user shall be able to enter his own data for the deduction of preferences (e.g. genres he is interested in) and also be supported by automatic procedures (e.g. content-based filtering). The personalization component has a profile manager, which deducts and stores preference information on the end device, compares it to TV content and gives recommendations. Based on the user profile, additional information can be personalized and alternative content can be offered (e.g. suitable on-demand content or stored content in case the desired live content is unavailable).

A "stacking" function (Ortelbach, Seidenfaden, Hagenhoff & Schumann, 2005, p. 16) is also imaginable, which allows to collect related content, e.g. sequels of a serial. Limited memory space and energy supply of the end device have to be taken into account here.

On the provider side, the VoD portal can be personalized by integrating personalized recommendations into an individual request for a program overview of on-demand content. The end device sends relevant profile information to the provider who considers it for its recommendations. In this way, content can also be recommended by using so-called

collaborative filtering. For this, direct semantic agreement with the user profile is not needed (Kaspar, 2005, p. 134).

4.2 Architecture of the Mobile TV application

There are two applications required for the realization of Mobile TV: (1) A client application to be installed on the mobile end device of the client, enabling the operation, display, recording and personalization of Mobile TV and (2) a server application on the provider side, adding meta information to the TV program and making it available via mobile and broadcasting technologies. Figure 4 provides an overview of these two applications and the components described in the previous section.

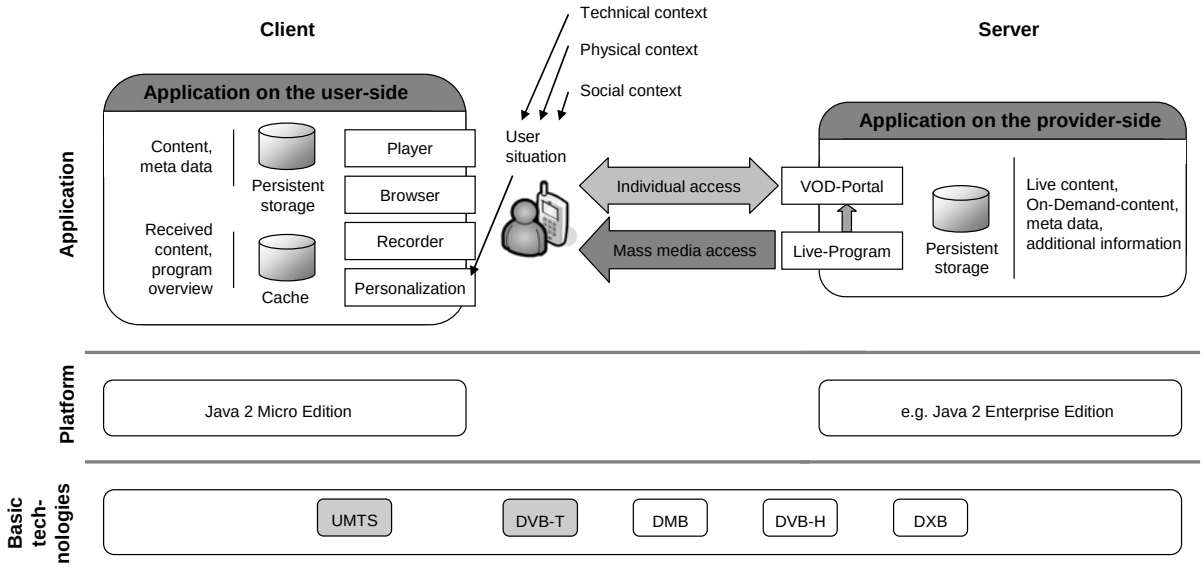

Figure 4: Architecture of the Mobile TV system

Besides the application layer, Figure 4 shows two more layers, which will be explained in the following paragraphs:

4.2.1 Platform layer

The application should run on as many types of end devices as possible. As Java 2 Micro Edition (J2ME) is now supported by almost all mobile phones and as it provides interfaces for processing TV content via radio technologies (JSR 272), this platform should be chosen for the application development on the client side. On the provider side, several platforms can be

used. To gain a maximally platform-independent system, the use of Java would also be suitable here.

