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MOBILE TV

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EXECUTIVE SUMMARY

The aim of the present study is to assess key issues in the debate on mobile TV in Europe. The commercial market for mobile TV is nascent, with the completion of technical pilots and the release of the first full-scale commercial offerings. While the potential market for mobile TV is substantial, the take-up of services in Europe remains slow in comparison with the United States and Asia. Fragmentation as a result of multiple technical standards may hamper the emergence of a strong internal market for mobile TV. In response, and inspired by the success of GSM (the Global System for Mobile communications), the European Commission has announced that it will push for a single standard and a consistent regulatory regime across Member States to achieve economies of scale and flexibility for users. This should also stimulate Member States to earmark spectrum released from the switchover from analogue to digital TV for mobile TV in dedicated bands. The industry, represented by the European Mobile Broadcasting Council (EMBC), argues however that no regulation is necessary at this point in time and that a single standard enforced throughout the European Union would favour some technologies over others. This study evaluated the merits of various strategies and standpoints from the perspective of technology standards, market developments and spectrum management.

Technology developments

Four bearer technologies currently dominate the mobile TV landscape: Digital Audio Broadcasting — Internet Protocol (*DAB-IP),* Terrestrial Digital Multimedia Broadcasting *(T-DMB),* Digital Video Broadcast - Handheld *(DVB-H)* and Forward Link Only *(FLO).* There is no industry consensus on which bearer technology is best suited for mobile TV, nor is there consensus on the differences between the various technologies. In our opinion, none of the bearer technologies provides a significant advantage over the others, *when considering the technical aspects of the technologies.* All four bearer technologies are in principle fully capable of carrying mobile TV.

The service-layer technologies that are currently considered for provisioning mobile TV broadcasts differ significantly. Of the service level architectures, both Digital Video Broadcast Internet Protocol Datacast (DVB IPDC) and Open Mobile Alliance Broadcast (OMA BCAST) fully specify the mobile TV service, including provisioning, service guide, interactivity and various methods for service and content protection, in an open and standardised manner. Both rely on an Internet protocol (IP)-based abstraction layer between the service and bearer technology. *DVB IPDC and OMA BCAST provide an advantage over other technologies when considering a mobile TV broadcasting service.*

With respect to technology developments in the future, we expect that broadcast and unicast services will coexist on the network side and will be integrated in the terminal. TV content which is of interest to large numbers of consumers will be broadcast, while content that is of interest to a smaller group of consumers can be offered on-demand via unicast networks. The user will ultimately be offered an integrated service of regular broadcasting and on-demand content. Recording, time-shifting and super-distribution of content are likely developments which will also depend on the implementation of security in the terminal.

Market development

Four countries in the European Union – Finland, Italy, Germany and the United Kingdom – have released full-scale mobile TV offerings; eleven countries are conducting trials in preparation for a launch in 2007 or 2008. The predominant standard in trials and offerings is DVB-H. BT-UK has recently announced it will abandon its DAP-based Movio service partly because of the EU endorsement of the competing DVB standard. That leaves DMB-based Mobile Fernsehen in Germany as the only significant non-DVB-H offering. However, a DVB-H offering is planned for Germany as well. ***DVB-H is a clear contender to become a single standard in the EU market.***

Estimates of the size of the mobile TV market vary widely. ***We estimate that the maximum penetration of mobile TV broadcasting services will be between 20 and 40 per cent, with average revenue per user (ARPU) of a maximum of €10 per month for a mobile broadcast subscription.*** In the long run, on-demand video services will overtake mobile broadcasting. The ARPU of these services will depend heavily on the emerging business models (flat fee, pay-as-you-go or advertising-sponsored).

Standards and harmonisation

E*conomy of scale* and an *anytime, anywhere* service paradigm – can be facilitated by the following measures:

- Harmonising on a single network bearer.

- Licensing a wholesale-based model with a single operator for each Member State.

- Harmonising *within* a single service layer.

For mobile TV it would seem justified to regulate the use of a single network bearer layer in combination with a wholesale-based model in each Member State. This promotes economies of scale and prevents market fragmentation in the cellular terminal industry. Furthermore, it fulfils an important precondition for end-users: to freely choose and switch between service providers with a single mobile TV terminal. At this point in time DVB-H is the most favourable, not because of its inherent technical properties, but because it offers multiple and completely standardised service layers, which allow for a standardised means of sharing broadcast content, while tailoring the service offering to the conditions of each individual provider, thus leaving room for service differentiation. In addition, DVB looks to be the only standard with sufficient potential spectrum available.

While anywhere and anytime usage can be enabled by harmonisation *within* a single service layer, the mobile TV service providers have legitimate reasons to choose components within a service layer that are not fully interoperable with other service providers, from the end-user point of view. Hence we feel that harmonisation by regulation is not justified. Other lighter regulatory incentives to stimulate service providers to harmonise on a single service layer and *within* a single service layer may be appropriate.

The risks of harmonisation on a single bearer layer (such as DVB-H), with a single wholesaler in each Member State, are that

i)   there are already countries in which mobile TV services based on other bearer layers are in place, and

ii)   a single wholesaler also means that only a single party has the control over the major part of the content offering.

On the first point, the fact that there are mobile TV services available over various broadcast bearers is the very reason a common standard is being considered. On the second point, we believe that for broadcast mobile TV the content will for the major part consist of the most popular material (to justify a broadcast distribution), and hence would serve the majority of the end-users. Finally, it can be argued that 2G/3G services have benefited from competition between service providers that were all licensed a part of the available spectrum. However, a key difference between 2G/3G interactive services and mobile TV is that the first is a *one-to-one* service, while the latter is a *one-to-many* service. Since relevant spectrum for broadcast is scarce, there are good reasons for having a single wholesale broadcast network operator and avoid wasting spectrum on parallel systems and parallel distribution of (identical) content. This is exactly the reason why mobile broadcast has advantages over unicast based 2G/3G solutions for the mobile TV service, in spite of potentially reducing competition on the network level.

Spectrum management

Key to the success of any system for mobile TV is the timely and guaranteed availability of sufficient spectrum in a sufficiently large part of the European Union. Summarising the issue, we note the following.

In most countries, the VHF band III offers a capacity of one 7 MHz layer, but the right to decide is within the domain of the Member States. This spectrum will not be available before 2012. 1.75 MHz spectrum is available in the short term.

The UHF band IV/V offers one or few layers per country on the short term, but not in a harmonised sub-band. To evolve toward harmonised sub-bands in the long term, we recommend the European Commission to take the lead to identify early the most appropriate sub-bands and orchestrate the process. There is capacity for two harmonised sub-bands**Error! Bookmark not defined.**.

To some extent, the current 1.7 MHz channels in the lower L-band can be aggregated into 5.1 MHz channels. The extent is not clear. With a full revision of the Maastricht Agreement, which will take many years to accomplish, it is doubtful a full 5.1 MHz band could be available everywhere (full coverage).

In summary, in the distant future, bands III and IV/V and the lower L-band will provide from three to four layers for mobile TV services with national coverage. In the short term, spectrum is available but subject to a narrow channel width of 1.75 MHz (VHF) or 1.7 MHz (lower L-band) or scattered over the whole 470-862 band IV/V.

In view of the spectrum shortage, the application of wholesale models and modern spectrum management models like an easement model and spectrum trading next to the conventional spectrum management approaches would be instrumental in the efficient use of the spectrum. *We recommend the European Parliament to call on the European Commission to pursue the application of a wholesale model and modern spectrum management approaches next to the existing "command and control" spectrum management practice, albeit that the introduction of such new management models should be given the necessary caution.*

Community action

Even though the impact, for example, of copyright provisions and the rules in *the new AVMS Directive must be considered in this context, the greatest regulatory obstacle is the range and variation in national approaches among Member States.* This could prove an impediment to the development of pan-European services. The introduction of a common technical standard for mobile-TV such as DVB-H could pave the way for harmonisation of national regulatory regimes.

Although a decision on the use of a common standard, such as DVB-H, seems to run counter to the principle of technology neutrality, the provisions in the general framework and the 2006 Review accept that public interest may justify such decisions. It can be argued that the public interest is well served by a single market in mobile TV when economies of scale and interoperability allow for affordable pricing, a wide range of (pan-European) services and (international) roaming.

A key aspect in choosing between technology standards is the existing technology trajectory in Europe and the related decisions regarding spectrum use. In countries that deploy DVB-T, there are natural arguments for using DVB-H as the mobile TV standard. The specific reasons are related to, first, backward compatibility; second, the fact that DVB-T and DVB-H are using capacity in the same frequency bands and that resources for DVB-T can therefore be allocated more easily; and third, that there is a wide European experience base in deploying the DVB standard.

Regarding the allocation of frequencies *in the medium term*, for as long as the current agreements are in place, only the Member States are in the position to propose and negotiate changes with the other countries that have signed the Agreement. Furthermore, only adaptations that fit within the scope of the current Agreement are feasible. In that sense the European Commission is not in the lead. However, the Commission can coordinate and promote new directions. It can propose a new spectrum management framework or elements of such a new framework and persuade the Member States to negotiate these with the other administrations that have signed the Agreement. As such we recommend the Commission to outline an EC spectrum management policy that is supported by all Member States and that fits within the current Agreement, and convince the Member States to negotiate the implementation of this policy.

In the long term, when respectively a next revision of the Geneva 2006 Agreement and of the Maastricht 2002 Special Agreement is at hand, *the European Commission can aspire to become the representative of all EU Member States in the preparations and negotiations of a new Agreement.*

An important hurdle in the development of a single internal market for mobile TV are the differences in national authorisation regimes both in the allocation of frequencies and in the awarding of content licenses to mobile TV service providers. These differences are associated with cultural, professional, economic and market factors, making it difficult for actors to have a presence in all markets.

Regarding the market organisation of the provision of mobile TV, the analysis concludes that the most efficient organisation of the bearer layer is to have a single provider at the national level. One of the main tasks of the regulatory bodies at national level is to find models for assignment of the spectrum and license to the 'bearer layer operator'. *The European Parliament could encourage the European Commission to prepare guidelines on the implementation of the wholesale model. The wholesale model can provide the framework to also address issues such as standard authorisation procedures and patent exchange mechanisms.*

INTRODUCTION

In a July 2007 communication[1] on *Strengthening the Internal Market for Mobile TV*, the European Commission lays down its plans and ambitions for promoting a successful take-up of innovative mobile TV[2] services in Europe. The communication highlights three key strands in its approach to creating a favourable environment for mobile TV in Europe:

- *A common technical standard.* The Commission favours DVB-H over other standards currently in use in Europe.

- *A transparent and light-touch regulatory environment* that ensures sufficient regulatory certainty for industry while promoting consistency and a level playing field across Europe.

- *A dedicated, harmonised quality spectrum in the UHF band* (470–862 MHz) in the long run, employing spectrum released in the switchover from analogue to digital terrestrial broadcast (the 'digital dividend'). In the short term temporary allocations in other bands will serve to enable the start of mobile TV operations.

Overall the Commission approach is aimed at achieving ***economies of scale*** in the deployment of mobile TV that creates a favourable environment for operators and consumers, as it is regarded as the key to a successful take-up of this innovative service. Furthermore the approach is aimed towards the ***anytime, anywhere*** service paradigm for users of mobile TV across Europe that requires ***interoperability*** as indicated by Commissioner Reding in the assignment towards the EMBC: *"The challenge is the following: providing technological solutions that are best suited to ensure the availability of mobile TV anytime and everywhere, including at home, and making technological choices that allow attractive commercial offers[3]."* and "*Achieving a maximum of **interoperability** between distribution technologies and mobile TV devices – be it mobile phones, PDA, communication enabled game consoles or other devices - is also of key importance[4].*" That strategy was also the basis of the success of GSM by facilitating a strong, single EU market for mobile communications.

The present study will look at four key aspects of the debate on mobile TV in Europe: *technologies*, *markets*, *harmonisation* and *regulatory action*. It will inform the discussion on the merits of the Commission strategy in achieving the goal of a strong internal EU market for mobile TV.

This study focuses on mobile TV *broadcast* rather than unicast for two main reasons. First, broadcasting remains for the foreseeable future the most efficient way for the large-scale provision of regular TV programming. Second, unicast mobile TV will exist – and very likely grow – *in parallel to* but not necessarily *at the expense of* broadcast TV.

