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1. Introduction

The aim of the paper is to discuss EU policies in the area of mobile TV. The European Commission has strongly promoted an EU-wide common policy on mobile TV including the choice of DVB-H as the standard to be used. The paper aims at discussing this policy in view of the technological and market developments in the field of mobile media.

There are two main areas of policy intervention and regulation relating to mobile TV: networks and content. The present paper concentrates on the network aspect as do most current EU initiatives in the field. The EU approach is that content regulation is essential for the development of mobile TV and that the Audiovisual Media Service (AMS) Directive (Directive 2007/65/EC) is an important step in this area. Although there are and will be many problems relating to mobile TV content, such as advertisement regulation, copyright, must-carry, etc., the present paper will not venture into these questions and will stay with the network issues.

Mobile TV is a clear example of convergence of telecommunications and electronic mass media and has, therefore, attracted much attention. In the minds of some observers, the fact that mobile TV clearly exemplifies convergence is an argument in itself for its certain success - as there is a general trend towards convergence. This is, however, not necessarily so. The success or failure of mobile TV has to be proven in the market, and an important aim of the paper is to contribute to a realistic assessment of the development of mobile TV.

As it stands today, the general assessment must be that mobile TV is not a success. Even the success stories of Korea and Japan are less successful when studied more closely. In a Communication on mobile TV from 2007, the Commission stated that '2008 is generally considered as a crucial year for mobile TV take-up in the EU owing to important sports events, such as the European Football Championship and the Olympic Games...' (COM(2007) 409 final, p.3). As is evident now, 2008 did not turn out to be such a 'crucial' year – in the positive sense of the word. There are thus serious matters to be discussed with respect to the development of mobile TV.

One of the major issues since mobile TV started being developed revolves around the kinds of services offered. Interactivity and personalisation in addition to one-way transmission of TV programs are considered as crucial – not only to provide the user with a richer experience – but also to form a stable basis for charging users for the service. Right from the beginning, there has been a general agreement among people promoting and debating mobile TV that interactivity and personalisation are necessary attributes of mobile TV if it is to succeed. However, the fact is that these kinds of interactive and personalised services in combination with one-way TV transmission are only experiencing a very slow development. What users can watch on their mobile devices is mostly traditional TV.

This may not be that surprising, as this is a kind of development seen in other media as well. When a new media is in its infancy, it will often build on and adopt the forms and expressions of existing media, in this case traditional TV. In later phases, additional services will be included and the new media will develop its own 'language', forms of expression and services. In the interim, there will be uncertainty as to the exact direction of this development. With respect to mobile TV, this presently results in different approaches, where some lament the fact that mobile TV, at the moment, is basically traditional TV on small mobile devices, while others say that a development path of some length has to be foreseen. It may even be (and often is) that a new media totally fails and simply disappears from the market or reappears in a new context. In the case of mobile TV, it is difficult to imagine that video on mobile screens will not have a future in one or another way. But the successful recipe is still not there.

From the political arena there has been heavy pressure. Mobile TV has been one of the major focus points of commissioner Reding during the past 2-3 years (e.g. Reding, 2007). The concern is that here is a field, where technologies converge and new business opportunities arise, but where Europe is at danger of being bypassed by Asian countries as well as the US. This has resulted in initiatives not only of seeking to harmonise the radio frequency spectrum set aside for mobile TV, but also selecting a specific technology (DVB-H) as the European standard for the mobile TV infrastructure and even pointing at a preferable type of business model for the provision of mobile TV.

This has obviously affected the development of mobile TV in Europe but has not yet resulted in the major success anticipated. Explanations for this situation are not primarily related to the hesitation of Member States of the EU in implementing the recommendations proposed by the European Commission. It is, first and foremost, related to the lack of sufficiently attractive services for the users, as mentioned above, and to the uncertainty with respect to the appropriate technological solutions, which are relevant for mobile TV because of the fast development in technologies. It is, furthermore, connected with an uncertainty regarding the business models to be implemented, which again is related to the technological development and the types of services available for the market.

The present paper is, therefore, organised in the following manner:

- First, there is a section on the policy initiatives of the European Commission and the background for these initiatives.
- In the following section, the technological solutions are discussed.
- Furthermore, the business models implemented are examined.
- Thereafter, market developments are presented.
- Finally, as part of the conclusion, the paper returns to the policy area and discusses the appropriateness of the present initiatives.

In the analyses in the paper, there is emphasis on the critical factors determining the development of mobile TV:

With respect to market developments, this primarily concerns the kinds of services offered, i.e. whether there are new and attractive offers or whether we are dealing with traditional TV on a new set of devices. Charging specifically for traditional TV on mobile devices is or will at least in the long run be relatively difficult. Users already pay for TV in different ways, and TV material can be accessed in other manners than on mobile devices. Charging will become easier when mobile TV

with new interactive and personalised services will be able to provide a new experience. However, at present, mobile TV providers will be dependent on making a business of mobile TV in its more primitive forms. This is done, for instance, by making mobile TV part of packages of services (e.g. voice and data) selling it as multi-play service packages.

Regarding technological solutions, the two major sets of platforms are out-of-band broadcast and in-band transmission. Although in-band solutions often have been considered as the losing choice because of the relatively low quality and high costs of using the mobile connection for getting access to TV, new mobile technologies are developing. This applies, for instance, to Multimedia Broadcast Multicast Service (MBMS), which will allow for cheaper transmission and also avoids the costs of building a new broadcast (e.g. DVB-H) network. It also, e.g., applies to the Long Term Evolution (LTE) development, which will facilitate high quality TV because of the very large bandwidth. The final word in the technological development has not yet been said and the outcome can still go in different directions.

Concerning business models, the traditional issue of open vs. closed business models is being replayed. However, when involving broadcasting, there is a strong political influence, as there is a tradition for policy decisions on how frequencies allocated for broadcasting are used. In Finland, for instance, the policy decision has been to implement a very open business model for the operation of mobile TV. In Italy, on the other hand, the operator '3' jumpstarted the process by acquiring the broadcasting operator Canale 7, and '3' has implemented a more closed/walled business model. There are thus different business models implemented. And, this is only a small fragment of the different business possibilities created when other technological possibilities arise. In more general terms, the business model discussion is still very open.

The prospects of mobile TV are thus still in flux. In order to assess the prospects and the appropriateness of policy initiatives, the paper provides an examination of the actual experiences with the introduction of mobile TV in a selected number of countries focusing on the prospective technology developments in the field, the business models implemented, the preliminary rates of success or failure, and the policy decisions influencing these developments.

2. Policy initiatives

This section focuses on EU policy initiatives and regulatory recommendations regarding mobile TV. In the following sections, experiences from non-European countries will be included, but the present section is concerned with EU initiatives, as the aim of the paper is to discuss the appropriateness of EU policies seen in the context of the latest developments in the fields of mobile media.

The background for the EU initiatives in mobile TV is clearly spelled out in the following statements:

- 'Mobile TV is a prime example of digital convergence which can generate new business opportunities and benefit consumers' (MEMO/07/298, p.1).
- 'Mobile TV allows consumers not only to watch TV while on the move but also to have access to personalised, time-shifted and on-demand audiovisual content' (MEMO/07/298, p.1).

- 'It represents a tremendous opportunity for Europe to maintain and expand its leadership in mobile technology and mobile services' (MEMO/07/298, p.1).
- However, 'competitors from Europe's main partners, most notably from Asia and the US, have made significant progress, and Europe risks losing its competitive edge in mobile services' (COM(2007) 409, p.2).
- 'The Commission sees a strong risk of market fragmentation in Europe' (MEMO/07/298, p.1).

In other words, here is an example of the much and long discussed digital convergence, bringing personalised and interactive audiovisual services to users and new business potentials and opportunities for maintaining and expanding the European position in the mobile field; however, competitors from other parts of the world are challenging Europe, and fragmentation is a risk in Europe with its many individual countries. In addition, the Commission has observed that there have been signs of deadlock in the cooperation between network, platform and content providers.

The answer of the European Commission has basically been to act fast (to counter the risk of being by-passed by competitors) and to institute a common European approach or blueprint (to limit the dangers of fragmentation). The aim has been to promote a single European mobile TV market so that economies of scale can be reached for companies in the different areas of mobile TV production, equipment, devices, network and platform operation and content production. Otherwise, there would be a risk of losing pace.

More specifically, policy initiatives have centred on the following three areas (see (COM(2007) 409 final), p.4):

- Technical aspects (standards and interoperability)
- The regulatory environment
- Spectrum for mobile TV services

2.1 Technical aspects

The standards issue regarding basic infrastructural technologies has been the most contended area. There are many different technology solutions for providing the infrastructure for mobile TV. The Commission has opted for a broadcast solution and more specifically DVB-H. A wide range of good reasons for this decision has been listed by the Commission and many other observers and organizations (e.g. European Parliament, 2007).