4.2.2 Layer of basic technologies

The request of individual content or the on-demand program overview requires communication via mobile technologies as his individual access needs bi-directional communication. The format mentioned above transmits 384 kbit/s during streaming. Such bandwidth is only provided by UMTS and HSDPA. Due to the available bandwidth, the content could also be retrieved via WLAN or WiMax.

As the communication includes the user profile and the program overview in addition to the content, there is a certain complexity in the data transmission. The content exchanged should therefore be transmitted in a structured way. XML schemata are most suitable to make the communication process via the interface indicated as uniform as possible and to guarantee its easy extendibility. Data security during transmission shall be guaranteed by the use of encryption methods.

For efficient mass media access, the content should be transmitted by broadcasting (PTM) via radio technologies. It is feasible to use DMB, DVB-H or DVB-T, which nowadays can be integrated into mobile end devices (see section 2.3). The Mobile TV application should support all the radio technologies. Theoretically, this is possible using J2ME via JSR 272. However, this strongly depends on whether end device manufacturer implement JSR 272 making this interface usable for other applications. IP-based communication is only possible via DVB-H and DVB-T. For DMB, transmission stations either need an upstream gateway, or they have to use the IP-compatible standard eDMB. All three methods are able to provide a special channel for the one-sided data transfer of non-video based content in addition to the live content. This can transmit program overviews without building up a chargeable mobile connection. This function is already available in practice in DVB-T, which, different from cable TV, provides "video text of the next generation" for the TV channels it offers, with extended interaction features and high solution graphics (DVB-T-Portal, 2008).

Only if meta data are transmitted together with the respective content, the application will be able to filter content or to give recommendations. DMB's "tagging" concept already provides a possibility of integrating meta data. DVB-H and DVB-T can integrate these data directly into the data stream transmitted. Where mobile technologies are used, it is even possible to transmit the meta information separately before the streaming starts. However, these

possibilities do not provide a uniform solution, and therefore the meta information should be integrated into the IP parcels. This supports a uniform transmission of meta data in all technologies used, with the exception of DMB.

UMTS and DVB-T have been highlighted in Figure 4 as these technologies are already in the market in Germany, and available on the provider side (transmission stations, program provision) as well as on the demand side (suitable end devices and mobile phone contracts). For the other technologies, transmission has either been cancelled in Germany (DMB) or there are no suitable end devices in the market (DVB-H and DXB) (see section 2). Therefore, the concept is to be realized based on DVB-T together with an UMTS return channel. Thus the user can benefit from a basic offer that is free of charge and highly available, which he can complement by chargeable on-demand content, additional information and other services. This also helps to diminish typical network effect problems in connection with Mobile TV as users receive a direct benefit through the DVB-T program which is already available, and do not have to wait for the infrastructure to be upgraded or suitable programs to be designed.

4.3 Limitations of the concept

This section will show the limitations that could affect the concept and the personalization it includes. The following paragraphs deal with technical and legal limitations.

4.3.1 Technical limitations

(a) Limited availability of mobile networks

Recorded content may be able to temporarily bridge situations where a network is not available, but still the respective radio network must have been available at the time of recording. Although the concept provides other ways of access, these are again based on wireless access networks.

(b) Watching TV while recording

In order to grant the access to content independent of time, the recorder was conceptualized to automatically sustain content according to the user's individual preferences. However, this personalized functionality of the recorder is limited by the radio technologies used (e.g. DVB-T) and the resources of the mobile end device. Currently available end devices are only equipped with a single receiver module for wireless radio technologies. When DVB-T is used, only one channel can be actively received.

(c) Limited data storage and energy supply in mobile end devices

The activation of one or several broadcasting receivers consumes energy, and therefore TV-reception should be used sparingly. The internal memory of mobile phones usually only suffices for a few minutes of TV content (Samsung, 2009), making it recommendable to use an external memory card for Mobile TV. The memory space is also needed by the personalization component to deposit user data, live and on-demand content, and to provide program overviews.