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[1] *Communication on Strengthening the Internal Market for Mobile TV*, COM (2007), 409 of 18 July 2007.
[2] For the purpose of this study 'mobile TV**'** refers to broadcast terrestrial mobile TV services only unless otherwise indicated.
[3] Commissioner Reding's speech at CeBIT, March 2007, http://europa.eu/rapid/pressReleasesAction.do?reference=SPEECH/07/154&format=HTML&aged=1&language=EN&guiLanguage=en.
[4] Ibid.

1. TECHNOLOGICAL DEVELOPMENTS

Mobile TV broadcast concerns the simultaneous wireless broadcast of multimedia content to large numbers of consumer devices. The delivery of a mobile TV service requires the selection of a *bearer* technology and on top of that a *service architecture.* The bearer technology relates to the physical and transport layer aspects such as modulation and transmission, whereas the service technology covers specification of content formats, service and content protection, and service description. Typically, an abstraction layer is defined that decouples certain aspects of the bearer technology from the service technology. The consumer experience is mostly determined by the service architecture.

Since the main focus of this study is broadcast rather than unicast transmission, as mentioned in the introduction, this section describes the main bearer and associated service technologies that are considered for mobile TV broadcasting. Figure 1 details these technologies.

Figure 1: Main bearer and service technologies
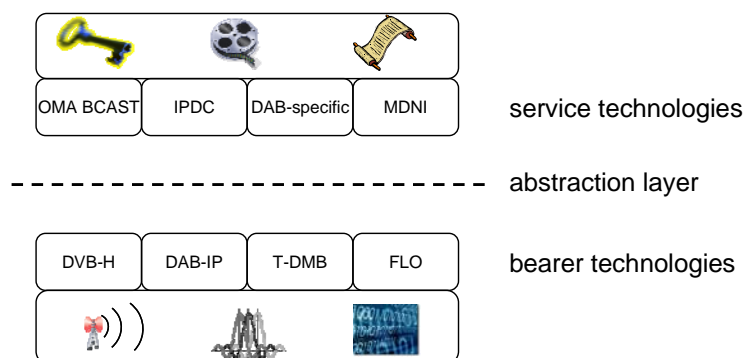
Source: TNO, 2007.

1.1 Main bearer technologies

While there are other bearer technologies for mobile TV in existence or under development, four technologies currently dominate the mobile TV landscape. Detailed descriptions of most bearer technologies can be found in the EMBC technical workstream document[5].

DAB-IP and T-DMB

DAB (digital audio broadcasting)[6] is a series of standards established by the original European-funded Eureka 147 project. Initially designed for the transmission of digital audio, DAB currently offers a range of audio and multimedia broadcasting services including audio, video, data, image, text and other applications. There are many DAB variants, each with dedicated transport protocols for specific services. In the context of mobile TV there are two primary derivatives: DAB-IP and T-DMB.

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[5] EMBC (2007e) *Technical Workstream*, http://www.ebu.ch/CMSimages/en/tec_embc_technical_report_tcm6-50235.pdf.
[6] ETSI EN300 401, *Radio Broadcasting Systems: Digital audio broadcasting (DAB) to mobile, portable and fixed receivers.*

The DAB-IP[7] derivative of DAB targets audio/video delivered directly over the IP protocol layer using the so-called DAB enhanced *packet* mode. T-DMB[8] is essentially a combined video and data service based on the DAB enhanced *stream* mode. It places a number of services on top of the basic audio service that are transported using the MPEG-2 transport stream[9].

DVB-H

DVB-H (digital video broadcasting – handheld)[10] is the new digital broadcasting standard, developed by the international DVB Project, for the transmission of video, audio and data to mobile handset terminals. It builds upon – and is largely compatible with – the existing DVB-T standard[11] for terrestrial broadcasting. The standard describes several extensions to DVB-T, specifically tailored to the requirements of mobile reception and transmission environments. These extensions include time-slicing to achieve reduction of terminal power consumption, seamless service handover, and increased error correction to improve performance in typical mobile channels.

FLO

The FLO (forward link only) Air Interface[12] is the bearer technology of the MediaFLO system developed and owned by QualComm and now further developed by Qualcomm in conjunction with the FLO Forum for the efficient transmission of multiple multimedia streams to mobile devices. The FLO specification for terrestrial mobile multimedia multicast defines all aspects of the FLO bearer layer. Since FLO technology is designed from the ground up to enable a broadcast network overlaid onto the cellular network, it is not hampered by backward compatibility constraints.

Comparison

All the bearer technologies that are currently being considered for the provision of mobile TV broadcasting have addressed the key challenges involved in the wireless broadcast of multimedia content to large numbers of consumers:

- fast channel switch time;

- efficient use of bandwidth;

- minimisation of power consumption;

- providing robust reception in a mobile fading environment; and

- integration of broadcast and unicast services.

- the ability to receive broadcast services in conjunction with other mobile services such as telephony and Internet access on their device.

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[7] ETSI ES 201 735, *Digital Audio Broadcasting (DAB): Internet Protocol (IP) datagram tunneling.*

[8] ETSI TS 102 428, *Digital Audio Broadcasting (DAB): DMB video service; User Application Specification.*

[9] ETSI TS 102 427, *Digital Audio Broadcasting (DAB): Data Broadcasting - Moving Picture Experts Group (MPEG) - 2 TS streaming.*

[10] ETSI EN 302 304, *Digital Video Broadcasting (DVB): Transmission System for Handheld Terminals (DVB-H).*

[11] ETSI EN 300 744, *Digital Video Broadcasting (DVB): Framing structure, channel coding and modulation for digital terrestrial television.*

[12] TIA-1099, *Forward Link Only Air Interface Specification for Terrestrial Mobile Multimedia Multicast.*

As such, each of the aforementioned technologies can serve as the basis for a fully operational mobile TV service. In fact, they share many common properties such as the use of COFDM (coded orthogonal frequency division multiplexing) transmission, QPSK (quadrature phase shift keying) and/or QAM (quadrature amplitude modulation) modulation schemes and various manners of error correction. **A variety of system and performance comparisons between the technologies can be found**. In an European Broadcasting Union (EBU) technical review,[13] DAB is claimed to outperform DVB-H. Similarly, the WorldDMB forum comparison of T-DMB and DVB-H[14] claims T-DMB has an advantage over DVB-H. On the other hand, the DVB project has released documents in which DVB-H is compared favourably with both T-DMB[15] and FLO[16]. A detailed overview of the common properties of and the differences between the bearer technologies can be found in the Broadcast Mobile Convergence (BMCO) forum bearer comparison[17].

There is no industry consensus on which bearer technology is best suited for mobile TV, nor is there consensus on the differences between the various technologies. In our opinion, none of the bearer technologies provides a significant advantage over the others, when considering the technical aspects of the technologies. All four bearer technologies are in principle fully capable of carrying mobile TV.

The main questions that remain to be answered when selecting a bearer technology are:

- What is the availability of preferred spectrum bands for each bearer technology?

- What is the possible and available integration with service layer technologies? For example, are multiple service layer technologies available on top of a bearer technology? How tight is the link between bearer and service technology?

1.2   Main service technologies

Service technologies specify some or all aspects of the mobile TV service as experienced by the consumer. All service technologies specify the three main components for a broadcast service: the content format, the manner of service and content protection, and the description of service information (typically through what is described as a service or programming guide). Some go beyond describing basic service requirements and specify all aspects related to the business processes that service providers encounter when deploying a service, such as subscription management, roaming and interactivity services. Detailed descriptions of the service technologies can be found in the EMBC *Technical Workstream* document[18]. An important fact to consider is that *each of the existing service technologies is defined for a limited number of bearer technologies. Thus, the selection of a bearer technology precludes the selection of service technologies*.

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[13] A. Sieber and C. Weck, What's the difference between DVB-H and DAB in the mobile environment? *EBU Technical Review*, July 2004.

[14] WorldDMB, *Mobile TV, Advantages and Possibilities: Closer look into DMB and DVB-H*, http://www.mtvnl.nl/files/2007_07_11_MTVNL3_Worlddmb.pdf.

[15] DVB Technical Module 2006, *System Comparison T-DMB vs. DVB-H*, TM3490_DVB-H281r1.

[16] DVB Technical Module 2006, *MediaFLO vs. DVB-H C/N Performance*, TM3615_DVB-H334.

[17] BMCO Forum, *Mobile Broadcast Bearer Technologies – A comparison*, http://www.bmcoforum.org/fileadmin/user_upload/Downloads/Mobile_Broadcast_Bearer_Technologies.pdf.

[18] EMBC *Technical Workstream*, http://www.ebu.ch/CMSimages/en/tec_embc_technical_report_tcm6-50235.pdf.

IPDC over DVB-H

The DVB project IPDC (IP Datacast)[19] over DVB-H is a set of DVB specifications for IP datacasting that can be described as the essential components required to deploy a commercial mobile TV service based on an IP abstraction layer. IPDC covers system architecture, use cases, the electronic service guide (ESG), content delivery protocols, service and content protection and the aspects related to the business processes as mentioned above. IPDC was originally designed for use with the DVB-H physical layer, but adaptations to other bearer technologies, such as DAB/DMB, are currently being considered.

OMA BCAST over DVB-H and MBMS

The Open Mobile Alliance (OMA) BCAST standard for mobile broadcast services[20] is a set of specifications for the complete provision of a mobile TV service. It comprises system architecture, use cases, ESG, content delivery protocols, service and content protection, interactivity services and the aspects related to the business processes. A key feature of OMA BCAST is that the specification is independent and agnostic of the underlying network bearer, although a main requirement is that the underlying bearer technology has an IP abstraction layer in order to transport all (streaming) media and file data. For the first release of the specification, OMA BCAST incorporated adaptations to three underlying bearer technologies: DVB-H, MBMS and BCMCS (see section below on *other technologies*). Adaptations to other bearer technologies, such as DAB/DMB, are currently being considered.

DAB-specific service technologies

Rather than specifying a single service technology for all DAB-derived services, DAB allows for a whole range of independent service specifications, as well as proprietary service technology. As an example, the BT Movio/Virgin Mobile Service employs a complete Windows Media codec-based solution on its DAB-IP layer. T-DMB relies on standard MPEG technology such as the MPEG-2 Transport stream, and MPEG-4 systems specifications which are widely used for TV services in a fixed environment. Other transports and protocols are available for specific services such as traffic information and navigation support (TPEG[21], TMC[22]).

MDNI over FLO

The upper layer communication between a FLO network and an FLO enabled device is primarily defined by the FLO forum approved System Information (SI)[23] and Multicast Device Network Interface (MDNI)[24] specifications. The MDNI specification consists of two main parts, which together define the protocols for delivering services over the FLO air interface. MDNI has been designed specifically for the FLO air interface.

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[19] ETSI TR 102 469-473: *IP Datacast over DVB-H*, http://www.dvb.org/technology/standards/#internet.
[20] OMA Mobile Broadcast Services V1.0,
http://www.openmobilealliance.org/release_program/bcast_v1_0.html.
[21] Transport Protocol Experts Group, http://www.tpeg.org.
[22] Traffic Message Channel, http://www.tmcforum.com.
[23] SI-FLO *Forum Technical Specification*, FloForum-p0001.088.00.
[24] MDNI-FLO *Forum Draft Technical Specification,* FloForum-2006.138.00.

Comparison

The service technologies that are currently being considered for the provision of mobile TV broadcasting differ significantly in key aspects such as:

- possibility and existence of adaptation to more than one bearer technology;

- separation between bearer and service layers by defining a general abstraction layer;

- completeness and openness of service specifications;

- usage of service guide, including provision of interactivity;

- service and content protection mechanism.

In a DAB-based network, service operators can choose from a wide range of service technologies. The separation layer is often either IP or MPEG-2 TS-based. DAB offers flexibility to service providers. However, the lack of uniformity in service and transport layers can impede large-scale implementations by terminal manufacturers and deployment by service operators. MDNI is tightly coupled to the FLO bearer technology, without a clear and separate abstraction layer. Furthermore, it is not available as an open standard and the patent licence pool is owned by a single company. Both DVB IPDC and OMA BCAST fully specify the mobile TV service, including provision, service guide, interactivity and various methods for service and content protection, in an open and standardised manner. Both rely on an IP-based abstraction layer between the service and bearer technology. As a bearer-agnostic technology, OMA BCAST has several adaptations to bearer technologies, while DVB IPDC is mainly targeted at DVB-H. **Therefore, in our opinion, DVB IPDC and OMA BCAST provide an advantage over other technologies when considering a mobile TV broadcasting service.** The main differences are summarised in Table 1.