The reason for choosing broadcast in addition to an in-band mobile solution has been the lack of capacity, hitherto, for video communications in mobile networks and hence a relatively low quality and high costs. The reason for choosing DVB-H and not the DMB or MediaFLO solutions, for instance, has been that DVB is already the technology chosen in Europe and many other regions of the world for other kinds of TV transmission (terrestrial, cable, and satellite). Other and related reasons have also been mentioned or have played a role in the background, e.g. the fact that most trials in Europe have used DVB-H technology, that DVB-H is the result of partly EU-funded research projects, and that European-based companies (first and foremost Nokia) have been focusing on DVB-H. There is thus a clear industrial policy aspect involved, which has been openly stated in the rhetoric regarding competition with Asian countries and the US.

There is no doubt that the Commission would have preferred that the industry had opted enthusiastically for DVB-H by itself. In 2006, a European Mobile Broadcasting Council (EMBC) was created with the participation of representatives from all relevant parts of industry (manufacturers, broadcasters, mobile operators, content providers, etc.). The idea was that they should come up with an agreement on which way to go technologically and otherwise. However, they didn't. The recommendations of the EMBC reflected the differences of interests between the different players, much to the disappointment of Commissioner Reding. In her address to the CeBIT in 2007, she said that 'I would have much expected more in terms of proposed solutions and strategic vision', and 'I find the recommendations of the EBMC report too consensual'. 'What we really need now', Reding said, 'is to decide and draft a European strategy for a swift and large take-up of mobile TV in Europe' (Reding, 2007, p.3).

EMBC and the industry at large had not opted clearly for DVB-H. Consequently, the EU had to do it for them. This, obviously, runs counter to the general technology neutrality policy of the EU. However, as stated in MEMO/07/298: '…a departure from this principle is possible in specific cases where justified by market developments, the need for economies of scale, interoperability and freedom of choice for users' (MEMO/07/298, p.7). The ideal precedent often mentioned in EU documents is the decision to make GSM the European standard with all its subsequent market success around the world. This is a story that the EU would like to repeat in the area of mobile TV.

The result has been that the DVB-H standard has been made a European standard: DVB-H was added in March 2008 to the (very limited) 'List of standards and/or specifications for electronic communications networks, services and associated facilities and services' (based on Commission Decision 2007/176/EC). This clearly emphasises the resolve of the EU to make DVB-H the European standard in the field and to roll out the technology as fast as possible.

However, some observers believe they can detect a certain hesitation in the EU position arising since the spring of 2008. In an article in Mobile Europe (11 December 2008), it is noted that in the Commission Communication of 10 December 2008 (COM(2008) 845 final), the language has slightly changed compared to the statements from 2007 and the beginning of 2008. In this Communication it is said that 'interoperable solutions should be favoured' and that 'interoperability can be achieved when stakeholders act together with a common aim of implementing a technical standard <u>such as</u> DVB-H' (COM(2008) 845 final, p.9, our emphasis). When comparing these formulations with the former bold statements regarding DVB-H, the article in Mobile Europe asks whether 'the European Commission's enthusiasm for DVB-H is on the slide' (Mobile Europe, 2008).

2.2 The regulatory environment

In its Communication of July 2007 (COM(2007) 409 final), the Commission noted that there are considerable differences in the regulatory environments relating to mobile TV in the Member States and that it is necessary to create a greater degree of regulatory certainty a to avoid a legal vacuum. This does not mean that mobile TV should be subject to any strict regulation in the Member States. According to the Commission, a light-touch regulatory environment should be implemented, but there should be a common regulatory foundation regarding standards, spectrum and other kinds of regulation, which will contribute to the establishment of a level playing field in Europe and thus give an impetus to mobile TV and the creation of a single market in the field. For this purpose, the

2007 Communication announced that best practice in relevant regulatory areas would be identified and summarized.

This is what is done in the mobile TV Communication of December 2008 (COM(2008) 845 final). In this Communication, regulatory best practice is identified in relation to the following categories: general framework, authorisation regimes, award procedures, and a category named specific aspects:

- The general framework recommendations relate to the creation of greater clarity, transparency, efficiency and timeliness of procedures; the provision of public consultation mechanisms to deal with differences in interests between the various players from different communication area; and the establishment of a balance between the pace of change and the need for legal certainty (COM(2008) 845 final, p.6).
- The recommendations regarding authorisation regimes identify it as important to clearly define the relationship between e-communications, spectrum and content aspects, as different areas of legislation have an influence on mobile TV developments; in extension to this, a one-stop shopping procedure – or at least a limited number of public authorities to approach - is recommended (COM(2008) 845 final, p.7).
- In the area of award procedures, clarity and transparency is recommended; in addition, collaborative approaches between the players is considered as best practice with the aim of minimising the risk of deadlock; moreover, it is recommended to include the possibility of withdrawing spectrum licenses if spectrum is not put to use within reasonable time (COM (2008) 845 final, p.8).
- Finally, different specific aspects are mentioned: must-carry rules should not be imposed at the present start-up stage; network infrastructure sharing is recommended; and interoperability and EU-wide roaming should be given due consideration (COM(2008) 845 final, p.8-9).

In summary, clarity and efficiency are as always considered important; more specifically, the fact that mobile TV covers different kinds of regulation and is at risk of being deadlocked because of the different types of players going in different directions should be dealt with; and mobile TV should not be burdened with too strict regulations, but should be subject to provisions facilitating international roaming.

The issue of deadlock is, moreover, dealt with in a specific recommendation. The Communication describes three main regulatory models currently identified in European countries. One is the extension of existing rules for digital terrestrial TV, which according to the Communication is seen in Italy and the UK. Another model is called the 'plain wholesale model', which is seen in Finland and focuses primarily on the wholesale platform operator. The third model is termed the 'integrated approach', where all the players in the value network have to find an agreement before the authorisation is granted. This is the model applied in Austria and is the model recommended by the Commission. The reason is that problems of cooperation between the network, platform, service and content providers have been witnessed in some of the countries having launched mobile TV commercially. But it means that the Commission in reality recommends a specific type of business model – or at least a manner of establishing a business model.

2.3 Spectrum for mobile TV

Radio spectrum is obviously of central importance to the development of mobile TV, and the switch-over from analogue to digital broadcasting frees frequency resources to that effect and many other applications - hence the term digital dividend. There is an EU decision that the switch-over must take place no later than 2012. However, it is anticipated that some countries will not be able to meet this deadline, while others have already performed the switch-over.

For mobile TV, the advantage is not only that frequencies will be available, but also that the frequencies are in the UHF spectrum (470-862 MHz), which is well suited for broadcast as well as mobile communications. The problem is that the frequencies are scattered not only when looking at the broader European picture but also in the individual countries. There are also countries using the L-band (1452-1492 MHz), which the Commission considers as a fall-back possibility for countries, where there is no other spectrum available for mobile TV (COM(2007) 409 final, p.8). It is, however, the UHF band, which is in the focus of interest of the Commission.

The interest is much broader than just mobile TV. The idea is to cluster the different types of usage in three groups: One for unidirectional high power networks mainly for fixed broadcasting services; another for unidirectional medium to low power networks, for instance mobile TV; and a third for bi-directional low power networks primarily for fixed and mobile broadband (COM(2007) 700 final, p. 9). More broadly speaking, the aim of the Commission is to establish a common spectrum plan at the EU level.

The Commission aims at instituting a common EU-wide approach, which will facilitate the establishment of a single European market and cross-border interoperability where feasible and needed. The purpose is not only to make it possible, for instance, for mobile users to get mobile TV on their terminals when travelling across Europe. There is also an industry policy aspect to this. In a Communication from the Commission from November 2007 on a common approach to the use of the spectrum released by the digital switch-over (COM(2007) 700 final), it is mentioned that the US as well as Japan is already on the way to take advantage of the digital switch-over. A central statement in the Communication is, therefore, that 'Europe cannot afford to stay on the sidelines. It is critical to address strategically the key issues underlying the digital dividend' (COM(2007) 700 final, p.7).

Coordinated actions are necessary, and mobile TV is one of the areas where this is considered as highly needed. In the 2007 Communication on 'Strengthening the Internal Market for Mobile TV' (COM(2007) 409 final, p.7), it is this stated that 'The Commission urges the Member States to make part of the UHF spectrum available for mobile TV services as it is freed', and furthermore, that 'The Commission's services have asked the Member States to assess the feasibility of earmarking a sub-band for mobile TV within the digital dividend'.

The question is how this will be achieved. In the Communication on the digital switch-over (COM(2007) 700 final), it is clear that the Commission is not satisfied with the results of the last ITU Regional Radiocommunication Conference in 2006. The channels freed by the digital switch-over are scattered and intertwined with digital broadcasting channels. The answer of the Commission to this situation is the above mentioned plan to cluster frequencies. This entails a number of initiatives and preparatory work regarding the establishment of sub-bands and harmonized clusters, and once this preparatory work has been done, 'the Commission would then

use a binding Community law instrument to adopt a clustering decision' (COM(2007) 700 final, p.8).

