



Mobile TV UMTSF/GSMA Joint Work Group



Final Whitepaper



“Mobile TV: The Groundbreaking Dimension”

Revision 2.21

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1. EXECUTIVE SUMMARY

TV will inevitably – like voice, music and text – migrate to the world’s most popular electronic device, the mobile phone. Many studies have declared confidence in the mobile TV concept and predict it will become a mass market service in a few years. Meanwhile many companies around the world are spending considerable sums of money on trials and commercial launches.

As with most new technologies, several different standards for mobile TV have evolved around the world. Some standards have several variants. The Joint Mobile TV Group has carried out an intensive analysis of these different technologies, focusing on spectrum, economic deployment, regulation and service delivery.

Some of the results of these technology studies are summarised in this white paper.

The cellular industry is becoming part of a far larger "digital communications" industry. Many of the major opportunities and challenges are now shared with broadcasters, content providers, platform providers, internet companies and device manufacturers. A critical factor in creating an appropriate economic environment in the emerging digital communications sector is regulatory stability and predictability. Regulation now extends beyond traditional silos such as telecoms and media. Consequently a new regulatory environment is required in which everyone can innovate, and which provides for increased flexibility and equal investment opportunities for all players.

Traditional TV is one of the most highly regulated media in many countries, normally to ensure sufficient local content. It is important, therefore, that mobile TV should not be bound by the same rules as broadcasting and that these rules should not be extended to all new delivery platforms. These complexities and overlaps between current regulatory regimes, including broadcasting and media laws, must be simplified and harmonised to ensure a well-understood and level playing field. Otherwise there will be a disincentive for industry to invest.

The complexity of rights associated with content and the way they are currently licensed threatens to hold back the development of new content markets. This will affect different segments in different ways and can differ greatly from one country to another. Interoperability of TV content across boundaries could be challenged by the complexity of rules and regulation and could hinder mobile TV roaming.

It seems that trials and commercial launches in a number of countries have not only provided new experiences for operators but have also identified important new directions such as collaborations for shared mobile TV broadcast infrastructure. Mobile TV brings operators more directly into the media world and opens opportunities for new industries to develop.

Mobile TV might not follow the path of traditional multichannel TV but could deliver a combination of unicast, multicast and broadcast services including new interactive services using the return channel which would represent a new opportunity for innovative multimedia services.

To cater for the most demanding mobile TV content it is proposed to enhance unicast and multicast-based mobile TV services by introducing new mobile device screen formats, codec technologies and higher bit rates. This could coincide with the step change of the wider introduction of terrestrial High Definition (HD) services.

A favourable regulatory environment is needed for mobile TV to prosper. Such an environment would be flexible and harmonised, leading to economies of scale, and would result in favourable end user prices.

New spectrum opportunities such as the digital dividend in Europe could open the way for innovation in wireless multimedia services, producing mobile services with high quality video and interactive media directly to handheld devices. The mobile industry calls for the consideration of the necessary harmonised spectrum to enable the development of such mobile TV services.

The UMTS Forum and the GSM Association look forward to seeing agreements that are sufficiently flexible to facilitate the rapid introduction of new and innovative multimedia services in broadcast frequency bands.

2. INTRODUCTION

Today's mobile networks, with their increasing transmission rates for wireless internet access, enable a wide variety of multimedia services. These include multimedia messaging, news, travel information, navigation, numerous portal services, on-demand services, streaming of audio and video files, and live broadcasts via online streaming. Multimedia services are not only deployed by mobile operators but also by broadcasters and independent publishers and content providers.

Mobile operators tend to regard mobile TV and video as 'must have' multimedia services. Broadcasters, however, are facing, for the first time, a major change in their environment and are seeking to generate additional revenue streams from their content offerings through multi-channel distribution strategies. Some broadcasters are securing their content supplies and related Intellectual Property Rights (IPR) to allow them to distribute their services and channels anywhere to anyone. They are attempting to leverage their core business, either on a timesharing basis, selling "TV viewers' eyeballs" to advertisers, or by monetizing top TV and radio programmes directly to consumers.