Table 1: Comparison of service architectures

	DAB services	**MDNI**	**DVB IPDC**	**OMA BCAST**
Bearer technology adaptations	DAB-IP, T-DMB	FLO	DVB-H	DVB-H, MBMS
Layer between bearer and service technology	IP or MPEG-2 TS	FLO service layer	IP	IP
Completeness and openness of specification	Only basic service specification, open	Only basic service specification, closed	Full service specification, available under FRAND	Full service specification, available under FRAND
Service guide and interactivity	No single specified service guide	Service guide	Service guide	Service guide, interactivity
Service and content protection mechanisms	Proprietary solutions for service and content protection		18C and OSF	DRM (digital rights management) and Smartcard profile

Source: TNO, 2007.

1.3 Other technological developments

While the bearer and service technologies described in the previous sections are considered as the dominant technologies for delivering mobile TV services via *broadcasting*, other developments are taking place that can be employed for a similar purpose. These include technologies that *make use of existing interactive channels such as third-generation (3G) cellular networks and wireless IP connections*. Please note that we believe that the technologies mentioned below will coexist with the broadcast technologies mentioned earlier, and do not necessarily compete with them. Content which is of interest to the large part of the consumers can be broadcasted, while content that is of interest to a smaller group of consumers should preferably be offered on an on-demand basis via unicast networks. 3G networks are specifically suitable for that purpose. The share of content consumed via on-demand versus via broadcast models will only increase when viewing habits change. These habits are to a large degree determined by cultural factors as evidenced for example by the popularity of on-demand viewing in the younger generations[25]. For the coming decade traditional TV viewing practises are likely to persist ensuring a continued and central role for mobile TV broadcast. The description of MBMS and unicast streaming is, therefore, provided for additional reference and is not considered in the overall technology comparisons.

3G (MBMS)

The Multimedia Broadcast and Multicast Service (MBMS)[26] is a multicasting service that can be offered via existing GSM and Universal Mobile Telecommunications System (UMTS) cellular networks. Recently standardised in 3GPP Release 6, it aims to provide a more efficient method of delivering multimedia content to multiple users over a 3G cellular network. MBMS is described in the MBMS Bearer Service and the MBMS User Service specifications. The MBMS User Service, also called TDtv when carried over the TDD part of UMTS[27] is basically the MBMS service layer, offering streaming and download delivery methods. The streaming delivery method can be employed for mobile TV services, whereas the download method is intended for on-demand services such as video on demand (VoD), where content is first downloaded to the consumer device. The MBMS Bearer Service can be combined with other service layer technologies, such as OMCA BCAST.

As an UMTS-based service, MBMS has to cope with a relatively small cell size. This makes the network better suited for mobile applications that can benefit from a small geographical coverage. Additionally, the total bandwidth at an UMTS site has to be divided between MBMS services and unicast services. Consequently, it is likely that MBMS services will be used for instant streaming services instead of linear broadcasting.

Unicast streaming

Besides the use of multicast services the 3G network also enables the point-to-point streaming services. One has to take into account the limited capacity of 3G networks for video services. Typically an UMTS cell can carry 3 high quality mobile video streams per licensed frequency block of the operator. With about 5-6 available frequency blocks in a country, 3G unicast services are limited to ~20 simultaneous video streams in an area that is bound by the size of an UMTS cell. Furthermore, capacity has to be shared with other point-to-point data services, such as browsing or mobile data connections for remote users.

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[25] The popularity of mobile TV in Asia could also be due in part to cultural factors.
[26] http://www.3gpp.org/ftp/Specs/archive/22_series/22.246/22246-800.zip.
[27] UMTS networks consist of time-division duplex (TDD) and frequency division duplex (FDD) components, where FDD is currently used for all cellular services. The 'MBMS Service' is typically related to the broadcast over the FDD component. 'TDtv' is related to the MBMS broadcast over the TDD component.

Therefore, this type of usage is especially interesting for Video on Demand services where the usage pattern of consumers is distributed over the time.

With the introduction of HSDPA, the capacity of the UMTS network is increased. However, due the time varying behaviour of the capacity increase it is especially useful for download services and less useful for streaming services.

The introduction of 4G networks will increase capacity of mobile networks further and add Quality of Services. This allows for more simultaneous use of streaming services with better degradation performance. However, in comparison with those technologies the broadcast networks will have no scalability issues when the amount of users increases. Therefore it is much more likely to see a separation of services than a complete shift of distribution of services from broadcast networks towards unicast networks. We believe that services carried over broadcast networks and multicast networks and unicast networks and will all coexist.

Future technological developments

With respect to technology developments in the future we expect that broadcast and unicast services will coexist on the network side and will be integrated in the terminal. In light of this convergence of consumer electronics and mobile communication (fixed-mobile convergence, or FMC), coupled with the emergence of ubiquitous heterogeneous network environments and in-house home multi-device personal networks, further technological integration will bring about an increased and diverse range of terminal classes that support both mobile TV (as in broadcast delivery of live video) and on-demand unicast video streaming. These developments are currently considered for standardisation in various bodies, such as in *Telecommunications and Internet Converged Services and Protocols for Advanced Networking*[28].

The user will be offered an integrated service of regular broadcast and on-demand content. Recording, time-shifting and super-distribution of content are likely developments[29] that will depend on the implementation of security in the terminal. Content could be stored on external memory cards, which have rapidly increasing capacity. Roaming to foreign services is interesting for end-users but will require service providers to implement a message exchange, which is currently only standardised in the service layers on top of DVB-H. Finally, chipset vendors are improving the battery performance of receivers, allowing longer watching times for the end-users[30].

Overall we do not foresee, at present, any technological developments that will significantly alter the landscape of provisioning mobile TV. In line with the fixed-mobile convergence we expect increased terminal diversity with a high level of both mobile and fixed technology integration, and increased functionality offered to the consumers.

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[28] Draft ETSI TR 181 011 (TISPAN) Fixed Mobile Convergence; Requirements Analysis.
[29] http://www.techonline.com/product/underthehood/198700205.
[30] http://eetimes.eu/products/analog/197006018.

2. DEPLOYMENT AND CURRENT MARKET SITUATION

2.1 Current status

This paragraph presents the market situation with regard to mobile TV services and projects within the European Union.

Within the European Union four countries have so far launched a full mobile TV service[31]. Finland's Mobiili-TV is a mobile TV service based on the DVB-H standard. Mobiili-TV features an open business model and shared networks.

Mobiles Fernsehen Deutschland (MFD), a private equity-based start-up, launched mobile TV services in Germany following the DMB standard. MFD operates a wholesale model in which MFD acts as the independent service provider. Germany has also completed DVB-H trials and is set to launch a full DVB-H services in the first quarter of 2008.

Italy now has three commercial mobile TV services based on the DVB-H standard: 3 Italia, TIM and Vodafone. Network operator 3 Italia operates a mobile network, operator-led model. TIM and Vodafone are resellers in the wholesale business model of Mediaset. Italy is also running a trial based on the DMB standard[32].

In the United Kingdom BT Movio launched its mobile broadcast entertainment service based on DAB-IP technology and a wholesale business model. Virgin Mobile started retailing the service to the customers, but discontinued services in July 2007[33]. UK pilots on DVB-H and MediaFLO have been completed.

Table 2: Commercial mobile TV services in the European Union

	Mobile TV standard				
Country	DVB-H	DMB	DAB-IP	MediaFLO	Regulatory approach[34]
Finland	•				Nationwide 20 year DVB-H licence was awarded to DIGITA. Licences are awarded to the most competent bidder.
Germany		•			Tender procedures have been specified (first frequencies). No long-term licences have been awarded.
Italy	•				Individual licences are allowed. Applicants have to meet provisions specifying content and signal transmission standards.
United Kingdom			•		Regulator Ofcom is considering releasing spectrum ahead of the completion of the digital switchover in 2012.

Sources: BMCOForum, WorldDAB, Guardian Unlimited.

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[31] BMCOforum: http://www.bmcoforum.de/index.php?id=53

[32] WorldDAB: http://www.worlddab.org/upload/uploaddocs/April-May07_DAB_update.pdf

[33] Guardian Unlimited: http://business.guardian.co.uk/story/0,,2135478,00.html

[34] 'Mobile TV regulation in the EU', Freshfields Bruckhaus Deringer, August 2006.
DVB: http://www.dvb.org/about_dvb/dvb_worldwide/finland/index.xml

The following countries in Europe are running mobile TV trials[35]:

- Austria has completed DVB-H trials and is planning to launch a commercial DVB-H service in 2008.

- Belgium is still in the DVB-H trial phase (MADUF), which will end in April 2008.

- Denmark has launched a DVB-H Pilot (ViasatTDC), which will end in July 2007.

- France has finished DVB-H trials. Commercial services are expected to launch some time during 2007.

- Hungary has launched a DVB-H trial, which will end in July 2007.

- Ireland has launched a DVB-H trial, which will end in September 2007.

- The Netherlands has completed DVB-H trials and is planning to launch a commercial DVB-H service in 2008.

- Poland has completed a technical DVB-H trial and is planning to initiate a larger-scale commercial trial.

- Spain has completed DVB-H trials and is planning to launch DVB-H services some time during 2007.

- Switzerland has completed DVB-H trials and is planning the launch of DVB-H based services in 2008.

- Ukraine is currently in a DVB-H trial phase for commercial use.

Table 3: Launched trials of mobile TV services in Europe

Country	Mobile TV standard			
	DVB-H	DMB	DAP-IP	MediaFLO
Austria	•			
Belgium	•			
Denmark	•			
France	•			
Germany	•			
Hungary	•			
Ireland	•			
Italy		•		
Netherlands	•			
Poland	•			
Spain	•			
Switzerland	•			
Ukraine	•			
United Kingdom	•			•

Sources: DVB-H project office, WorldDAB.

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[35] DVB-H Project Office: http://www.dvb-h.org/services.htm,
WorldDAB: http://www.worlddab.org/upload/uploaddocs/April-May07_DAB_update.pdf.

Because spectrum is more readily available in many Asian countries, commercial DVB-H broadcasts have been introduced in <u>India</u> and <u>Vietnam</u>, with <u>Malaysia</u>, the <u>Philippines</u> and <u>Indonesia</u> set to open networks in 2007. Although DVB-H has been taken up globally, countries such as Korea, Japan, the United States and China are embracing local technologies[36].

<u>South Korea</u> is the world's most successful mobile TV market. Commercial services there have been launched based on the DMB (S-DMB and T-DMB) standard[37].

Mobile TV services in <u>Japan</u> are based on the ISDB-T (Integrated Service Digital Broadcasting) standard.

Commercial mobile TV services in the <u>United States</u> have implemented the MediaFLO standard. DVB-H is also available in the United States.

<u>China</u> has launched commercial mobile TV services based on a DAB standard[38]. Recently, trials for mobile TV using the MediaFLO standard have been launched as well[39].

2.2 Regulatory approaches

Commercial mobile TV services have been launched in Finland, the United Kingdom, Germany and Italy. The <u>UK</u> regulator Ofcom is considering releasing spectrum for mobile TV ahead of the completion of the switchover to digital terrestrial broadcasting in 2012. The UK's III band is reserved for DAB, of which 20 per cent could be used for non-radio purposes. This would facilitate a DAP-IP-based mobile TV deployment[40]. Ofcom is currently reviewing how the fourteen UHF channels released as 'digital dividend' could be allocated, mobile TV being one of the candidates.

In all federal states of <u>Germany</u> tender procedures for the DMB standards have been completed and the first frequencies have been awarded. Five northern states have completed a DVB-H pilot and four have completed tender procedures. No long-term licences have been granted so far.