This rather unspecific but, on the other hand, determined statement reflects the resolve of the Commission to do something about the spectrum issue, but it also reflects the fact that it will be very difficult to sort it out. Spectrum is freed, but is scattered, and the different countries plan to use it in different ways. Although frequency allocation mostly is a matter dealt with at the ITU Radiocommunication Conferences, the EU has powers in the area. These powers are based on the decision on a regulatory framework for radio spectrum policy in the European Union (Decision no 676/2002/EC). However, even though the EU has powers in the field, there is a long way to go when one takes the present spectrum situation into account. This is why the Commission proposes a set of preparatory works to be done. Whether it will provide the desired result is, however, uncertain.

3. Technology solutions

Mobile TV is a service which requires a number of different technologies and standards in different parts of the value network to work together. Some of these technologies are developed in relation to other services and later adapted to mobile TV and some of them are specifically developed to enable mobile TV services to be provided to the market. The focus of this section is on network technologies, as this has been the prime area of policy discussions. However, the development of other technologies on the production side, service and device side can also have major influence on the overall development of the market.

Figure 1 shows a simple schematic overview of different elements included in the value network for mobile TV provision.

Figure 1: Value network for mobile TV
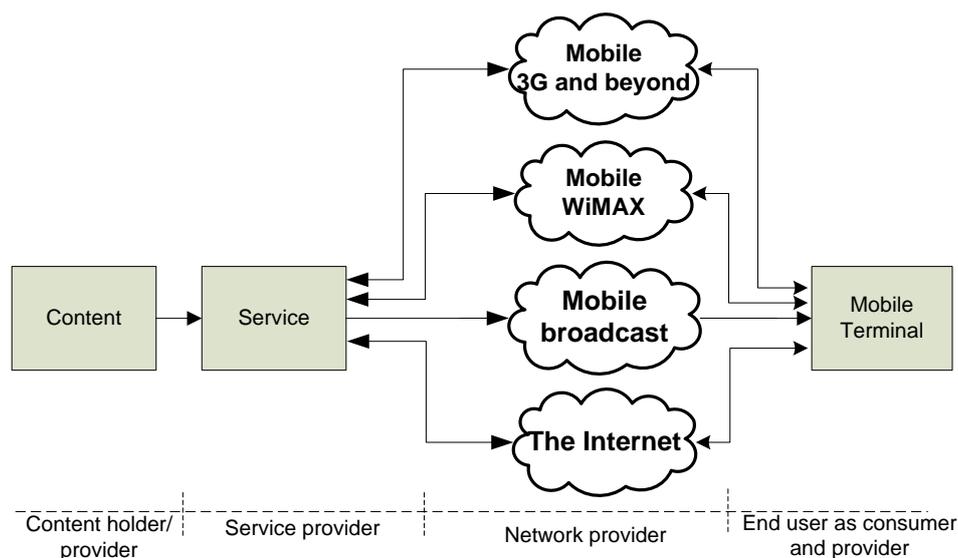
The figure illustrates that there will be service providers who take the content from the professional content providers and the user generated content and combine it into a service, which will be

delivered to the users by means of a network infrastructure. The service providers can either be mobile operators, broadcasters or third party broadcast service operators. In several markets, the mobile operators act as service providers - a solution which may facilitate the development of the market as the mobile operators have access to the customers and are key players in bringing the terminals to the market. Another important issue is that a combination of networks will be used in many actual implementations, for example a combination of broadcast and 3G, where the TV content is delivered through the broadcast network and the return channel is established through 3G. The level of the development of the terminals (hardware and software) and the implemented service infrastructure are decisive for the degree of interactivity and integration of user generated content.

The description in the following covers the different technological solutions for network infrastructures and the scenarios, where a combination of different network infrastructures is used to deliver mobile TV services.

3.1 The Internet

Mobile TV services can be accessed through Internet in several ways. First, the development of Wi-Fi enabled mobile terminals provides the possibility of using Internet services in locations where Wi-Fi networks are available. Second, the development of mobile Internet platforms on the 3G and beyond 3G networks and the flat rate business models provided by the operators make access to mobile Internet easy. As the market data shows, the penetration is fast[1]. Third, content from the Internet can be downloaded to the mobile devices and consumed offline in a podcasts like solution.

The first and second solutions are based on unicast technology, which is not the most efficient way of delivering TV services to mass audiences and is more appropriate for offering streaming services in an on-demand manner like YouTube. The podcast solution becomes more and more interesting and important as the terminals become more advanced and the memory capacity becomes cheap. Podcast has the disadvantage of not being able to deliver live services and network-based services, but the majority of TV content is not live, and offline TV services can be downloaded to the mobile terminals. Hence the service provider can offer a number of 'virtual TV channels' composed so that the content is placed on the terminal through, e.g., podcats.

The discussions on mobile TV through mobile Internet are very much similar to the discussions on Internet TV/WEB TV when it comes to the technological parameters as well as the policy and business oriented issues. The services are based on best effort and the provisions are global and beyond national or European regulations. These are not direct competitors to the managed mobile TV provisions discussed in the following. However, it is important to follow this development, as the changes and innovations in the field happen fast and future developments may shift the balance.

The podcast and in particular the virtual TV services discussed above could be complementary platforms/services to the network based services. The service providers can, for instance, compose

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[1] According to Ericsson, the number of mobile broadband users will be higher than fixed broadband users in 2011, and in 2012, more than 50% of European citizens will have access to mobile broadband. In Denmark, for example, more than 550,000 mobile subscribers used mobile broadband in the first half of 2008 and the market is growing with 20% every month. (Source: presentation named 'LTE introduction or Mobile Internet Evolution' by Lars Nielsen, CTO Ericsson Denmark. The presentation is not publicly available but can be acquired by contacting the authors of this paper)

their services based on these virtual TV services and other live services without the users being aware of the content placement problem (on the terminal or from a network). To implement this, there would be a need for transparent procedures that settle the rights of the service providers to utilise the resources (e.g. storage capacity) on the devices.

3.2 Mobile 3G and beyond

Mobile TV through public mobile infrastructures (3G and beyond), also called in-band mobile TV services, are provided in several markets, where 3G networks are implemented. One of the main drivers for the development from 2G to 3G was foreseen to be video and TV services. TV and video services were seen as important revenue generators and one of the reasons for the operators to pay huge sums for 3G spectrum. The experience so far shows that 3G and particularly 3.5G will be driven mainly by mobile Internet services. However, several 3G operators have dedicated TV services delivered as packages with a variety of services at different prices, strongly inspired by the satellite and cable TV provisions in basic, optional and premium packages. The main questions are whether the operators earn any money on these services and whether the 3G and beyond networks are optimal network platforms for TV services. The answer to the first question is a bit difficult as the operators keep this type of information secret. However, informal talks with experts and operators document that they simply don't earn money on these services. The second question is discussed in the following.

The bandwidth capacity of the networks is a crucial parameter when the network is used for mobile TV services. In Table1, the capacity requirements for video services in the baseline profile of the H264 codecs, which are used for mobile TV provisions on several platforms, are depicted. Experience shows that profile A is simply not good enough; to be able to provide tolerable quality, you need to use profile B or C.

Table 1: Profile bitrates

Profile	Video resolution	Frame rate (f/s)	Maximum bit rate
A	QCIF(176 x 144)	15	128 Kbps
B	CIF(352 x 288)	15	384 Kbps
B	QCIF (176 x 144)	30	384 Kbps
C	CIF (352 x 288)	30	2 Mbps

Source: ETSI TS 102 005

In Table 2, the downlink and uplink capacities of the current and near future mobile networks are shown.

Table 2: Down- and uplink capacities[2]

Network	Downlink	Uplink	Availability
3G (WCDMA)	2 Mbps	384 Kbps	High
3.5G (HSPA)	14 Mbps	2 Mbps	Medium
3.9G (LTE)	100 Mbps	50 Mbps	Start date: 2009

Source: 'HSPA, the undisputed choice of mobile broadband', white paper by Ericsson 2009, AND 'Towards a global mobile broadband', white paper from UMTS forum 2008)

It is important to note that these are theoretical figures and that the real bandwidth delivered to the devices is below these theoretical figures and lowers as a function of the distance from the transmitters (see Figure 2). Another important issue is that the bandwidth is shared by a number of users, and that the actual capacity available for one user depends on the number of users sharing the same network unit.