Mobile operators and broadcaster cooperation should help to avoid the risk of unsuitable pricing regimes or value propositions for end users and would provide the best opportunities to develop interactive return path capabilities for some TV and radio events.

But while both network operators and broadcasters enthuse about the great potential of converged media, investigations continue into the emerging cellular and non-cellular mobile broadcast technologies and the services they will enable. These investigations analyse the implications of different business models for key participants in the value chain, aimed at determining which technology delivers the most economic and effective solution for a mutually beneficial "win-win" situation.

Mobile TV is not simply conventional TV 'on the go' – it is personal TV and a multimedia device in your pocket. Its primary value is in a converged environment where a single system can deliver all kinds of mobile TV services – an environment where viewing times are not necessarily the most relevant metric.

Mobile TV trials and commercial services have proliferated recently. Rather diverse approaches have been taken to services, pricing, marketing and technology. Getting the approach right is extremely important as mistakes could be expensive and the potential of mobile TV may not be fully realised.

Mobile TV services are also challenged by the fact that customer demand for acceptable form factors can limit the radio sensitivity of terminals that are often used indoors. Such constraints impose particularly demanding coverage requirements on mobile TV services. Providing the necessary level of service quality and reliability requires mobile TV to match the design parameters of a cellular radio network including the delivery of in-building coverage. Mobile TV broadcast networks therefore have to provide a higher level of received signal strength on the ground and indoors than digital terrestrial TV.

Several countries are beginning to call for consultations, a few countries are going live with DVB-H and DMB¹ systems, yet others are still trialling solutions. There is considerable confusion in the market. The industry should try to avoid market fragmentation which would require the consolidation of a variety of solutions to a common service in order to generate economies of scale.

This white paper is based on initial analyses of the various solutions available for mobile TV deployment. It also addresses the challenges and requirements operators will need to consider when rolling out any of the technologies. But the Joint Mobile TV Group does not make any recommendations nor point to deficiencies of any of the technologies. The group presumes that the market will make its own judgement and select the most appropriate technology to meet its demands.

² DVB-H = Digital Video Broadcast – Handheld; DMB = Digital Media Broadcasting

3. THE BENEFITS OF MOBILE TV

Interactive services linked to mobile TV represent new opportunities for mobile as well as for media industry stakeholders by providing richer and more fulfilling services to end users. Today, interactivity based on the traditional TV service model, is very different to what can be achieved using mobile TV coupled to a mobile network return channel. Mobile TV enables much more personalised and enriched communications between end users and service providers which represents a step change in terms of marketing effectiveness. This enables stakeholders to communicate with their audience on a more individual level. These new communication opportunities will bring added value for operators, broadcasters and end users in the form of new content formats, targeted advertising, personalised content programming and presentation, as well as improved customer relations.

The benefits for the main stakeholders are as follows:

Benefits for End Users

End users are no longer restricted to their homes to access their favourite TV programmes. They will discover and adapt to the click-through opportunities presented by mobile TV which in turn will build new behavioural models based on personalisation, content and product needs and community building. This will develop into a step change in the way that users can get access to new services based on mobile TV delivery.

Mobile TV allows end users to consume TV or radio in any place at any time. They could buy content or products without being at home or in a shopping mall, deciding to buy now and consume later. This richer and more diverse content or information enables better time management, even when they are away from the home or office. They will benefit from “long tail” economics through access to niche content delivered over an almost limitless range of TV channels compared with analogue TV and radio broadcast services.

This opportunity will only be realised once the fundamentals of the ecosystem and the mobile TV business model are in place. Service quality, ease of access, ubiquity and overall usability are key aspects. Service providers have to make sure that users can easily access the new click-through services with protection to ensure that they must not become the junk mail traps of the future. This aspect must not only be taken into account in the design of the joint ecosystem but must also be policed by the industry to ensure appropriate service solutions and widely accepted services.