<u>Italy's</u> regulator, AGCom, introduced mobile TV regulation in May 2006 ahead of the FIFA soccer World Cup in Germany. It is largely based on the 2001 regulation of digital terrestrial video broadcasting. The May 2006 resolution allows for individual licensees. Applicants can be content providers or conditional access providers. Both have to meet relevant provisions specifying content and signal transmission standards. Existing DTB operators are automatically granted a licence for mobile TV broadcasting. This is similar to the Netherlands, where DVB-T licences may be used for mobile TV as well.

In <u>Finland</u> a nationwide 20-year DVB-H licence was awarded to Digita in March 2006. Licences are awarded to the most competent bidder. The Finnish Communications Regulatory Authority is expected to issue licences for the provision of television and radio services in the near future. These will be used on the newly built DVB-H network managed by Digita. Programme licences will not be necessary for broadcasters, provided the television content is simultaneously transmitted on both the conventional television networks and the DVB-H network. In addition, interactive services, such as games, do not require a licence[41].

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[36] Reuters:
http://www.reuters.com/article/technologyNews/idUSL2117903520070622?pageNumber=2&sp=true
[37] BBC: http://news.bbc.co.uk/2/hi/technology/6902541.stm.
[38] ChinaTechNnews.com: http://www.chinatechnews.com/2007/05/22/5418-china-launches-cdmb-mobile-tv-technology-standard/.
[39] Wireless week: http://www.wirelessweek.com/article.aspx?id=141066.
[40] Freshfields Bruckhaus Deringer (2006) *Mobile TV Regulation in the EU*, August 2006.
[41] DVB: http://www.dvb.org/about_dvb/dvb_worldwide/finland/index.xml.

2.3   Market value

Different market research firms[42] have made estimates of the global market size for mobile TV. Figure 2 gives an overview of these forecasts.

Figuur 2: Revenue forecast for mobile TV
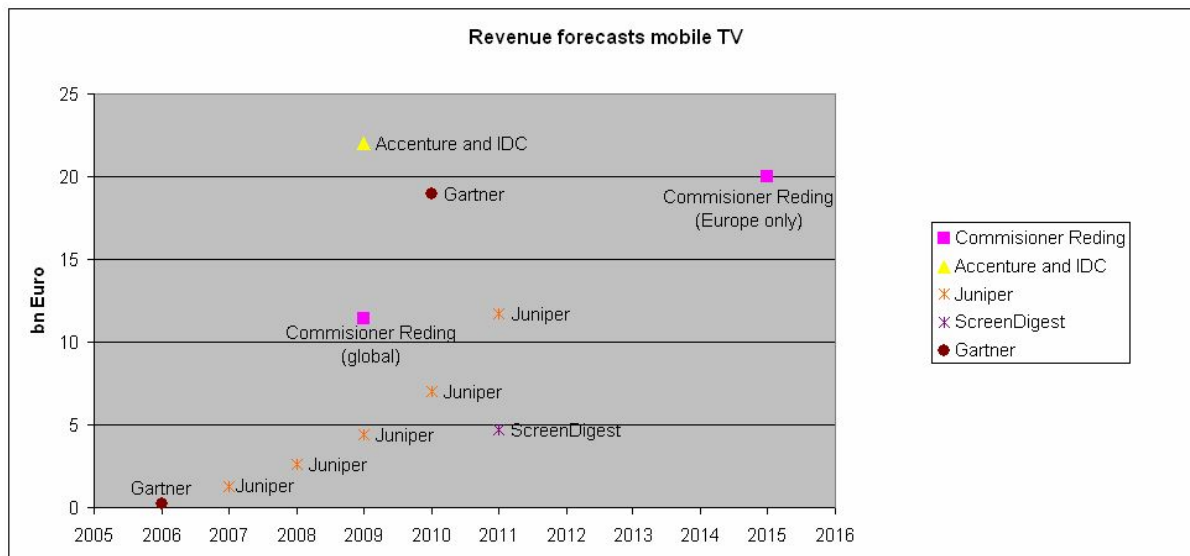
Sources: Gartner, Juniper, Screendigest, Accenture, IDC, 2005–07; all forecasts are worldwide unless mentioned.

The forecasts show a wide range, with ScreenDigest being most conservative with a market size of €4.7 billion worldwide by 2011, generated by 140 million subscribers (which means an ARPU of €2.80 per month). Accenture/IDC seems very optimistic with an estimated market size of €22 billion by 2009. The variation may result from the use of different definitions of the scope of mobile TV.

The market size will depend heavily on consumer uptake of the service and the pricing in comparison with willingness to pay. Forrester conducted interesting research on willingness to pay for mobile TV services, including a survey among Western European consumers[43]. The results show that 65 per cent of these consumers are not interested in watching TV on a mobile phone, 19 per cent are interested only if it is free and a mere 4 per cent were prepared to pay a small fee of €3 per month. A similar survey in the United Kingdom showed that listening to the radio is far more popular than watching TV on mobile phones, with 23 per cent and 9 per cent of mobile phone users respectively being interested. However, with more services announced, popularity will rise.

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[42] Gartner: http://www.gartner.com/it/page.jsp?id=503578,
Juniper: http://www.juniperresearch.com/shop/products/report/pdf/brochure/7721Mobile%20TV2%20(NS).pdf,
Screendigest: http://www.screendigest.com/press/releases/press_releases_09_05_2007/view.html,
Commissioner Reding:
http://www.europa.eu/rapid/pressReleasesAction.do?reference=SPEECH/07/154&format=HTML&aged=1&language=EN&guiLanguage=fr,
Accenture and IDC:
http://www.accenture.com/Global/Research_and_Insights/Outlook/By_Industry/Communications/exmobilevideoservices.htm.

[43] Veen, Niek van, Forrester Research, *The European Mobile Landscape 2006*, June 2006 . In Q4 2005, Forrester surveyed 19,046 consumers in France, Germany, Italy, Spain and the United Kingdom.

We estimate that maximum penetration of mobile TV broadcast services will be between 20 and 40 per cent, considering that current mobile TV penetration in South Korea is about 10 per cent at the moment (and will grow higher), and market estimates vary from 7 per cent in 2010 to 50 per cent in 2017[44]. To reach this penetration of 20 to 40 per cent, we expect a maximum ARPU of €10 per month for a mobile broadcast subscription to be realistic. Although 3 Italia charges €19 monthly, the above mentioned research by Forrester and a recent Swedish trial suggest that most consumers are not prepared to pay more than a few euros per month[45].

In the long term, on-demand video services will overtake mobile broadcasting, when bandwidth becomes less expensive and users gradually change behaviour from TV zapping to on-demand viewing. The ARPU of these services will of course depend heavily on the business models (flat fee, pay-as-you-go or advertising sponsored).

2.4   Restructuring in the value chain

The value chain for traditional broadcast TV is relatively straightforward. This model largely applies to mobile broadcast TV as well, with the possible addition of a retailer in between the distributor and the consumer in the case of a wholesale model:

**Figure 3: Value chain for broadcast TV**
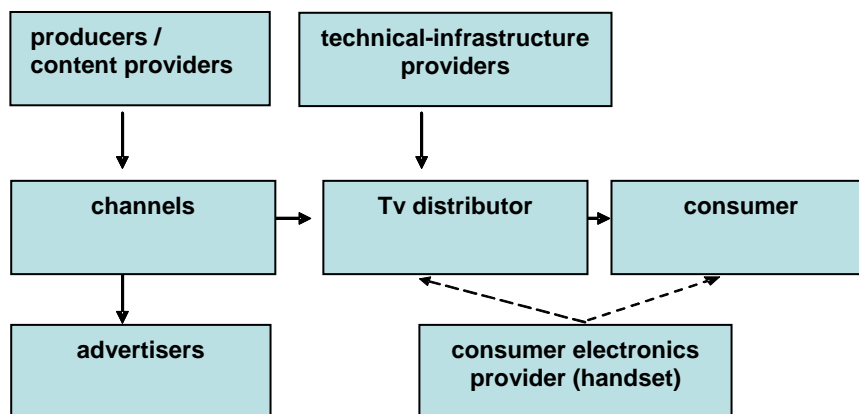
Source: TNO, 2007.

The IP has a far-reaching influence on many markets, making them more transparent and global. This will also influence the TV market, for both fixed and mobile TV. Through on-demand models via IP, consumers will obtain direct access to a global content market. A key example is the YouTube content model, allowing consumers to view content from content providers throughout the world, but also facilitating users to become content providers.

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[44] On http://www.slideshare.net/patsch/mobile-tv-schweiz-praesentation-tsystems T-Systems expects to reach 2 million customers in Switzerland by 2017; this corresponds to 50 per cent penetration in the area that is covered. In South Korea, mobile TV penetration is about 10 per cent at the moment (http://europa.eu/rapid/pressReleasesAction.do?reference=IP/07/1118&format=HTML&); Park Associates forecast a penetration of 7 per cent by 2010 in the United States; Strategy Analytics forecasts 10 per cent penetration in Europe by that time (http://www.eetasia.com/ART_8800451511_499488_d8b66aa0200702.HTM).

[45] http://www.analysys.com/mobile_tv_opportunity/ In a recent Swedish trial, 80 per cent of consumers were prepared to pay for the service, but only 20 per cent were prepared to pay more than €5 per month. In the above-mentioned research of Park Associates a revenue of $1.6 billion for 15 million US users by 2010 is mentioned, which corresponds with an ARPU of €6–7 monthly. 3 Italia charges €19 monthly, TIM €9.90 per month. To reach a penetration of 20–40 per cent, we think €10 per month is a maximum price.

Figure 4: Value chain for on-demand content
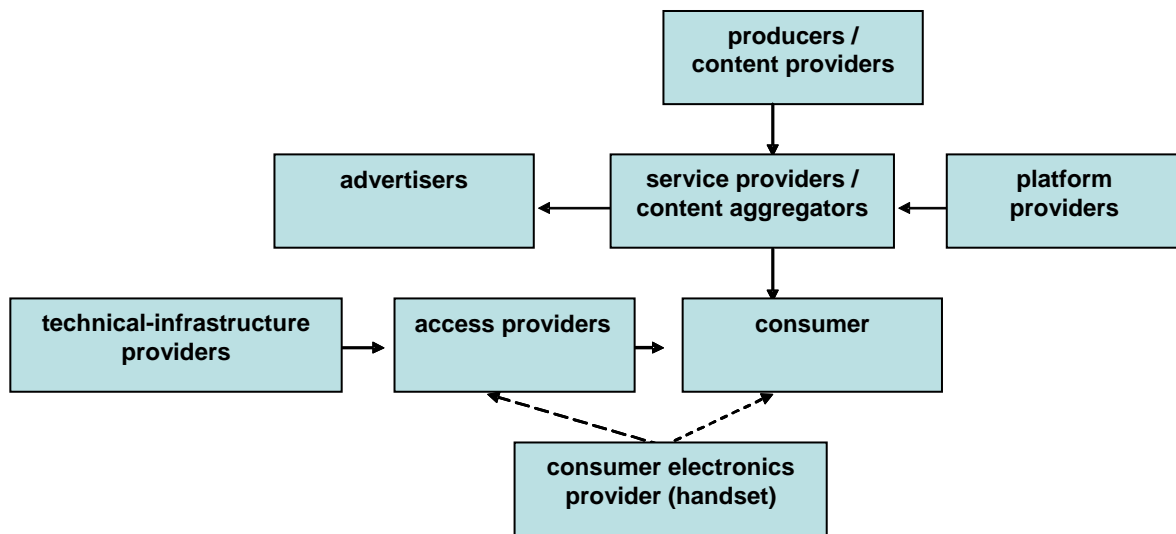
Source: TNO, 2007.

The role of channels will gradually decrease. Channel owners are looking for new business models and ways to distribute their content via the Internet[46]. Content providers are getting direct access to a global market. However, they will still distribute their content via service providers (content aggregators) that are well placed to do business with advertisers. Highly personalised advertising may sponsor more and more free content.

The market for on-demand content is still in its infancy. Some companies are looking ahead with a strategic view and are already acquiring companies that strengthen their position in the mobile TV market. Content providers are looking for a way to distribute their content via mobile channels (e.g. News Corp acquired a 51 per cent stake in mobile content distributor Jamba[47], IMG acquired Nunet, a mobile media solution provider[48], and Aspiro acquired Rubberduck[49]).