Figure 2: Bit rate as a function of coverage
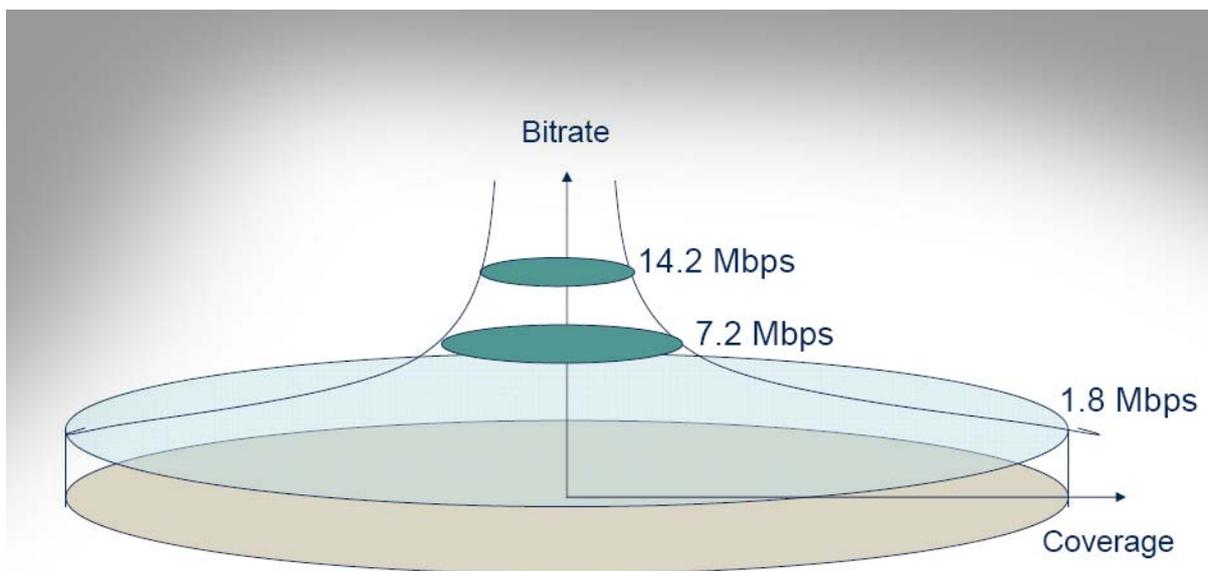
Source: Ericsson

The conclusion is that the provision of acceptable quality TV requires, at least, HSPA and that it may be more realistic to wait for LTE networks to be implemented. Even in HSPA, only a few people can use the services in a mast's coverage area at the same time. If the services become popular, massive investments in the network will be needed. However, as already mentioned, the market has not shown to be sufficiently profitable to bear massive investments.

A new standard, MBMS (Multimedia Broadcast Multicast Service), has been developed by 3GPP to enable the utilisation of multicast/point-to-multipoint in mobile networks. This will definitely help

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[2] These are the typical numbers. The bit rate bandwidth depends on the amount of the assigned frequency bandwidth. Also important to mention is that there are different versions of standards and, for example, HSPA+ has an uplink of 11.5 Mbps and a downlink of 28 Mbps.

alleviate the resource utilisation issue. MBMS utilises the resources more efficiently than the current unicast provisions, as the same link is used by several users when viewing the same service. However, we have not found commercial implementations of MBMS on the market yet. There have been a number of successful pilots in Europe, Asia and Australia, where in particular Huawei, Qualcomm and Ericsson have participated actively, and there is a commercial operation of a pre-MBMS platform (CMB) in Hong Kong operated by PCCW.

LTE and in particular MBMS implemented on LTE can change this situation and establish a powerful infrastructure, which can also be used for mobile TV services. This is in particular important in Europe as LTE seems to be the preferred 4G technology in Europe.

From a policy and regulatory point of view, the allocation and assignment of spectrum for LTE (and beyond LTE) networks is important. The allocation of the digital dividend spectrum is essential and on the policy agenda in several countries. The assignment process of the spectrum has started in some countries. Sweden, for example, has assigned 140 MHz spectrum to four different mobile operators (three times 2 X 20 MHz and one 2 X 10 MHz)[3]. With regard to the digital dividend in Denmark for example, the Ministry of Science, Technology and Innovation has allocated research resources for a one year period to evaluate examples of other services/applications than TV in this spectrum area. The beyond 3G technology platforms like LTE can play a major role here.

3.3 Mobile WiMAX

Mobile WiMAX (IEEE 802.16E) is the competing technology to beyond 3G and in particular to LTE, and the analysis of the technical parameters given in the previous section is also valid in the case of mobile WiMAX. The bandwidth capacity is 70 Mbps and the next step in the development is IEEE 802.16M, which also is called Gigabit WiMAX with bandwidth capacity of about 1 Gbps.

Multicast (MBS - Multicast and Broadcast Service) is also implemented in the case of mobile WiMAX, making the network more interesting for mobile TV services. Mobile WiMAX will probably be the preferred technology in the US. However, there will also be Mobile WiMAX in Europe. In Sweden, alongside the LTE licenses, a 50 MHz spectrum was allocated for mobile WiMAX to Intel Telecom[4].

3.4 Mobile broadcast

Mobile broadcast platforms are essentially broadcast TV infrastructures optimised for mobile reception. There are different standards on the market. The services are viewed using mobile terminals, which are enabled for one of these standards, and there can be a return path for interactivity and on-demand services through an IP network based on Wi-Fi, 3G or beyond, etc.

Broadcast networks are characterised by one-to-many transmission and high capacity. By combining broadcast and a return channel (offered by a mobile operator), the service provider can split the services into different elements and transmit the elements with high capacity requirements and mass appeal within the broadcast networks. This combined platform enables service providers to develop new services including high quality video/audio components and interactive services.

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[3] The Swedish Post and Telecom agency: http://www.pts.se/
[4] The Swedish Post and Telecom agency: http://www.pts.se/

It is important to mention that the on-demand aspects will also be coped with in these platforms, as the return channel offered by the mobile operator can also be used as a forward path to deliver on-demand services to the users. Therefore, the same content, which is delivered 'live' over the broadcast channel, can also be sold to individual users at other times. This creates several possibilities for packaging the content in different forms and delivering it to the users in specific contexts using different business models.

The main advantage of the mobile broadcast platform is that video/TV is transmitted within the broadcast networks and that one person's use of video/TV services doesn't influence the use of others. This is a very important advantage for the video/TV services with mass appeal. An important drawback of these platforms is that it needs specific mobile terminals which can connect to broadcast networks.

A number of different standards for mobile broadcast platforms exist on the market. Apart from the technological efficiency issues, a number of other issues are related to the mobile broadcast standards. The spectrum issue is a main problem for literally all mobile broadcast standards, in particular the ones like DVB-H, which preferably use the UHF spectrum. UHF spectrum is valuable to all mobile communication technologies and even though new spectrum is released with the transition from analogue to digital TV, it is not at all certain that parts of this spectrum will be used for mobile TV. Other market actors from the communication sector are pushing for their interests.

The satellite platforms play an important role here. This is due to some important reasons: 1) technological developments have improved the capabilities of the satellite platforms as a feasible mobile broadcast platform, 2) the spectrum resources are assigned commercially using fast mechanisms, 3) the resource allocation and assignment for the satellite platforms are not within the jurisdiction of the individual national governments, 4) it is easy to enable wide area service provisions, for example pan European services, which are very difficult in the UHF band. As seen in the following, however, the satellite standards for mobile broadcast are in many cases combined with a terrestrial infrastructure to enable the provision of services in the urban areas and also for the provision of indoor services.

A number of competing standards for mobile broadcast are emerging: DVB-T, DVB-SH, DAB/T-DMB, S-DMB, MediaFLO, ATSC-MH, ISDB-T, and CMMB.

DVB-T
Mobility is one of the strengths of the DVB-T standard. This has been an important argument for promoters of terrestrial digital TV networks for legitimising the use of this standard even in countries where other multi-channel infrastructures (cable and satellite) have been reasonably well developed. The argument is that terrestrial DVB (DVB-T) in contrast to satellite and cable makes mobility and nomadic use (indoors as well as outdoors) possible. This is valid when it concerns nomadic as well as mobile use of TV in camping vans, cars, busses and trains and, due to the rapid technological development, when it comes to pocket mobile terminals, PDAs, etc. DVB-T for stationary reception has a bandwidth of about 20 Mbps in an 8 MHz channel; the bandwidth when designed for mobile reception is about half of this.

Even though mobile DVB-T terminals are on the market and can be used, there is still a problem of power consumption which is best solved with other dedicated mobile broadcast technologies like

DVB-H and also the next generation DVB-T standard (DVB-T2)[5]. DVB-T2 deals with a number of the limitations of DVB-T. It has, for instance, a more efficient power utilisation and it provides more than a 40% bit rate improvement compared to DVB-T. The draft standard has been handed over to the European Telecommunications Standards Institute (ETSI) by DVB.ORG in June 2008[6]. The final standard is expected to be published in Q2 2009. The aim is that the standard should be ready during 2009 and expected to be put into service in 2012, when many countries shut down the analogue transmission.