4.3.2 Legal limitations

(a) Data protection

The guidelines of the Federal Law on Data Protection (e.g. BDSG in Germany) limit the use of user information to certain causes. Other guidelines of this law aiming at the transparency of the application for the user and the security of data also have to be taken into account.

(b) Unclear legal basis for content providers

The Mobile TV concept is subject to further obligations as mass communication has "an immanent special potential of influence" (Reinemann, 2006, p. 523). The legislator has provided a three-pronged broadcasting structure, including broadcasting, media and tele¬com-munications. However, a clear classifi-cation is not always possible (Reinemann, 2006, p. 529f.). According to the currently prevailing opinion, DVB-T, DVB-H and DMB belong to broadcasting, while the individual retrieval of content belongs to the media services (Reinemann, 2006, p. 528f.).

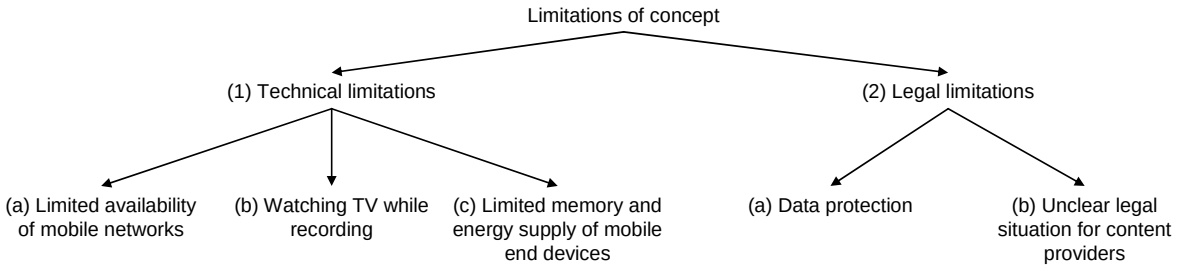

Figure 5: Summary of the limitations of the mobile TV concept

The personalization concept developed here, however, includes elements of individual as well as of mass communication, which makes an unambiguous classification impossible at this point. If the conceptualized application were classified as broadcasting service, a balance of

content of the program would, for example, have to be assured, a basic supply guaranteed, and specificities of the law on youth media protection would have to be fulfilled (Reinemann, 2006, p. 525f.). Figure 5 provides an overview of the technical and legal limitations discussed.

5 Summary and Outlook

It is possible, using the technologies available now, to realize the vision of watching TV on the move, using an end device that fits into a trouser pocket. The present contribution aimed at the development of a concept for context-adaptive Mobile TV applications that consider the special usage situations of Mobile TV and the subsequent requirements towards providing mass media content to the user according to his needs. The technical outline of the concept discusses possibilities to address the deducted requirements and the problems described (see sections 2.2 and 2.3). Ways to reduce search and operation efforts in Mobile TV, to individualize content and to allow for the usage of Mobile TV independent of time and place were shown. The opportunities pointed out are mainly limited by technical restrictions, e.g. limited memory capacity, limited energy supply or available radio technologies (see section 4.3).

To reduce the tension between the traditional programming formats of TV and its mobile usage mentioned in the beginning, the concept developed here offers a solution allowing for a flexible usage also in brief and spontaneous situations.

DVB-T is presently the only standard suitable for mobile usage with adequate programming and end devices available on the market in Germany. Mobile TV based on DVB-T is currently available on the market, and by adding a UMTS return channel, the Mobile TV concept presented here could be realized; it could be free of charge for basic services (DVB-T TV) and provide additional services (e.g. personalization, VoD, additional infor-mation) for a fee. It remains to be seen which standard will become accepted. On the one hand, DVB-T without additional services does not provide additional income for mobile network providers, on the other hand they missed out when the frequencies for the DVB-H standard were allocated, because the State Media institutions went for the consortium Mobile 3.0 (Digitalfernsehen, 2008).

More research is needed for the development of adequate business models as the different transmission technologies of Mobile TV applications are based on different pricing models.

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