For the future mobile TV market this means that:

- The market for *mobile broadcasting* will highly resemble that of fixed broadcast TV, where mobile operators will have a role comparable to that of cable operators.

- In the market for *on-demand content* the role of mobile operators will be reduced to that of access providers, unless they make the shift to become service providers in the short term. The market for service providers/content aggregators will become a global market.

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[46] For example BBC is offering its content via the Internet, on http://news.bbc.co.uk/

[47] http://www.mobile-ent.biz/news/24369/Fox-eats-Frog

[48] http://www.3g.co.uk/PR/Jan2007/4192.htm

[49] http://www.made-in-sweden.biz/index.php?p=512

3. STANDARDS AND THE NEED FOR HARMONISATION

3.1 Standards

Mobile TV standards have their roots mainly in the digital TV standards. Some of the digital TV standards (like the Japanese ISDB-T and the European DVB-T) have been capable of offering mobile services from the beginning, and some, for example the digital TV standard in the United States (Advanced Television Systems Committee, ATSC) did not address the mobility issues at all. In the standardisation process of digital TV in the United States, mobility did not play any role, as the standardisation of ATSC was very much influenced by requirements of the broadcast sector, and the main objective was to transmit high-definition TV (HDTV) signals in terrestrial networks.

In Section 1 we have observed the proliferation of standards for mobile TV. In its advice to the European Commission the EMBC Technology Workstream Group advocates a technologically neutral standpoint with respect to the existing standards and deployments. The European Commissioner has expressed the desire for harmonisation on mobile TV. As mentioned in the introduction, the EC approach is aimed at achieving *economy of scale*[50] in the deployment of mobile TV, and an *anytime, anywhere*[51] service paradigm for users across Europe enabled through *interoperability.* End-users of mobile TV should be able to use the service anywhere and anytime they want and have a freedom to choose from and switch between service providers. This strategy is inspired on the success of GSM in facilitating a single EU market for mobile communications. The degree to which these goals can be achieved depends on the level of harmonisation.

Economy of scale

The first step in achieving economy of scale is facilitated by *harmonisation on the bearer level*. This means that only a single bearer network is used for delivering mobile TV. Throughout the European Union the same type of transmission facilities can then be deployed, and detailed knowledge regarding network coverage planning can be exchanged. For a single Member State fewer broadcast transmission sites and licences would be required, which is beneficial from the point of view of cost and aesthetics while speeding up deployment. Terminal manufacturers only require a single type of chipset and a single type of antenna for the bearer reception to be integrated in the end-user device. This speeds up deployment and lowers costs.

However, harmonisation solely on the bearer level does not offer any guarantee for preventing duplication of networks throughout Member States. When a bearer network is deployed multiple times in a Member State, there is a reduced cost advantage for the broadcast operators or service providers. Economies of scale can be achieved much faster when only a single licensee of the broadcast network in each Member State is present to deploy a *wholesale-based business model for services*.

In the wholesale model, a dedicated mobile broadcast network operator (wholesaler) acts as the facilitator for multiple service providers in the aggregation of channels and the usage of broadcast transmission capacity and broadcast transmission sites. As a result, content that is part of the service proposition of all service providers, such as TV channels which consume the largest part of scarce broadcast capacity, will only need to be distributed once, and will be available to all customers of each of the individual service providers.

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[50] See footnote 1.
[51] See footnote 3 and the introduction.

Duplication of content distribution, regardless of whether single or multiple underlying bearer networks are used, is not only undesirable from a cost perspective but also leads to inefficient usage of scarce network capacity. When broadcast capacity is shared for content that is part of the service proposition of all service providers, more bandwidth is available for content that is part of the service differentiation between service providers.

As such, economy of scale is best served by a single bearer technology in combination with a wholesale-based business model for the mobile TV service. In Section 1.3 it was explained that there is no industry consensus on which bearer technology has the best properties. In other words, it seems that none of the bearers is incapable of delivering mobile TV. Besides the properties on the radio layer, it is important that an open market can be created for various service providers, when harmonising on the bearer level with a wholesale-based business model. We believe that this is best enabled by open standards on the service layer. At this point in time DVB-H is most favourable, not because of its inherent properties at the bearer layer, but because it offers two completely standardised service layers, i.e. IPDC by the DVB forum and BCAST by the Open Mobile Alliance. Both standards have fully specified the interface between wholesale broadcast operators and individual service providers, which allows for a standardised means of sharing broadcast content, while tailoring the service offering to the conditions of each individual provider, thereby leaving room for service differentiation, i.e. subscription models and interactive services.

## Mobile TV anytime and anywhere through interoperability

Harmonisation on the bearer layer is not only important for achieving economy of scale; it is also a requirement for unrestricted roaming and switching throughout Europe with a mobile TV terminal. End-users with terminals that are tailored to one specific bearer cannot be used in the area of another bearer. It is generally expected that mobile TV terminals will be integrated with second-generation (2G)/3G cellular devices. The opportunity for consumers to roam with a single device combining phone and mobile TV services would be lost in the case of multiple bearer technologies.

Roaming and switching cannot be accomplished by harmonisation on the bearer layer alone. They also require harmonisation on the *service* layer. As described before, on top of every bearer layer one or more service layers have been standardised. In general, the service layer standards on top of the bearers that are specified for mobile TV enable *server-side* interoperability: that is, multiple service providers can offer solutions that can coexist. This is even valid in a wholesale model where the broadcast content (the TV channels) is shared among service providers.

However, the use of multiple service layers on top of a single bearer layer does not guarantee end-user-side interoperability. Even the use of a single service layer does not guarantee full end-user-side interoperability. That is, even *within* a single service layer there is optionality in the components that the service providers can choose from. As a result different content and service protection solutions implemented by different service providers in a single Member State will impede end-users from switching service providers; and different solutions throughout the Member States will impede end users from roaming.

For example, there are two service enablers standardised on top of the DVB-H bearer level: IPDC of the DVB forum and BCAST by the OMA. The two service layers have achieved harmonisation on the content component, but differ on major service components such as the ESG and the service and content protection solution, as displayed in Figure 5.

Figure 5: Illustration of the two service layers that are standardised on top of DVB-H
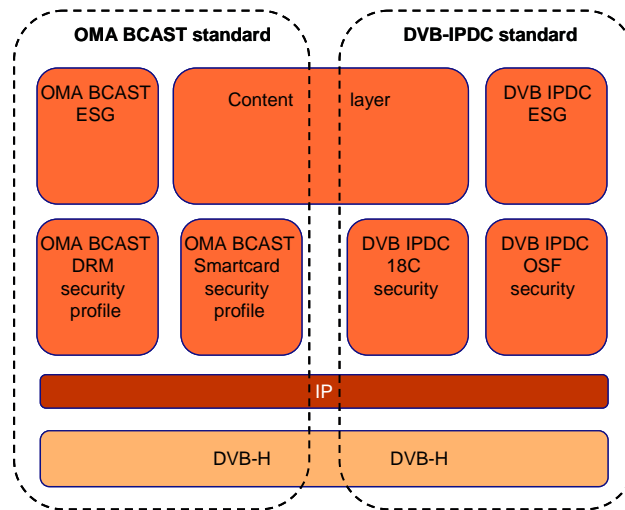
Source: TNO, 2007.

The DVB and OMA have standardised on four different solutions for service and content protection: the digital rights management (DRM) profile and Smartcard Profile *within* the OMA, and 18C and an Open Security Framework (OSF) solution *within* the DVB forum. The first three solutions are open standards, while OSF is a solution that provides the ability for a proprietary protection mechanism to coexist via standardised message signalling and transport.

For cost and complexity reasons it is not expected that terminal or service providers will implement all types of open and proprietary service and content protection mechanisms to cater for this issue. Furthermore, different implementations of service and content protection solutions reduce the economy of scale advantages for the mobile handset manufacturers, because they might need to implement different solutions for different service providers in different Member States. Thus, it would appear at first sight desirable and logical to strive for harmonisation of a service layer and even within a service layer: in other words, having a single service and content protection solution.

However, it should be understood that every service provider has legitimate reasons for preferring a particular solution, since the service and content protection solution may be of vital importance for the business case of the service provider. That is, the providers select either i) one of the open standards, which enables an open market, so service providers can choose and switch security vendors and handset manufacturers; or ii) a proprietary protection mechanism, which is typically provided by a unique vendor, but one that offers accountability for the end-to-end security and can restore the system in case of a security breach independent of standardisation timelines. ***Therefore we believe that there is no justification for favouring one type of service and content protection mechanism over another, or promoting a certain profile to be used by the industry.***

So in conclusion the anytime, anywhere service paradigm could best be served by harmonisation within a service layer and especially by having a single service and content protection mechanism. However, we see no justification for high-level regulation as this issue is of vital importance to the service provider and subject to rapid evolution. Other lighter regulatory incentives to stimulate service providers to harmonise on a single service layer and within a single service layer may be useful, however.

This could include a European Commission guideline on a voluntary labelling scheme for industry to inform consumers on interoperability or security standards for example through a '*mobile TV service ready´* or '*Anytime Anywhere*' logo on handsets.

From the above, it may appear that the anytime, anywhere service paradigm might never be achieved because of the availability of multiple standards on and within the service layer, and multiple solutions for service and content protection. As a result this can even seem to negate the reasons for harmonising on the underlying bearer level with a wholesale-based model. However, our view is that service providers do have the opportunity to migrate service and content protection systems (switch from service layer or within a service layer), but cannot easily switch network distribution systems (switch on the bearer layer) for cost reasons. The short life cycle of mobile terminals limits the duration of the migration phase where the current and new systems are both active. Furthermore, market forces may eventually result in a uniform solution on the service layer to be deployed throughout the Member States. For example, terminals with a certain service and content protection solution might be capable of being manufactured cheaply, or be favoured by end users because they allow roaming between some of the service providers.

Conclusions on standards and the need for harmonisation

In summary we note that the goals of harmonisation – *economy of scale* and the *anytime, anywhere* service paradigm – can be facilitated by the following measures:

- Harmonising on a single network bearer.

- Licensing a wholesale-based model with a single operator for each Member State.

- Harmonising *within* a single service layer.

For mobile TV it would seem justified to regulate the use of a single network bearer layer in combination with a wholesale-based model in each Member State. This promotes economies of scale and prevents market fragmentation in the cellular terminal industry. Furthermore, it fulfils an important precondition for end-users: to freely choose and switch service providers with their mobile TV terminal. At this point in time DVB-H is the most favourable, not because of its inherent technical properties, but because it offers multiple and completely standardised service layers, which allow for a standardised means of sharing broadcast content, while tailoring the service offering to the conditions of each individual provider, thus leaving room for service differentiation. In addition, DVB looks to be the only standard with sufficient potential spectrum available.

While anywhere and anytime usage can be enabled by harmonisation *within* a single service layer, the mobile TV service providers have legitimate reasons to choose components within a service layer that are not fully interoperable with other service providers, from the end-user point of view. ***Hence we feel that harmonisation by regulation is not justified.*** Other lighter regulatory incentives to stimulate service providers to harmonise on a single service layer and *within* a single service layer may be useful, however. This could include an agreement with industry to inform consumers on interoperability or security standards for example through a '*mobile TV service ready´*, '*Anytime Anywhere*' or '*Open Security Layer*' logo on handsets.

The risks of harmonisation on a single bearer layer (such as DVB-H), with a single wholesaler in each Member State, are that

i)   there are already countries in which mobile TV services based on other bearer layers are in place, and

ii)   a single wholesaler also means that only a single party has the control over the major part of the content offering.

On the first point, the fact that there are mobile TV services available over various broadcast bearers is the very reason a common standard is being considered. On the second point, we believe that for broadcast mobile TV the content will for the major part consist of the most popular material (to justify a broadcast distribution), and hence would serve the majority of the end-users. Finally, it can be argued that 2G/3G services have benefited from competition between service providers that were all licensed a part of the available spectrum. However, a key difference between 2G/3G interactive services and mobile TV is that the first is a *one-to-one* service, while the latter is a *one-to-many* service. Since relevant spectrum for broadcast is scarce, there are good reasons for having a single wholesale broadcast network operator and avoid wasting spectrum on parallel systems and parallel distribution of (identical) content. This is exactly the reason why mobile broadcast has advantages over unicast based 2G/3G solutions for the mobile TV service, in spite of potentially reducing competition at the network level.