DVB-H
DVB-H is an upgrade of DVB-T for mobile reception; it reduces the power consumption and enables better performance in a multi path environment. In November 2004, DVB-H was adopted as a European Norm by ETSI and there is political support from the EU to use DVB-H as the preferred technology for mobile TV in Europe.

A single DVB-H carrier of 8 MHz in a typical operating environment has a bandwidth of about 10 Mbps and can carry between 20 and 40 channels of good quality with video encoded in H.264 and sound in AAC. Statistical multiplexing is also possible in DVB-H, ensuring optimum use of bandwidth to deliver services. DVB-H is designed for use in Bands III, IV and V as well as the L-band.

DVB-SH
Digital Video Broadcast – Satellite services to Handhelds (DVB-SH) is the satellite version of DVB-H and will be deployed for the provision of mobile TV services to handheld devices. DVB-SH can be used in any frequency spectrum below 3GHz, including UHF, L-band and S-band, and in terrestrial, satellite or hybrid networks. Typically DVH-SH operates around 2.2 GHz and the system and waveform specifications have been published as ETSI standards. One of the interesting deployments is the hybrid satellite/terrestrial mode, where the terrestrial repeaters installed in the urban areas retransmit the satellite signal on the same frequency and by that enable indoor coverage.

DAB – T-DMB
Digital Audio Broadcasting (DAB) is a standard developed by the European Eureka 147 project and was originally for digital radio with the assumption of future digital radio being more than radio and being a delivery platform for multimedia services. DAB operates in spectrum blocks of 1.7 MHz and can be deployed in any frequencies up to 3 MHz. DAB spectrum is allocated to broadcasters in different European countries but the level of success as a platform for digital radio varies a lot. The major European success examples are the UK and Denmark.

DAB can be deployed for mobile TV in several ways; one of the examples is DAB-IP or IP over DAB, which implements IP Data Cast over DAB. This was used by British Telecom (BT Movio) in a successful pilot. However, we have not seen commercial deployment of the technology. Another example is Terrestrial Digital Multimedia Broadcasting (T-DMB). T-DMB is commonly known as the 'Korean standard' and is mostly deployed in South Korea. T-DMB is standardised by ETSI and there is some interest in European countries for DMB. A major European introduction of DMB is the deployment of the technology in Norway by the strong public service broadcaster, NRK[7].

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[5] The DVB-T2 draft standard (EN 302 755) was ratified by the DVB Steering Board on June 26, 2008, http://www.dvb.org/news_events/press_releases/press_releases/DVB_pr174%20T2%20Final.pdf
[6] ETSI time table DVB-T2 <http://omploader.org/va2Rp>
[7] http://www.broadbandtvnews.com/

S-DMB
S-DMB is the satellite version of DMB.

MediaFLO
MediaFLO is a proprietary standard developed by QUALCOMM. MediaFLO is designed specifically for mobile TV purposes and is not backwards compatible with other legacy standards. This non-dependence on legacy standards has been propagated as one of the strengths of the MediaFLO, as the design has only been concentrated on developing the most efficient broadcast standard for mobile terminals. FLO operates in VHF, UHF and the L-band, over channel bandwidths of 5, 6, 7 and 8 MHz.

ATSC-M/H
Advanced Television System Committee (ATSC) is the standard for digital terrestrial TV in the US. ATSC was not developed for mobile reception and was developed to deliver highly robust signals to ordinary stationary reception of TV and primarily to offer HDTV to the US citizens. The ATSC-M/H standard is developed to enable mobile reception, and it uses a portion of the regular ATSC bandwidth for this purpose. ATSC-M/H will enable different modes of mobile reception; in one configuration mode, it enables mobile reception for cars, buses, trains etc. and in the other mode it will enable reception by handheld devices.

ISDB-T
Integrated Services Digital Broadcasting (ISDB) is the Japanese standard for digital broadcasting. The ISDB family of standards supports cable, satellite and terrestrial broadcasting. The terrestrial standard (ISDB-T) was standardized in 1998 with mobility as one of the requirements. Hence, ISDB-T is a mobile broadcast standard and is deployed for the provision of mobile TV services for a number of years. Like DVB-T, the ISDB-T can provide services from HDTV to mobile TV depending on the configuration.

CMMB
China Mobile Multimedia Broadcasting (CMMB) is the Chinese standard for mobile TV and operates in a hybrid satellite and UHF band. The satellite band is intended to be used in the rural areas and the UHF band in the urban areas. It can operate in two different frequency bandwidths: 8 MHz and 2 MHz. The 'bit rate bandwidth' is respectively 16 Mbps for the 8MHz channel and 3 Mbps for the 3 MHz channel. Like many other standards, the video and audio coding in CMMB are H264 for video and ACC for audio.

3.5 Summary

The technology section clearly illustrates that there are a number of different technological platforms that can be used for the delivery of mobile TV services. This number is not diminishing; it's growing, and there does not seem to be any confluence around a dominating technology internationally. All of the technologies are, admittedly, not in direct competition with one another. Some are competing and some are complementary.

There are basically three types of platforms: Off-line (podcast), in-band (mobile data channel), and out-of-band (broadcast). Internally in each of these types of platforms, there is primarily competition. The broadcast technologies (DVB-H, DMB, etc.), e.g., are mostly in direct

competition though terrestrial broadcast and satellite broadcast can supplement each other. The same applies for LTE and WiMAX though frequencies may be assigned in a co-existing manner as for instance in Sweden. The relation between broadcast and in-band technologies will, in contrast, often be complementary although competition also takes place, and complementary relations will also mostly prevail between off-line and on-line technologies.

In the choice of technologies, the suitability of the different solutions for mobile TV is obviously an issue. Off-line solutions have the disadvantage of not being able to provide live transmissions. However, off-line solutions are well suited for downloading the favorite programs of users and actually have an important market position in, for instance, the UK. The in-band solutions can build on the advantage of already being available – to some extent, at least. However, the problem is the capacity of these networks whether it runs on managed platforms or whether the general Internet is used. Even 3.5G technologies will not be sufficient in the longer run.

The broadcast solutions, on the other hand, are specifically designed for mobile TV. They require investments in new networks, but they offer an efficient and cost-effective solution. There may be other types of problems relating to business models, but from a purely technical point of view the major problem with these solutions relates to the requirement with respect to standardization and the allocation of frequencies. New high capacity mobile technologies such as LTE and mobile WiMAX may, partly therefore, become viable options for mobile TV. Furthermore, satellite solutions may also increasingly be used as they bypass the problems of international cooperation in the use of the valuable UHF spectrum.

The issue of regional standards is most pronounced in the case of the broadcast solutions. Internet is completely international. Podcasting can exist with many co-existing standards. In the case of mobile technologies, there is technology competition, for instance between LTE and WiMAX, but they also co-exist. Broadcast technologies thus seem to be the most regionalized at the moment: DMB in Korea, ISDB-T in Japan, MediaFLO in the US, DVB-H in Europe (and other places), and CMMB to develop in China. There is heavy inter-regional competition in this field, as especially governments view this as an area of strategic positioning.

Like other regions in the world, Europe has chosen its own broadcast standard namely the DVB family of standards for TV broadcasting in cable, satellite and terrestrial (DVB-C, DVB-S and DVB-T). As discussed in this section, DVB-T is also a mobile standard and is able to deliver mobile TV services to mobile devices in cars, buses and train as well as mobile pocket devices. Looking at mobile TV as an extension of broadcast TV, it is quite natural for Europe to support DVB-H, which from a technical point of view is an upgrade version of DVB-T, developed specifically to be used in the mobile environment.

With regard to the satellite platforms, the development is still in its infancy (except for Korea) but is very interesting. Satellite platforms and in particular a hybrid satellite/terrestrial platform can be quite powerful for the provision of mobile TV services. Satellite also offers a more efficient infrastructure for pan-European service provision. Also in this context one may say that the preferred standard in Europe is likely to be DVB-SH, as the whole backend of DVB-SH is similar to DVB-H and the whole argument about supporting the DVB family of standards in Europe is valid.

As a very general conclusion it seems that the technology uncertainty in the field is the result of the convergence between broadcasting and mobile technologies. If mobile TV was just seen as a new platform for receiving TV on mobile devices, terminals would be developed for TV reception just as many mobile devices presently also function as radio receivers. This is, to some extent, what has happened in Japan and Korea. But the convergence between broadcasting and mobile technologies has opened the way for mobile technologies as carriers for mobile TV and for the integration of broadcasting and interactive services. This is the technological basis for the ongoing controversies in the area.