Benefits for Mobile Operators

To date homebound interactive TV services – implemented via SMS or call back by free-to-air, cable TV as well as satellite TV operators – have had success in niche market applications but have yet to reach mass market scale. This is probably due to the restricted possibilities for audience interaction in static traditional TV services. Some of the main reasons for the limited market uptake of interactive TV services are: little interaction functionality over the return channel for the user, set-up effort, service complexity, poor usability, lack of personalisation (more family oriented content than personalised), inappropriate context for interactivity (programmes tend to be viewed in passive, laid-back situations) and overall costs.

By contrast, the concept of an identifiable and addressable user is inherent to a mobile network. Such a user is authenticated by default, has ubiquitous access and can conduct transactions over networks with acceptable latencies via mobile TV click-through requests. Furthermore, the user can connect directly to mobile web services, provided either by the mobile operator or other service providers, potentially fully synchronised with on-air TV programmes². The opportunities for mobile operators to drive the interactive TV market are substantially larger as a result of this greater personalisation and faster user interaction.

As mobile operators have recognised service portfolios through their mobile service delivery platforms they can act as a service provider for interactive services, as a service distributor or can manage hosted products for 3rd parties (such as commercials and advertising). Operators agree there is no "one size fits all" applicable to all markets and business structures. The separation of bearer layer and service layer has the potential to encourage an open market for device and backend system development.

Infrastructure should be sufficiently flexible to allow service providers to create offerings tailored to the requirements of individual markets.

Benefits for Broadcast Operators

In contrast to telecommunication service providers, broadcasters in Europe have been operating in a fairly fragmented market environment. So far their business models have focused on capturing value from the distribution of audiovisual content to consumers without much interactivity between producers and consumers. This applies equally to free-to-air and pay-tv content distribution. But there are similarities with the telecommunications industry as broadcasters face an increasingly competitive environment. In particular they compete for advertising expenditures not only among themselves but also against other media. Broadcasters are therefore constantly looking for innovative content formats and services to deliver new opportunities for revenue and long term customer retention.

Mobile TV provides broadcasters with opportunities for personal targeting. Mobile TV click-through concepts introduce a whole new dimension to the traditional TV broadcast model. The combination of personal targeting with richer click-through capability enables reality TV shows to reach into audiences in a way never seen before. In addition, the traditional advertising model is turned on its head. Currently, traditional TV advertising is structured around brand introduction and refresh – the introduction of new products and services and the refresh of existing products and services. Today's advertising is time-based, directed at captive home-based audiences with special shaping at peak times to reflect specific demographics and segments.

Mobile TV brings a whole new opportunity, breaking away from the household-based model and introducing a powerful ubiquitous and interactive capability to open up new areas of customer engagement and fulfilment. This new opportunity opens up the potential of cooperation between operators and broadcasters based on appropriate ecosystems and business models.

² For example au KDDI in Japan offers supplementary mobile internet services alongside 'one segment' mobile TV.

Mobile TV will aid broadcasters to strengthen their relations with specific target segments such as young users and early adopters of web-based technologies by leveraging their existing brands through new delivery channels and content formats.

Benefits for Other Industries

Mobile TV opens up new opportunities for many industries either 'adjacent to' or 'distant from' mobile multimedia.

Manufacturers and suppliers of handsets, platforms, broadcast systems, content editing and distribution systems, customer relations centres, billing and IT systems, advertising agencies, IPR and rights owners could all benefit from wider distribution of their products and services. Rights owners are pushing for greater control over the distribution of their creative output. The return path of mobile TV could help by introducing DRM.

Local channels or shops could benefit from more effective broadcast advertising using the personalisation or the regional broadcasting capability of mobile TV. However, advertising markets are based on audience and cannot by themselves justify the investment in new broadcasting networks or systems. Without an audience, advertisers are not interested.

'Adjacent' industries include the traditional TV broadcasters, content creators and content aggregators. These industries will benefit greatly from the wider introduction of mobile TV, although achieving the required mass audience will take some time.