3.2   Frequency issues

New technological, societal and market developments exert pressure to change the current approach to radio spectrum management. In essence, the conventional approach is based on a robust technical and regulatory coordination of

i)   the use of the spectrum so that service degradation associated with interference is minimised while the total capacity is maximised; and

ii)   the rigid allocation of spectrum for specific users and applications.

This conventional approach is currently being challenged by new spectrum management paradigms.

Traditionally, the national states have the primacy to develop the radio spectrum management framework. Since radio waves propagate (far) beyond state borders, international coordination is essential. Bodies like the Conférence Européenne des Administrations des Postes et des Télecommunications (CEPT) and the Regional Radio Conference under the responsibility of the International Telecommunications Union (ITU) prepare the framework, after which it is implemented in an international agreement. Via an elaborate and time-consuming process, nation-states agree on a new set of spectrum management rules, including a frequency plan and a process for revising the plan. The specification of the technical models and tools to calculate the signal levels and the interference levels are an integral part of this process. Thus, in the Geneva 2006 Agreement the states of Africa, Europe and North Asia committed themselves to a new frequency plan designed for the transition from analogue to digital TV for the UHF bands IV/V[52].

Over the past decade, an evolution toward a more liberal spectrum management regime has taken place, based on technology and service-neutral deployment rules. The European Commission advocates such an approach; the Radio Spectrum Committee (RSCOM) and the Radio Spectrum Policy Group (RSPG) are respectively charged to develop and shape the appropriate technical implementation and policies toward this goal. A new regulatory framework is being crafted, providing a much larger flexibility to use spectrum. For example, WAPECS (Wireless Access Platforms for Electronic Communication Services) targets a service and technology-neutral use of specific frequency bands. Furthermore, new spectrum management approaches other than the conventional 'command and control' model applied to the bands IV/V are being developed and applied in other frequency bands: for example the market-based property rights approach.

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[52] The Geneva 2006 Agreement was prepared during the Regional Radio Conference 2006 (RRC06).

These new developments are challenging the conventional approaches of spectrum management. However, the European Commission cannot overrule international agreements like the Geneva 2006 Agreement; the interests of the national states (EU and non-EU) and the basic laws of the propagation of radio waves have to be respected.

Spectrum

Convinced of the potential economical and societal value of mobile TV, and the importance of harmonising the technology, the European Commission has urged the mobile TV stakeholders to define a common opinion. In response, the EMBC was formed. In a dedicated Spectrum Work Stream, the EMBC has formulated its opinion and recommendations on mobile TV[53].

According to the viewpoint of the EMBC, candidate bands for mobile TV encompass bands for terrestrial broadcast services in the VHF band III, the UHF band IV/V and the lower L-band (1452–1479.5 MHz), for satellite broadcast services in the L-band, for mobile satellite services in the L-band and S-band and for mobile terrestrial services in the IMT2000 TDD bands. In the following we discuss the bands for terrestrial broadcast services[54].

VHF band III (174–230 MHz)

For this band, the RSPG states that no specific action is needed at EC level[55], a viewpoint that is supported by the EMBC[56]. Following the Geneva 2006 Agreement, this band is assigned to both digital radio and digital TV broadcasting, whereas the Agreement provides the flexibility to implement a mobile TV service based on a 'cellular low-power' network. As a rule, each country has been allocated one 7 MHz digital TV layer with a national coverage[57]. The Member States can decide on the use. Channels allocated for radio broadcasting (1.75 MHz) will be available in the short term. According to the RSPG, the Europe-wide availability of 7 MHz channels for TV broadcasting is expected no earlier than 2012[58].

UHF band IV/V(470 – 862 MHz)

According to the EMBC, the allocation of channels for mobile TV spread out over the whole band, in agreement with the current Geneva 2006 frequency plan, is a short-term option; for the medium and long term a harmonised sub-band for mobile TV is preferred[59].

In band IV/V, as a result of the transition from analogue to digital broadcast TV services, there is room for new services such as more TV stations, HDTV broadcast, or conceivably mobile services. This extra capacity associated with the switch-off of analogue services is called the 'digital dividend'. Today, the use of band IV/V is subject to the Geneva 2006 Agreement. This agreement provides the frequency plan for terrestrial digital TV services in Europe, Africa and North Asia. The deployment of other services such as mobile TV or mobile communication services, or a deviation from the current frequency plan, must be duly evaluated with respect to the Geneva Agreement.

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[53] EMBC, *European Mobile Broadcasting Council Spectrum Work Stream Report,* March 2007.

[54] In the context of the issue of spectrum for terrestrial services, the bands for satellite broadcast services (upper L-band 1479.5–1492 MHz) for mobile satellite services (L-band: 1518–1559, 1626.5–1660.5 and 1670–1675 MHz, and S-band: 1980–2010 and 2170–2200 MHz) and for mobile services (IMT2000 TDD bands: 1900–1920 and 2010–2025 MHz) are of secondary relevance only.

[55] RSPG, *The Introduction of Multimedia Services in Particular in the Frequency Bands Allocated to the Broadcast Services*, Opinion no. 5, 25 October 2006.

[56] See footnote 51.

[57] *Implementation of the Digital Dividend*, Jan Doeven, EBU Technical Review 2007.

[58] Id. EMBC, 2007

[59] Id. RSPG, 2006.

The European Commission has mandated the CEPT to study the compatibility of networks for fixed terrestrial TV services and mobile TV services[60]. In its report on this question, CEPT concluded that without any modifications of the plan, but with appropriate technical measures, such networks can coexist and that mobile TV can be offered in any of the channels of bands IV/V[61].

However, using the current frequency plan results in the allocation of mobile TV channels spread over the whole frequency band, with the disadvantage of the need for wideband antennas in user terminals. The integration of such wideband antennas in small handsets or palmtops is not trivial[61]. Therefore, to produce a small handset (which will be essential for the success of mobile TV), a system must be developed based on the use of narrowband antennas. As a consequence, the channels allocated for mobile TV services must all be located in a sub-band of bands IV/V. The current Geneva 2006 Agreement does not allow for such an allocation of a limited number of channels in a sub-band in each Member State. Moreover, for a full interoperability throughout the European Union, in all Member States the same sub-band should be allocated to mobile TV. Harmonisation of a narrow sub-band would yield the spectrum for at least two layers for mobile TV with full coverage up to the national borders[62].

Considering this need for a new and extensive revision of the current frequency plan, and the fact that many licences have been granted for a period of 10–15 years, yet a completely harmonised sub-band is not viable for the next decade, as recommended by the CEPT, a very pragmatic approach should be followed[61]. In the short term, Member States together with their neighbours should agree on the assignment of frequencies for mobile TV. In parallel, an evolution based on step-wise modification of the Geneva 2006 Agreement toward a harmonised sub-band should be orchestrated.

Apart from the compatibility issue of networks for fixed terrestrial TV and mobile TV services, the European Commission has mandated the CEPT to explore the feasibility of harmonising a sub-band for mobile communication services, in agreement with the objectives of WAPECS[60].

Currently, the situation regarding the deployment of digital TV amongst the Member States is fragmented. In some countries analogue has been switched off already, whereas elsewhere the switch-off is scheduled for the coming years, up to 2015 at the latest. This transition period creates opportunities to allocate spectrum for mobile TV services; the success of the harmonisation of a sub-band will depend on cooperation between the Member States and the orchestration of this process by the European Commission.

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[60] EC, *Mandate to CEPT on Technical Considerations Regarding Harmonization Options for the Digital Dividend*, EC Electronic Communications Policy, Radio Spectrum Policy, Brussels, 30 January 2007.

[61] *Final Report from CEPT in Response to the EC Mandate on the Digital Dividend, Part A*, RSCOM07-34, Brussels, 1 June 2007.

[62] Reference 61 § 1 and § 5.2.2.2 states the availability of two single frequency networks (SFN) in multi-border regions and eight SFN in networks away from the borders. This formulation suggests that at least two layers with a coverage up to the national borders could be created, whereas away from the borders all channels of the sub-band can be used.

Lower L-band (1452–1479.5 MHz)

For the lower L-band, the EMBC concluded that a limited adaptation of the Maastricht 2002 Agreement, without a full revision, would allow mobile TV services[63]. In anticipation of the work of the EMBC, the European Commission issued a mandate to the CEPT to address this issue[64].

The lower L-band has been allocated to Terrestrial Digital Audio Broadcasting (T-DAB) services; however, this spectrum is not much used. The current use of this band is laid down in the Maastricht 2002 Special Arrangement. From its studies, CEPT concluded that, without revision of this Special Arrangement, this band can be used for mobile TV services provided that the channel plan and the channel bandwidth of 1.7 MHz are not changed and that T-DAB or a similar technology is used[65]. Nevertheless, a bundling of two or three adjacent channels in wider bands, application of the envelope concept for radio network planning and the use of other radio technologies would add to the value of this band for mobile TV. The repair of these shortcomings only requires a partial revision of the Maastricht 2002 Special Agreement, which can be realised quickly[65]. However, *we note that the current CEPT study does not provide a final quantification of the regions with two or three channels that allow for aggregation into 3.4 or 5.1 MHz bands respectively. As such the advantages of a partial revision cannot be judged*.

Apart from such a partial revision, in principle it is possible to completely revise the agreement according to the needs of mobile TV. However, this route will take many years, whereas the outcome may not be fully satisfactory; there is insufficient spectrum for one 5 MHz block everywhere across Europe whereas the protection of other services in these bands will result in an inefficient use of the spectrum[65].

In its analysis, CEPT recommends the partial revision of the Maastricht 2002 Special Agreement because it brings a satisfactory solution in the short term, whereas a complete revision does not match the market developments and the need to introduce mobile TV over the next few years.

Optional measures to relieve spectrum shortage

Considering the limited number of layers for mobile TV and the desirability of the conveyance of a large number of TV stations, it seems appropriate that mobile TV services should be offered according to a wholesale model. Thus the simulcasting of the same TV station and the waste of spectrum can be avoided.

Most striking in the overall process of the harmonisation of spectrum is the slow progress that can be made and the lack of a guarantee that the radio spectrum is efficiently used. When re-planning the frequency bands following the current controlled spectrum management paradigm approach, spectrum may be unused temporarily or for long periods. *Modern and future radio technologies, like 5GHz WLAN (Institute of Electrical & Electronics Engineers (IEEE) 802.11a), offer interference control capabilities[66]. Such interference control technologies allow a more flexible use of the spectrum and a more relaxed spectrum management method.*

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[63] See footnote 53 on page 20.

[64] EC, *Mandate to CEPT on EU Harmonisation of the band 1452–1479.5 MHz (Lower part of the L-Band)*, EC Electronic Communications Policy, Radio Spectrum Policy, Brussels, 12 December 2006.

[65] EC, *Final Report from CEPT regarding the EC mandate on the L-Band*, EC Electronic Communications Policy, Radio Spectrum Policy, RSCOM07-11 Final, Brussels, 20 April 2007.

[66] F. Berggren et. al. (2004) *Dynamic Spectrum Access, Phase 1: Scenarios and research challenges*, 23 September 2004.

In a report, the Organization for Economic Cooperation and Development (OECD) discusses the conceivable spectrum management methods that could be applied[67]. The current spectrum management approach can be characterised as a 'command and control' approach, as explained earlier. Less rigid spectrum management methods could help to relieve the spectrum shortage in the short and long term, and the need for revision of the Geneva 2006 Agreement and the Maastricht 2002 Special Arrangement. For example, spectrum trading (a market-based property rights approach) may enhance the responsiveness toward market changes[67, 68]. This issue has been addressed by the RSPG too, which resulted in the opinion that spectrum trading in the terrestrial broadcasting bands spectral trading should be avoided or introduced only after careful studies[69]. In a next Opinion the RSPG summarizes the results from a public consultation on the spectrum implications of switchover to digital broadcasting[70]. According to the RSPG, additional market tools can be valuable instruments to deliver a successful policy to switchover to digital broadcasting in the UHF band IV/V, however, the digital switchover should not be made dependent on the introduction of more flexible spectrum management policies throughout Europe. In agreement with its policy to implement a favourable regulatory regime, the Commission proposes a market-based approach to spectrum management, including for the bands for terrestrial radio and TV broadcasting[71, 72].