4. Business models

Business modelling exercises often include service design as well as technology, organisation, and finance design (Bouwman et al., 2008). Service design elements are touched upon in the section on market developments, which also covers the revenue aspect of finance design, while the cost aspects have been left aside. Technology design is discussed in the section on technology solutions, and the present section focuses on the organisational issues. In the area of mobile broadcast TV, the organisational as well as the technology issues are closely related to policy and regulation. The present section, therefore, concerns the organisational issues seen in the light of policy and regulation.

With organisational issues is, in this paper, meant the relationships between the different functions and market players involved in the production and delivery of mobile TV services. These functions and players can obviously be categorised in different manners reflecting the specific divisions of labour in the markets. Functions can either be merged ownership-wise or they can be divided between different market players. However, the main relevant functions are the following:

- Content provision
- Broadcast service provision
- Broadcast network operation
- Mobile network operation

With *content provision* is, in the present context, meant TV channels. TV channels do not themselves produce all the content they assemble; they often buy content from production companies; however, for our purpose, focus will be on TV channels. *Broadcast service provision* functions have existed for a long time in the broadcasting area with cable and satellite operators offering packages of TV channels based on conditional access (CA). Broadcast service providers are, however, new 'creatures' in the terrestrial broadcast environment. With the digitisation of terrestrial broadcasting, they are inserted between the TV channels and the broadcast network operators. They aggregate broadcast channels and they organise the multiplexes (MUX) and add electronic service guides (ESG) and digital rights management (DRM) systems. Broadcast service providers are often called platform operators. Broadcast service provision functions may be performed by different entities. Content aggregation is often organised by mobile network operators in the case of mobile TV, while the organisation of multiplexes is seen to by the platform operators. Furthermore, *broadcast network operators* are the entities that perform the actual broadcasting of signals. Last by not least, the *mobile network operators* are the companies that operate the return channels and/or provide audiovisual material to the users on the mobile channels.

In addition, the network and device manufacturers could be mentioned. With respect to network manufacturing, this is basically covered by the analysis in the section on technology solutions. The different network manufacturers are promoting different network technologies and standards. Regarding device manufacturing, the availability of a variety of terminals has proved to be important for mobile markets to grow. Often, terminals are subsidized by the network operators and are part of packages offered to the users. The sale of terminals is thus dependent on operator subsidies. However, terminals are also sold without being part of subscription packages and are sometimes supporting functions which are not offered by operators; or they are subsidized but still support functions not offered by operators. Mobile terminals may thus be used for receiving mobile broadcast TV without the mobile operators being involved in the mobile TV operation. However, the mobile operators are important for the return channel to be included in the operation and for having access to audiovisual material via Internet or as managed audiovisual streams.

Moreover, advertisers and end users could be mentioned as important players. However, for reasons of simplicity and immediate importance for the business model discussion, this section concentrates on the four above mentioned types of players. Among these, much discussion, at first, centered on the likely problems arising from the cooperation between mobile operators and broadcasters, as they come from different parts of the world of communications and are not used to working together. In fact, the primary problems encountered are often more related to the cooperation between the broadcast service providers, on the one hand, and the mobile operators or the content providers, on the other.

The organizational aspects of the business models established in different countries primarily differ on two accounts: One is the ownership relations of different functions, i.e. whether they are performed by a single entity or by separate entities. This mainly applies to the broadcast service provision and the broadcast network operation, but it can also apply to content aggregation and mobile network operation. The other account relates to the customer contact and the billing of customers, i.e. who 'owns the customer'. In most cases, it will be the mobile operators, but pay TV service providers also have the customer contact in some cases. In extension to this, business models can differ on whether users of mobile TV have to subscribe to a mobile TV service or whether they can access mobile TV by just having a mobile TV enabled device.

4.1 Country cases

As mentioned in the sub-section on the regulatory environment, Italy, Finland and Austria are examples of countries, which have followed different paths with respect to the regulation of mobile TV and, consequently, also different business models. In addition, the German example is dealt with, as it illustrates a problem of cooperation between the different parties to providing mobile TV. Moreover, mobile broadcast in the US is included as an example of a market, which is less regulated than the European setting. Furthermore, the Korean example is dealt with, as Korea is supposed to be a key example of a successful mobile TV implementation[8].

In the case of *Italy*, the regulatory framework for mobile TV was drafted in 2006, instituting the same principles and rules that apply to traditional terrestrial TV and allowing owners of digital TV

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[8] Information in the following on the different countries comes primarily from bmcoforum (bmcoforum, 2008 and 2009) except for Korea. Information on Korea comes from a report from the CAMMP project (CAMMP, 2009).

networks to broadcast to mobile terminals. In parallel to this, the mobile operator '3' announced the acquisition of Canale 7, which had a license for the transmission of digital terrestrial TV. The acquisition was approved by the Italian regulator, AGCM, and '3' launched the world's first DVH-H mobile TV service in 2006 in time for the football world cup. Shortly after '3' announced its acquisition of Canale 7, RTI (Mediaset Group) acquired Europa TV and its digital terrestrial license. This acquisition was also approved by the Italian regulator with the condition attached that the network should be open to all mobile operators on equal terms. In practice, two mobile operators started using the Mediaset broadcast network, TIM and Vodafone.

In Italy, there are thus three different DVB-H based mobile TV offers on the market, provided by '3', TIM, and Vodafone respectively. Italy is an example of a country where no specific spectrum has been set aside for mobile TV; existing terrestrial licenses are used, which in a sense jumpstarted mobile TV in Italy. This model is termed 'extension of existing Digital Terrestrial Television (DTT) rules to new services' by the Commission (COM(2008) 845 final) and is commended for its simplicity and swiftness, but is also criticized for its lack of specific regime for mobile TV, which may prove to be inadequate after the initial period – as the Commission phrases it. The business model result has been a highly vertically integrated approach by '3' and a less integrated model with Mediaset. '3' is mobile network operator, mobile broadcast service provider and broadcast network operator in one and maintains the customer contact. In the Mediaset case, Mediaset is the operator of the broadcast network, while TIM and Vodafone are mobile broadcast service providers as well as mobile network operators and each maintain the customer contact.

The Finnish example is at the other end of the scale regarding openness and lack of vertical integration as compared to '3' in Italy. In March 2006, a DVB-H network license was awarded to Digita. Digita is the mobile broadcast network operator as well as mobile broadcast service provider. At the moment, no pay-TV channels are broadcasted. Instead, all mobile users with DVB-H enabled devices can receive the available free-to-air broadcasts, and users do not have to subscribe to the mobile broadcast TV service. The idea is to have one neutral network and broadcast service operator - a model which is called the 'plain wholesale model' by the Commission (COM(2008) 845 final). The advantage should be to lower the barriers to entry and to involve as many players as possible. However, it has turned out that this model may lead to a lack of incentive for content providers as well as mobile network operators. This is, at least, the analysis by the Commission and is backed by the situation on the Finnish market. The Finnish mobile TV market has never really taken off in terms of parties involved and users. The national public service broadcaster YLE has not yet started its service because of too few users and copyright problems, and the commercial broadcaster Nelonen has taken its channel off the DVB-H network because of copyright problems with foreign programs. YLE has given priority to delivering streamed content, which can be accessed by mobile devices via their yle.mobi portal. The mobile network operators are not involved in the DVB-H market, and do not even advertise the possibility of mobile users with DVB-H enabled terminals to get access to the free mobile TV channels.

At a superficial level, the *Austrian model* has similarities with the Finnish model. However, an important difference is that the market players in Austria had to form consortia before applying for the mobile TV license. This is why the Commission in its 2008 Communication on mobile TV (COM(2008) 845 final) called the Austrian model the 'integrated approach'. Furthermore, mobile TV can in Austria only be accessed by users subscribing to the service. The license tender in Austria included a range of requirements regarding cooperation with content providers, content aggregators and mobile operators and the presentation of promising service and business concepts.

MEDIA BROADCAST got the license in February 2008 and started operating by end May 2008. Before applying for the license, MEDIA BROADCAST had established cooperative relationships with the mobile network operators ONE (now Orange) and '3', and these had agreed on including 15 TV channels and 5 radio stations in their broadcast mobile TV offers. The mobile network operators are thus the content aggregators offering mobile TV services to their customers and having the customer contact. Four mobile operators are presently active in the field: '3', Orange, A1 and Red Bull (as MVNO). MEDIA BROADCAST fulfills the roles of broadcast service providers and broadcast network operators and does not have any influence on TV packages offered. The differentiation between the three mobile network operators involved is on prices, subsidies to handsets and additional TV and video channels offered as streaming media on the mobile channels.

Germany is an example of a country that similarly to Finland may well have led the Commission to recommend an 'integrated approach' of Austria. Three different kinds of licenses are necessary in Germany to offer mobile TV: frequency, platform, and media. But although this complicates matters, this is not the major problem. In October 2007, MEDIA BROADCAT was granted a license to operate the DVB-H mobile broadcast network. In February 2008, Mobile 3.0 won the platform license and content providers that already hold a media license can simulcast on the mobile TV network. The real problem turned out to be that the mobile network operators did not cooperate with the platform provider Mobile 3.0. In the beauty contest for the platform license, a consortium of O2, T-mobile and Vodafone had also applied for the license, but they lost. Instead of starting cooperating with the winner of the platform license, the mobile operators focused on their in-band mobile TV offers and on supporting DVB-T for mobile handsets. The result was that Mobile 3.0 gave up and handed in its platform license in October 2008. Before acquiring the platform license, Mobile 3.0 had negotiated contracts with content providers, but this was not enough. The mobile operators had not been taken in oath. MEDIA BROADCAST continues backing DVB-H, but it only needs to build the mobile TV network after getting a contract from the platform operator. The development has, therefore, been brought to a halt waiting for new initiatives.

The market in the *United States* differs in several ways from the European market, most importantly in the case of the nascent mobile TV market by being much less fragmented. This allows for a politically less interventionist approach in the creation of a market fostering a technology solution with a global impact. In the US, it was decided to auction frequencies from the 'digital dividend' in the 700 MHz range on a technology and service neutral basis. The US political authorities have thus not as the European Union decided to back a specific technology solution. In 2003 and 2004, the Federal Communications Commission auctioned a number of channels in the UHF spectrum prior to the digital TV switch-over, and additional channels were auctioned in 2008. Qualcomm acquired the 6 licenses for channel 55 and have a national foot-print with these licenses. Qualcomm's subsidiary MediaFLO USA uses the licenses for providing mobile broadcast TV in cooperation with its partners Verizon Wireless and AT&T. Presently, MediaFLO reaches approximately 130 million people in the US and Verizon Wireless started offering its service in March 2007 and AT&T started in May 2008. MediaFLO performs the functions of mobile broadcast service provider and mobile broadcast network operator, while Verizon Wireless and AT&T retail the service and have the customer contact. This business model is not different from what is seen in a number of European countries. The estimation is that, by end 2008, there were approximately 100,000 MediaFLO users (White, 2009). This is not impressive and there are and will also be other mobile TV solutions on the US market. MobiTV, using the data channel for streaming mobile TV, has been on the market for a number of years and presently has around 3 million subscribers (CAMMP,

2009), and it is foreseen that the new ATSC M/H solution will reach a number of subscribers slightly higher than MediaFLO by the end of 2009 (White, 2009).

South Korea is with Japan the world leader in terms of users of mobile TV. The Korean government has been heavily supportive of the mobile TV development in Korea promoting the DMB standard (T-DMB, the terrestrial standard, and S-DMB, the satellite standard) with clear industry policy aims of promoting the Korean position globally in the mobile TV market and the mobile media market more broadly speaking. It is estimated that there were 17.25 million mobile TV enabled devices in Korea by the end of 2008 of which 15.4 million for T-DMB and 1.85 million for S-DMB (White, 2009). This equals a penetration rate of app. 35 per 100 inhabitants. In-band data channel solutions are also on offer in Korea and started as early as 2000, but the focus in on the T- and S-DMB mobile broadcast solutions. S-DMB was launched in 2005 and T-DMB in 2006. Licenses for T-DMB are held by 6 broadcasters, while the S-DMB service is operated by a subsidiary, TU Media, of the largest mobile network operator SKT.

T-DMB mobile TV is free-to-air. Users do not pay for the service; they can access mobile TV if they have a T-DMB enabled device, which may be a mobile phone but may also be another type of device, a laptop computer, in-car TVs, etc. The growth in the number of T-DMB enabled devices in the Korean market was app. 70% in 2008. This vast growth is primarily attributed to the fast turnover of mobile terminals, as terminals will mostly be T-DMB enabled, though it may not be the T-DMB facility that users are looking for. They acquire new terminals partly because of other new facilities, primarily for positioning. The mobile network operators have not been happy with the business model (or the lack of it) around the T-DMB solution, as they do not hold the customer contact and do not make any money on it. But because of the fast pace of terminal change and the churn in the market, mobile operators are subsidizing terminals, which have T-DMB reception as one of the facilities. The mobile broadcasters do not make much money on T-DMB either. They make their money on commercials. However, this has been scanty partly because regulation only allows commercials in the breaks between programs, not during the programs Regarding the S-DMB solution, the business models is more straight-forward. Users subscribe to the service, and with a growth in the number of subscribers of 45% in 2008, the number of subscribers is reaching towards a figure, where an economic break-even is reached. However, until now the mobile TV development in Korea has not been driven by profitable operations in the field. It has been driven, to a large extent, by the government and its ambition to position the Korean equipment manufacturers in the global market and, in the T-DMB, area by the fast turnover of terminals.

4.2 Summary

In summary, here seems to be major issues that need to be resolved regarding the organisational aspects of business models. The European Commission has stated its preference for the 'integrated approach' in order to secure the commitment of the different market players, most notably the mobile network operators and the content providers. The Finnish model is an example of a situation where neither the mobile operators nor the content providers are committed to the project. The German model is an example of the problems with a lack of interest from the mobile operators. In three of the country cases described (Italy, Austria and the US) the mobile operators have a central position. They have the customer contact and market the mobile TV service to the users. Although one can discuss the rate of success in these countries, they seem to be among the relatively more successful. However, the most successful examples in terms of market penetration are Korea and Japan. But the character of the success in Korea can be discussed. The huge Korean penetration is

not the result of a profitable mobile TV market. It is largely due to the promotion by the Korean government and the equipment manufacturers.

Two basic conclusions come out of the country case analyses. The first one is that the mobile TV market is a technology/supply push market, to a large extent. Had it been a demand pull market, it would most probably have grown also in Finland. The rate of success of the Finnish model is based totally on the anticipation of a demand pull market. The Finnish model has similarities with the Korean model. The decisive difference, however, is the strong involvement of the government in Korea. The other conclusion follows from the former. The fact that the mobile TV market needs strong promotion points at the crucial role of the cooperation and commitment of the parties involved. There are differences between the different countries with respect to the relationship between the mobile broadcast network operation and the mobile broadcast service operation. But this is not decisive. The important thing is the relationship between the mobile network operators and the content providers, on the one hand, and the broadcast network operators and broadcast service operators, on the other. Much discussion in the field has traditionally been on the possible clash between the mobile world and the broadcast world. But this does not seem to be the case in reality. It is the above mentioned kinds of relationships which are important.

5. Market developments

5.1 Status

Various mobile broadcast standards have been launched in markets all over the world with varying success. Table 3 presents an overview of the market situation in major markets.

The majority of mobile TV deployments in Europe are based on the DVB-H standard. This is due to the status of the DVB-H standard as the preferred standard selected by the EU. As seen in table 3, the most visible development in Europe has been taken place in Italy.

Japan is the leading market for the deployment of mobile TV services. At the end of 2008, Japan had shipped more than 40 million handsets equipped with TV receivers. This huge number does, however, not reflect the real use of the services and mainly indicate the availability of the services on the market.

The Asian markets, despite their large subscriber numbers have not been generating much revenue. The primary reasons are 1) free-to-air services offer, 2) very restrictive regulation on advertising (in Korea), and 3) broadcasting regulation which prohibited special programming to mobile devices until 2008 (in Japan).

Table 3: Mobile TV markets, end 2008

Country	Standard	Subscribers	Funding model	Service providers
Austria	DVB-H	90,000 users (a)	FTA	MEDIA BROADCAST
			Pay service	3 Austria (H3G), Orange (formerly One), A1, Red Bull Mobile (b)
Italy	DVB-H	850,000 users	FTA	3 Italia
			Pay service	3 Italia, Vodafone Italy, TIM (c)
Finland	DVB-H	<10,000 users	FTA	Digita
Japan	ISDB-T "1seg"	40 mill. handset	FTA	DoCoMo, KDDI, Softbank (d)
Korea	T-DMB	15.4 mill. users	FTA	6 broadcasters: KBS, MBC, SBS, YTN DMB, U1 Media, KMMB
	S-DMB	1.85 mill. users	Pay service	TU Media Corp (e)
USA	FLO	100,000 users	Pay service	AT&T, Verizon Wireless

Source: Rethink Wireless, 2009

Notes:

a. The source for Austria is bmcoforum and the number indicates the number of people who use mobile TV once a months. They use either DVB-H or streaming.

b. All operators are offering 6 free-to-air TV channels.

c. Mediaset is operating the broadcast network.

d. DoCoMo, KDDI, and Softbank have introduced mobile TV handsets which support 1Seg mobile TV broadcasting in Japan.

e. A subsidiary of SK Telecom.

The US has generally adopted the Forward Link Only (FLO) standard. However, the ATSC-M/H (when completed) is seen to be an important driver for mobile TV developments in the US. This is mainly due to the interests of the local broadcasters in the US and, as stated in Rethink Wireless (2009), 'this will allow local broadcasters to begin transmitting free-to-air services ... giving a chance for the other parts of the broadcasting community's mobile TV ecosystem to bear fruit'.