Furthermore, new radio technologies may relive the spectrum shortage. For example 5 GHz WLAN (IEEE 802.11a) operates on a secondary basis in a frequency band with a primary use. For such secondary use, the radio system must feature an interference control mechanisms preventing transmissions in frequency bands locally in use by the primary service. This model where a secondary service is allowed in a specific frequency band provided it does not harm the primary service is denominated the "easement model"[67]. Therefore, the spectrum management models like the easement model and spectrum trading model in combination with new interference control technologies should be considered as a crucial tool to relieve spectrum shortage, to enhance the revision of the current agreements and to warrant the most efficient use of the spectrum. However, introduction of such new spectrum management models should be given the required caution.

Conclusions on spectrum

Key to the success of any system for mobile TV is the timely and guaranteed availability of sufficient spectrum in a sufficiently large part of the European Union. Summarising the issue, we note the following.

In most countries, the VHF band III offers a capacity of one 7 MHz layer, but the right to decide is within the domain of the Member States. This spectrum will not be available before 2012. 1.75 MHz spectrum is available in the short term.

The UHF band IV/V offers one or few layers per country on the short term, but not in a harmonised sub-band. To evolve toward harmonised sub-bands in the long term, we recommend the European Commission to take the lead to identify early the most appropriate sub-bands and orchestrate the process. There is capacity for two harmonised sub-bands[62].

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[67] OECD (2006) *The Spectrum Dividend: Spectrum management issues,* DSTI/ICCP/TISP(2006)2/Final.

[68] Analysys, DotEcon and Hogan & Hartson, *Study on conditions and options in introducing secondary trading of radio spectrum in the European Community,* May 2004.

[69] *The RSGP Opinion on Secondary Trading of Rights to use Radio Spectrum,* RSGP04-54 Final Version, November 19 – 2004.

[70] *The RSGP Opinion on Spectrum Implementations of Switchover to Digital Broadcasting,* RSPG04-55 Rev. (final), 19 November 2004.

[71] *A market-based approach to spectrum management in the European Union,* COM(2005) 400 final, Brussels, 14 September 2005.

[72] *Commission opens Europe's Single Market for Mobile TV services*, IP/07/1118, Brussels, 18 July 2007.

To some extent, the current 1.7 MHz channels in the lower L-band can be aggregated into 5.1 MHz channels. The extent is not clear. With a full revision of the Maastricht Agreement, which will take many years to accomplish, it is doubtful a full 5.1 MHz band could be available everywhere (full coverage).

In summary, in the distant future, bands III and IV/V and the lower L-band will provide from three to four layers for mobile TV services with national coverage. In the short term, spectrum is available but subject to a narrow channel width of 1.75 MHz (VHF) or 1.7 MHz (lower L-band) or scattered over the whole 470-862 band IV/V.

In view of the spectrum shortage, the application of wholesale models and modern spectrum management models like an easement model and spectrum trading next to the conventional spectrum management approaches would be instrumental in the efficient use of the spectrum. *We recommend the European Parliament to call on the European Commission to pursue the application of a wholesale model and modern spectrum management approaches next to the existing "command and control" spectrum management practice, albeit that the introduction of such new management models should be given the necessary caution.*

4. CURRENT AND FUTURE COMMUNITY ACTIONS

Mobile TV is a product of the convergence of media, telecom and information technologies. Challenges in regulating mobile TV stem from a regulatory framework in transition that needs to address the needs of a rapidly converging industry. As highlighted in the introduction, common *standards*, effective *spectrum allocation* and a uniform *regulatory environment* may facilitate the development of a strong single market for national and pan-European mobile TV services in Europe.

4.1   Standard setting

Technology neutrality

One of the main objections to enforcing a common technical standard for mobile TV, put forward among others by the EMBC, is *that it is not appropriate for regulators to favour particular technologies*. Indeed, the backing of a single technical standard such as DVB-H seems to be at odds with the principle of technology neutrality. Nevertheless, according to the Framework Directive, technology neutrality "does not preclude the taking of proportionate steps to promote certain specific services"[73].

The EU Review of the Common Regulatory Framework for Electronic Communications Networks and Services (2006 Review) addresses problems such as differences in obligations imposed on different types of operators, for instance mobile operators and broadcasters, providing similar services. The review maintains that in order to serve public interests certain restrictions on technology are allowed. It does not elaborate on *the kinds of public interest* that could justify restrictions in the choice of technology. There is no guidance yet on whether, for example, *the ability to roam* would qualify as a public interest that could warrant a standard such as DVB-H.

With regard to service neutrality, audiovisual policy, promotion of cultural and linguistic diversity, media pluralism, establishment of services with a pan-European coverage and safety of life are listed as examples of public interests justifying restrictions. Presently, particularly young generations use mobile devices to get access to information and entertainment. Mobile TV will in such a case be an efficient source to access broadcast TV, and therefore the public interest aspects of traditional TV regulations may hold.

In short, the principle of technology neutrality applied to the regulation of mobile TV does not necessarily preclude the setting of single technology-specific standards. However, a possible Community action enforcing the use of DVB-H as a common technical standard must be justified by the importance of serving public interests.

Decisions on standards

The possibility of delivering mobile TV has played a big role in the justification of digital terrestrial broadcasting in Europe. The argument has been that only the DVB standard in the terrestrial platform (DVB-T) offers mobility, and therefore it can not be replaced by cable and satellite. The possibility of offering mobility has also been seen as a major competitive advantage of the DVB standard compared with other standards like ATSC in the United States.

Even though the European DVB-T standard is designed for mobility support, there are limitations when it comes to the delivery of mobile services to personal handheld devices.

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[73] Directive 2002/21/EC of the European Parliament and of the Council of 7 March 2002 on a Common Regulatory Framework for Electronic Communications Networks and Services (Framework Directive), L108/35, citation 18.

It was in this process that the DVB group developed the DVB-H standard which is based on DVB-T. It 'solves' problems related to reception of mobile TV services on personal handheld devices (power consumption, multi-path interference, etc.).

In the countries that deploy DVB-T, there are natural arguments for using DVB-H as the mobile TV standard. The most important arguments are that

- DVB-H is backwards compatible with DVB-T, and therefore synergy can be gained in the development process;

- DVB-H uses the same frequency spectrum as DVB-T, and therefore in the post-analogue era the released resources (the digital dividend) can easily be allocated to DVB-H; and

- There is a knowledge and experience base in deploying the DVB standard (DVB-S, DVB-T, DVB-C) in Europe which can be transferred to the DVB-H development.

The fragmented mobile TV picture with respect to standards is by no means ideal for the European industry and consumers. On the supply side, huge resources are tied to the adaptation of the content to the different standards. On the demand side, either the consumers will be locked in to using only certain services as a result of their initial choice of terminal, or there will be considerable costs connected with moving from one service provider to another if they use different standards.

The success of the DVB family of standards is perfect evidence for how important it is to send a clear message to the European industry, creating optimal conditions for economies of scale. Particularly, it is important to learn the lessons from the rapid switch-over from analogue to digital satellite TV, which involved the deployment of DVB-S as the standard for digital satellite TV in Europe (and many other places in the world). However, when it comes to DVB-H and digital TV it is also important to learn the lessons from the failure of 'interactive TV', which was partly the result of the fragmented picture of standards for the middleware and application programming interfaces (APIs). It underlines the importance of common standards, including at the service level.

4.2   Spectrum management

In the 2006 Review, the Commission gives an summary of its objectives and proposals regarding spectral management[74,75]. The proposals aim at a market-based approach to spectrum management in Europe, which better corresponds with the principle of technology neutrality, as developed by the RSCOM. Amongst others, the proposals include:

The review includes the following proposals:

- freedom in choice of technology in a frequency band (spectrum neutrality);

- freedom to offer any electronic service in a frequency band (service neutrality);

- trading in rights of use of spectrum;

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[74] Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions on the Review of the Regulatory Framework for electronic communications networks and services, Brussels, COM(2006) 334 final, 29 June 2006.

[75] Commission Staff Working Document, Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions on the Review of the Regulatory Framework for electronic communications networks and services, Brussels, SEC(2006) 816, 28 June 2006,.

As discussed in paragraph 3.2, specifically for the broadcast bands, the competence to define spectral management is within the domain of the national administrations, and not within that of the EC. Instead, following the conventional spectral management approaches, the national administrations negotiate an agreement, for example, under the umbrella of the Regional Radio Conference. Since interference may deteriorate the services in these frequency bands far beyond national borders, the preparations and negotiations are not limited to EC Member States, but all concerning national states are involved, member state or not. In this process, the CEPT plays a crucial role since it coordinates the spectrum management between the European countries in order to avoid interference and to achieve harmonisation among countries.

The present spectrum management agreements regarding the frequencies considered for mobile TV (Geneva 2006 Agreement and the Maastricht 2002 Special Agreement) conflict in many ways with the spectrum technology and service neutrality principle, as it defines how different parts of the radio spectrum should be allocated. To define the technical and regulatory instruments to move toward the spectrum and service neutral spectral management framework, the Radio Spectrum Committee (RSCOM) has been established[1]. The RSCOM assists the Commission to develop binding measures on harmonisation and procedures for assignment of spectrum. To this end, it is authorised to issue mandates to CEPT. However, in this process of the development and implementation of a new spectral management regime, CEPT and RSCOM have to respect the mentioned Geneva 2006 Agreement and the Maastricht 2002 Special Agreement. As such, these agreements are delaying the implementation of a new spectral management regime based on spectrum and service neutrality. Therefore, a medium term and a long term strategy should be distinguished to move toward the new spectrum management framework.

Medium term strategy

For the time that the Agreements are in place, only the Member States are in the position to propose and negotiate changes with the other countries that have signed the Agreement. Furthermore, only adaptations that fit within the scope of the current Agreement are feasible. In that sense the European Commission is not in the lead, however, the Commission can coordinate and promote new directions. It can propose a new spectrum management framework or elements of such a new framework and persuade the Member States to negotiate these with the other administrations that have signed the Agreement. As such we recommend the Commission to outline an EC spectrum management policy that is supported by all Member States and that fits within the current Agreement, and convince the Member States to negotiate the implementation of this policy.

Long term strategy

In the long term, when respectively a next revision of the Geneva 2006 Agreement and of the Maastricht 2002 Special Agreement is at hand, the European Commission can aspire to represent all EU Member States in the preparations and negotiations of a new Agreement.

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[1] Decision No 676/2002/EC of the European Parliament and of the Council of 7 March 2002 on a regulatory framework for radio spectrum policy in the European Community (Radio Spectrum Decision).

4.3 Harmonising national regulatory regimes

A central concern in the development of pan-European mobile TV services is the divergence in national regulatory approaches. In most Member States there are two sets of institutions influencing the decisions regarding deployment of mobile TV: institutions that influence the *content* of broadcast such as ministries of culture and education and institutions that exercise control over communication *infrastructures* such as ministries of communication and telecom watchdogs. They are influenced by different stakeholder communities. Ministries of culture are historically more in tune with broadcasters, while ministries of communication tend to rely more on the views of telecom providers. These different cultures are at the root of a number of obstacles in the way of regulatory harmonisation:

1. The balance of power between broadcasters and telecom providers in a Member State is reflected in national decisions regarding the implementation of mobile TV. The variation in institutional settings further adds to the natural complexity that comes with twenty-seven different national contexts. Institutional differences are a key driver of fragmentation in the European market.

2. A further, related aspect is the importance that national authorities attach to the introduction of mobile TV. Finland assigned a single multiplex to mobile TV (DVB-H) early in the process. Unfortunately, many countries have only rudimentary plans for the introduction of mobile TV. Countries like Denmark have for the time being relegated mobile TV to the L-band.

3. Regulatory uncertainty at the national level is a barrier to investment in mobile TV. The situation of mobile TV today is in that sense similar to the situation of digital TV at the end of the 1990s where countries looked differently upon the introduction of terrestrial digital TV, resulting in slow overall progress with profit loss for the equipment manufacturers and further losses as a result of the inefficient use of spectrum.