New markets that are highly interesting to follow are China and India. China has developed its own standard and according to the Chinese authorities, 'there is a hope that 12 million viewers of mobile TV will exist in China in 2009' (Rethink Wireless, 2009). India is an interesting market also from a European perspective as the expectation is that India will go for DVB-H and DVB-SH standards. At

the moment, the incumbent broadcaster Doordarshan already has 8 MHz of spectrum and will try to launch DVB-H services (Rethink Wireless, 2009).

5.2 User preferences[9]

Based on the pilot studies and market research conducted in a number of countries, it can be pointed out that there are notable differences concerning users' preferences regarding mobile TV consumption and the attitudes of the users towards new services. There are also particular regional differences, which influence the rate of mobile TV adoption around the world.

Use context

The commercial implementations of mobile broadcast TV services have shown that usage patterns differ from country to country. In Italy, almost 60% of users watch mobile TV predominantly outdoors. Most users watch mobile TV in their professional environment, at work or school. In Austria more than 50% of the users are watching mobile TV at home. Users are also likely to watch mobile TV when travelling on trains, buses and other forms of public transportation. In South Korea and Japan, the expectation was that people would use mobile TV mostly outdoors, but viewing of mobile TV services at homes, offices and the subway are as common as outdoor usage. When studying the Korean case, it is surprising to see that people quite often watch mobile TV in their own cars (18%). In Japan, almost 40% of viewers watch broadcast mobile TV services at home in rooms with no TV.

Average use

Market research and usage data confirm that consumers are progressively adopting mobile TV services and, once adopted, they use mobile TV services with increasing regularity. In Korea and Italy, the average consumption of mobile TV is 64 minutes per day, which is higher than expected. In Austria, viewing time is almost 30 minutes per day. Data presented by MediaFLO show that FLO TV viewers are spending an average of more than 20 minutes per day watching television on their phones. This is comparable to the average time US cell phone users spend per day talking on their cell phones.

Revenue models and consumers willingness to pay

Research conducted in various countries has shown that payment for mobile TV services have a critical influence on the attitude of users towards adopting broadcast mobile TV. Free-to-air mobile TV services have been important for the relatively high adoption rates in Japan and Korea.

In Europe and the US, subscription business models dominate at the moment, but there is a trend towards introducing free-to-air programs for subscribers. Recently, 3 Italia introduced free-to-air mobile services. In Austria, MEDIA BROADCAST is providing public service channels for free. In the US, MediaFLO USA recently added a free-to-air promotional channel called PROMO. A

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[9] This section is mainly based on a report on country case studies developed as a deliverable in the CAMMP project[9]. The full version of the deliverable can be downloaded at the project's web site: http://www.cammp.dk

PROMO channel is available to all wireless customers with a FLO TV enabled mobile phone, but for a limited time only.

Research conducted in European pilots has shown that people are willing to pay a modest subscription fee for mobile TV, but it is more likely that the free-to-air model will be preferable for the fast take up by users. According to research conducted in Asia, however, customers are not willing to pay for services. 67% of T-DMB users say they will not use T-DMB if they have to pay for the service.

6. Conclusion

The aim of the paper is to discuss and shed light on EU policies in the area of mobile TV. Mobile TV has now been on the market for a few years and in contrast to discussions just a couple of years ago there is some evidence to support the discussion. Was it right to unequivocally support DVB-H as the network platform or, rather, has it turned out to be a too hasty decision in light of the developments since then?

There is hardly any doubt that mobile TV has been seen by the European Commission as the 'killer application' paving the way for new value-added mobile services and that the GSM experience with an EU decision on the technology to be implemented has been seen as the positive precedent. Does it seem as if mobile TV will become this kind of driver – it could be added to the first question?

In favour of the EU decision to support DVB-H are many good arguments:

- First of all, there are - and especially have been – good technical reasons for supporting a broadcast solution for mobile TV, as this is a far more spectrum economic solution than an in-band solution.
- Secondly, DVB-H is a natural extension of choosing DVB in general for digital broadcast in Europe.
- Thirdly, the European market is indeed more fragmented than, for instance, the US or Japanese markets, and common decisions are necessary if a single market is to develop in this field.
- Such a single market has different advantages in terms of cross-border services for users but just as importantly in terms of delivering an industry policy support for the mobile manufacturing and service industry in Europe in the global environment.

Against such a policy of support for the DVB-H standard for mobile TV speaks:

- The danger of politically supporting a standard, which runs the risk of being technologically or otherwise obsolete or bypassed.
- The fact that mobile TV, as at yet, has not turned out to be a market success.

The first argument against is the general argument against all policy decisions to support a specific standard. At the overall level, the EU is in favour of a policy of technology neutrality, but it is also part of the EU policy that there can be exceptions to the general technology neutrality principle. The second argument relates to the specific experience with the actual development of mobile TV in the

European market until now. There are thus good reasons to take a renewed discussion concerning the EU decision to support DVB-H and the way that it has been done.

In the technology area, there does not seem to be any confluence in the technologies used for mobile TV. There is a growing array of technologies, which can be used for mobile TV, and the fiercest competition between regions of the world is in the area of mobile broadcast technologies. The different technologies can be partly substitutive and partly complementary. For a mass take-up of mobile TV, the broadcast solutions are the most effective and cost-efficient. However, with the advent of mobile WiMAX and LTE, there can also be operators basing their mobile TV offers on such technologies. But satellite seems to be the most promising technology alternative. Satellite-based mobile TV is already on offer in Korea with S-DMB and the DVB-SH standard is on its way. This does not mean that EU support for DVB-H is a failing strategy, but it means that it is wise to keep an open mind, as new technology solutions can become important supplements or even alternatives.

The technology environment is thus unstable and so is the business model situation. Different business models are used in Europe and elsewhere. Implementing a broadcast solution, the biggest problem has turned out to be the cooperation between the content providers and the mobile operators, on the one hand, and the platform operators, on the other. Before the actual market launches, the focus was on the cooperation between the 'broadcast world' and the 'mobile world' in general. But this does not seem to be the real problem. The real problem is the other one, and this needs to be dealt with. An important issue is the diffusion of terminals/devices. Experience from the mobile market has shown that subsidization is instrumental in a fast diffusion of devices and the mobile operators play a major role in this context.

However, even though the technology choice is made and a promising business model found, there is no guarantee for success in the market. There is a serious lack of sufficiently attractive services, which users are willing to pay for. This is a lesson learnt until now. There is very little money to be made on traditional TV on mobile devices. Trials and market experience, indeed, show that mobile TV is used in situations not expected when it was developed. This may point at interesting market potentials. However, if mobile TV is to become a market success in terms of profitability, it will be necessary to develop the service with respect to interactivity and personalisation. This, promoters and observers have said all along, and market experience shows that it's right.

Until now, mobile TV has, to a large extent, been a supply/technology push market. The difference between the market penetration in Korea and Finland clearly proves the case. The business models used in Korea and Finland have many similarities, and it's the huge government push in Korea, which had made the great difference. In contrast to what was implicitly assumed in the policy of the European Commission, mobile TV in its present form is not a 'killer application'. It may also be that mobile TV illustrates a more general lesson, namely that users are not prepared to pay much for content as such. There is a greater willingness to pay for inter-personal communications and interactivity.

This does not mean that mobile TV or video on mobile devices will not eventually become a market success. It is difficult to imagine that different forms of video on mobile platforms will not grow in the coming years. However, as all other new media, mobile TV also has to find its own 'language'. As it is today, mobile TV is basically traditional TV on mobile devices, and it has some way to go before it becomes a truly new service including interactivity and personalization. The development

of targeted content for mobile TV is still in its infancy. Mobile TV content is yet to be provided and evaluated by the market. Examples of new content / services for mobile TV would be: 1) personalized interactive and context aware content, 2) user generated content 3) gaming services, 4) betting services, and 5) mobile soaps.

With regards to the development of the market, another important issue is that the deployment of broadcast technologies is a slow process. This is due to historical and cultural reasons and due to the fact that the whole area is within the jurisdiction of national governments and must go through different hearing procedures, balancing political interests, etc. making the process slow. The transition from terrestrial analogue TV to digital TV has, for example, taken more than one decade, while the transition from analog to digital for satellite TV took just a few years.

As a direct answer to whether the EU policy in the field has been right, the answer must, therefore, be that there has been nothing wrong with supporting DVB-H, but that the policy needs to be more flexible in the face of technological developments and the lack of success hitherto. There is, furthermore, nothing that indicates that mobile TV is the killer application that will drive the market for new mobile services. It will be part of it, but not any killer application – not even if a 'killer business model' is applied with much more commitment in the cooperation between the different business partners as recommended by the European Commission.

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