4. A final hurdle in the development of a single internal market for mobile TV is the difference in national authorisation regimes both in the allocation of frequencies and in the awarding of content licenses to mobile TV service providers. These differences are associated with cultural, professional, economic and market factors, making it difficult for actors to have a presence in all markets.

Organisational issues

As described in the introduction of chapter one, the *bearer layer* of mobile TV networks can be decoupled from the *service layer*. This implies a possibility to use different models for the organisation of the bearer layer and the service layer. The analysis of paragraph 3.1 concludes that the most efficient organisation of the bearer layer is to have a single provider at the national level. It is also argued that harmonisation of spectrum at European level is a precondition for the optimal development of mobile TV services, as this gives creates favourable conditions for terminal producers and service providers vis-à-vis roaming.

It is further important to mention that while the nation wide implementations of mobile TV provisions will be the prime driver of mobile TV development, there can be specific reasons to allocate resources at local level to promote local content. This spectrum should be allocated within the range of generic mobile TV handsets.

Organisational models for the provisioning of mobile TV – the wholesale model

The wholesale model of mobile TV provision is centred on the separation of the mobile TV market in a *wholesale (bearer level)* and a *retail* sector (content, subscriber and channel services – *service level*). The model involves three types of actors: the mobile telcos, content providers (including traditional TV broadcasters) and infrastructure providers[77].

The wholesale *network operator,* typically an infrastructure provider, plays the key role of network management, spectrum acquisition, licensing and, in some cases, content aggregation. Mobile telcos play a *retail* role 'selling' content by traditional broadcasters and other content providers to their subscribed user base. By using the wholesale network mobile telcos are able to reach entire markets in spite of commanding only a limited share of the mobile telephony market. This will facilitate wide and rapid uptake by users and, provided the majority of mobile telcos participate, lead to a reduction of the price of handsets[78].

There are a number of different service delivery configurations in the wholesale model:

- Wholesale *organised by a separate network operator*: Separate licenses are given to content providers and multiplex operators allowing for organisations with different competencies handling the two issues.

- Wholesale *organised by a separate network operator in an unlicensed content regime*: In this case, only the multiplex operator obtains a license. The multiplex operator can then sell capacity on the market. The content providers do not need any license and it is the multiplex operator's responsibility to ensure compliance with relevant regulation. This option allows for a flexible operation of the market.

- Wholesale *organised by multiple content-providers*: Several content providers obtain licenses for operating in the multiplex block and the license for operating the multiplex function is shared by these content providers. The difference compared to the single content-provider case is that the capacity of the multiplex block is assigned to more than one content provider. A competitive environment is therefore created on this area.

- Wholesale *organised by a single content-provider*: Licenses for content provision and multiplex operation are given to the same actor. That is, a content provider obtains a license for operating the whole multiplex block. Regulation can be implemented on the type, quality, and the number of the services available in the multiplex block, but the resources are organised by the content provider. This approach is not realistic for mobile TV and will have a negative influence on competition.

The specific relevance of the desired options depends on national market conditions including size of the market, number of companies already serving the relevant market and specific media or cultural policies. ***A European action in this respect could be for the Commission to prepare an opinion on the merits and licensing options of the wholesale model. The opinion could also address ways in which for example a standard authorisation procedure could prevent a myriad of national mobile TV licensing schemes from taking root.***

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[77] Chris Jaeger, *Contemplating the mobile-broadcast TV model*, The News - View from the Top, September 2007.
[78] Ibid.

4.4 Other factors

There are other areas of a more generic nature that may affect the emergence of a pan-European market in mobile TV services. These include, among others, the copyright provisions and rules regarding content regulation in the AVMS Directive.

The AVMS Directive

The goal of the AVMS Directive is to modernise the Television without Frontiers Directive (TWF) and to transform it into a Directive on audiovisual media and services. The TWF Directive takes the convergence between broadcast and telecom services into account, as it does not distinguish between broadcast services provided by different infrastructures (e.g. terrestrial, cable and telecom networks). However, the AVMS Directive goes further, including linear as well as non-linear services. The regulation of non-linear services is lighter than that of linear services, but non-linear services are still subject to regulation, for example to protect minors and restrict sponsorship and product placement.

The Directive is technology-neutral in the sense that the same regulations apply to broadcast services transmitted using traditional TV broadcasting networks as to broadcast services transmitted via other networks. This means that mobile TV broadcasting is subject to stronger regulations pertaining to all broadcast media, while VoD is regulated by means of lighter regulatory provisions.

The AVMS Directive will have a central role in shaping the future mobile TV landscape, both when it comes to the types of programming that will be available on the market and in the structuring of markets and the roles of the stakeholders. In contrast to broadcasting, mobile services have not been subject to content regulation. Therefore, the attitude and reactions of mobile operators and broadcasters will probably differ. The impact of the AVMS directive on mobile TV broadcast is uncertain[79]. The European Parliament could call on the European Commission to include a specific section on mobile TV in the new directive[80].

Copyright provisions

In all content media, copyright is an important issue. This also applies to mobile TV. In traditional broadcast TV, the broadcasters pay fees to the copyright holders for transmitting their content. These fees are paid from the revenues from licence fees, advertisement or pay-TV fees. In the case of pay-TV, conditional access (CA) systems can be used to restrict access in order to get users to pay. Exactly the same modes of operation can be used on mobile platforms, and it is likely that rights holders will demand payment for the variety of different platforms used for the delivery of their content, and not only for having their content transmitted regardless of the number of different platforms used. Such double or multiple fees may dampen the development of mobile TV. The Oxford mobile TV pilot, for example, was delayed several months because of copyright issues.

The problem of copyright is exacerbated as, due to the fall in memory prices, mobile devices are capable of storing and redistributing content. Another development that will put additional requirements on copyright contracts is the roaming issue. To cope with these challenges there will be a need for reliable CA and DRM systems. As seen earlier in this report, broadcasters (the DVB group) and the mobile industry (OMA) have developed different solutions to meet these challenges.

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[79] Assessing Indirect Impacts of the EC Proposals for Video Regulation, Rand Europe for Ofcom UK, 2007.
[80] As proposed by Santo Silva, Parliamentary affairs and radio and mass media representative when updating the Committee on Culture and Education (CULT) on Media Policy and the priorities of the Portuguese Presidency, http://www.aereurope.org/content/view/179/86/lang,en_GB/.

Patent rules

Another type of intellectual property right (IPR) is patents. Patents on elements in the different mobile TV solutions (DVB-H, DMB, etc.) have recently been the subject of heavy debate. An important argument against MediaFLO, for instance, is the unique position of the company Qualcomm with respect to patent rights. However, there are also a large number of patents in the other systems. Nokia, for instance, has a strong position regarding the DVB-H technology.

One of the ways for companies to circumvent a situation with mutually blocking patents is a mutual exchange of patents. *A possible EC action in this field could be for the commission to prepare an opinion on a patent exchange mechanism related to mobile TVpossibly as part of the wholesale model approach to pave the way for a competitive environment in the production of mobile TV equipment and systems.*

Must-carry regulations

Must-carry rules are implemented as part of the national broadcast regulatory system in several Member States. The must-carry principle conflicts in its current form with the discriminatory aspect of the technology-neutrality principle in that it applies to broadcast networks only. The 2006 Review suggests restricting the use of must-carry by demanding inclusion of a justification for must-carry in national laws. The argument is that technological progress has increased transmission capacity and that the transition to digital technology will make such rules redundant. However, to the extent that must-carry rules are in force, this can have implications for mobile broadcast TV solutions with limited allocated frequency resources.

When it comes to must-carry regulations, the DVB-H standard shows its strength compared with, for example, DMB because of capacity constraints on DMB. This will be vital if the national governments maintain must-carry rules for, for example, public-service and local TV and community programming.

4.5   Conclusions

Even though the impact, for example, of copyright provisions and the rules in *the new AVMS Directive must be considered in this context, the greatest regulatory obstacle is the range and variation in national approaches among Member States.* This could prove an impediment to the development of pan-European services. The introduction of a common technical standard for mobile-TV such as DVB-H could pave the way for harmonisation of national regulatory regimes.

Although a decision on the use of a common standard, such as DVB-H, seems to run counter to the principle of technology neutrality, the provisions in the general framework and the 2006 Review accept that public interest may justify such decisions. It can be argued that the public interest is well served by a single market in mobile TV when economies of scale and interoperability allow for affordable pricing, a wide range of (pan-European) services and (international) roaming.

A key aspect in choosing between technology standards is the existing technology trajectory in Europe and the related decisions regarding spectrum use. In countries that deploy DVB-T, there are natural arguments for using DVB-H as the mobile TV standard. The specific reasons are related to, first, backward compatibility; second, the fact that DVB-T and DVB-H are using capacity in the same frequency bands and that resources for DVB-T can therefore be allocated more easily; and third, that there is a wide European experience base in deploying the DVB standard.

Regarding the allocation of frequencies *in the medium term*, for as long as the current agreements are in place, only the Member States are in the position to propose and negotiate changes with the other countries that have signed the Agreement. Furthermore, only adaptations that fit within the scope of the current Agreement are feasible. In that sense the European Commission is not in the lead. However, the Commission can coordinate and promote new directions. It can propose a new spectrum management framework or elements of such a new framework and persuade the Member States to negotiate these with the other administrations that have signed the Agreement. As such we recommend the Commission to outline an EC spectrum management policy that is supported by all Member States and that fits within the current Agreement, and convince the Member States to negotiate the implementation of this policy.

In the long term, when respectively a next revision of the Geneva 2006 Agreement and of the Maastricht 2002 Special Agreement is at hand, *the European Commission can aspire to become the representative of all EU Member States in the preparations and negotiations of a new Agreement.*

An important hurdle in the development of a single internal market for mobile TV are the differences in national authorisation regimes both in the allocation of frequencies and in the awarding of content licenses to mobile TV service providers. These differences are associated with cultural, professional, economic and market factors, making it difficult for actors to have a presence in all markets.

Regarding the market organisation of the provision of mobile TV, the analysis concludes that the most efficient organisation of the bearer layer is to have a single provider at the national level. One of the main tasks of the regulatory bodies at national level is to find models for assignment of the spectrum and license to the 'bearer layer operator'. *The European Parliament could encourage the European Commission to prepare guidelines on the implementation of the wholesale model. The wholesale model can provide the framework to also address issues such as standard authorisation procedures and patent exchange mechanisms.*

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ACRONYMS

2G	Second Generation
3G	Third Generation
API	Application Programming Interface
ARPU	Average Revenue Per User
ATSC	Advanced Television Systems Committee (USA)
AVMS	Audio-Visual Media Services Directive
BMCO	Broadcast Mobile Convergence
CA	conditional access
CEPT	Conférence Européenne des Administrations des Postes et des Télecommunications
COFDM	coded orthogonal frequency division multiplexing
DAB	digital audio broadcasting
DRM	digital rights management
DVB-H	digital video broadcasting – handheld
DVB-T	digital video broadcasting – terrestrial
EBU	European Broadcasting Union
EMBC	European Mobile Broadcasting Council
ESG	electronic service guide
ETSI	European Telecommunications Standards Institute
FDD	frequency division duplex
FLO	forward link only
GSM	Global System for Mobile communications
HDTV	high-definition television
ICT	information and communications technology
IP	Internet protocol
IPDC	Internet protocol datacast
IPR	intellectual property right
ISDB-T	Integrated Service Digital Broadcasting
ITU	International Telecommunications Union
MBMS	Multimedia Broadcast and Multicast Service
MDNI	Multicast Device Network Interface
MPEG	Moving Picture Experts Group
MUX	Multiplex
OECD	Organization for Economic Cooperation and Development
OMA	Open Mobile Alliance
OSF	Open Security Framework
QAM	Quadrature Amplitude modulation
QPSK	Quadrature Phase Shift Keying
RFID	Radio Frequency IDentity tags
RSCOM	(EC) Radio Spectrum Committee
RSPG	(EC) Radio Spectrum Policy Group
SFN	Single Frequency Network
SI	System Information
T-DAB	Terrestrial Digital Audio Broadcasting
TDD	Time-Division Duplex
TWF	Television without Frontiers Directive
UMTS	Universal Mobile Telecommunications System
VoD	Video on Demand
WAPECS	Wireless Access Platforms for Electronic. Communication Services