New cooperation opportunities will arise between stakeholders such as different multimedia providers, broadcasters, mobile operators and IPTV service providers. Collaboration between these individual parties will open up opportunities for new mobile broadcast services and strengthen the interaction between user and service provider as well as between service providers themselves.

Some 'distant' industries currently not participating in the traditional TV value chain will grab the new opportunities offered by mobile TV. Such companies might specialise in electronic service guides for mobile TV³ or be 'TV-commerce companies' leveraging the click-through capabilities of the mobile TV ecosystem. Special mobile TV related web-based companies will be just one click away from TV programmes shown on a handset.

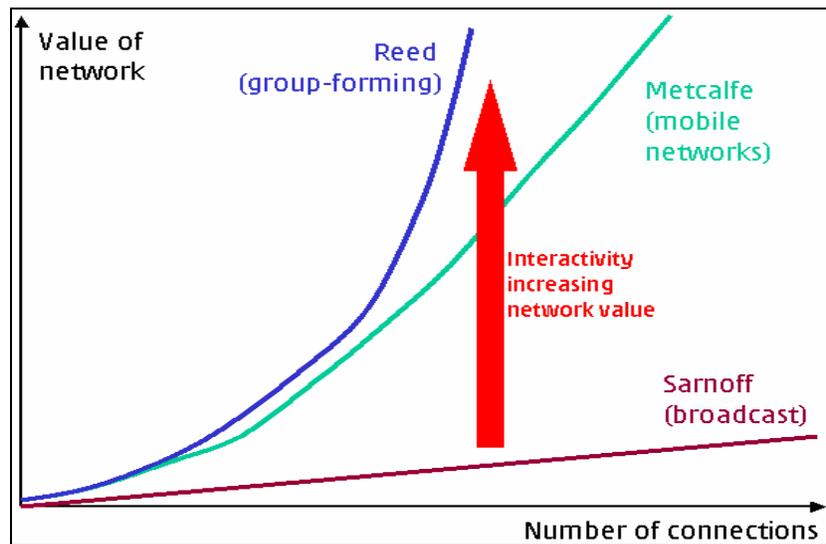
In the more 'distant' industries, the advertising value chain from creative through to production will also benefit from the fundamental differences between the mobile community needs and the traditional time-based and homebound captive terrestrial TV market. This will increase the interactivity and impulse 'buy now' opportunities closely linked to the more interesting segmentation profiles of mobile users.

Further 'distant' industry opportunities include opportunities for players in the nascent mobile commerce market through the creation and development of key partnerships or financial outsourcing arrangements. These players will benefit from the provision of mobile shopping TV, combining TV with mobile premium content offers such as the download of additional content, ring-tones, logos, trailers or clips.

³ For example G-Guide in Japan with over six million mobile users.

The Importance of Building Business Models Beyond Advertising

Commitment and buy-in of all players in the value chain depends upon satisfying mobile users, broadcasters (radio and TV, both analogue and digital), mobile network operators, content producers, rights owners, content aggregators and publishers, manufacturers (network, handsets, chipsets), aggregators and advertisers. One basic business model that has been proposed is supported simply by advertisements within the content stream. This is a marginal business case in some markets and difficult to justify without some form of collaborative model to distribute costs and improve the revenue opportunity. Enabling interactivity with other groups, however, introduces further revenue streams. Figure 1 illustrates how the promotion of interactivity can increase the value of a network considerably compared with the situation for traditional broadcasting.



Source: "Three UK"

Figure 1: Promotion of interactivity adds value to a network

Figure 1 shows that services aimed at individuals, such as news sites, benefit from additional users in a linear fashion. They obey Sarnoff's Law, named after the pioneer of the broadcast industry, which states that the value of a network grows in proportion to the number of viewers.

Services aimed at facilitating transactions, on the other hand, benefit far more as the number of connected users increase. In fact the value of the network in this situation grows in proportion to the square of the number of users. This is Metcalfe's Law which states that the value of the network that comes from switching (connecting one element to another) grows as the square of the number of elements.

Communities add yet another value creating dimension. So called group-forming services aimed at building communities benefit in an exponential fashion as the number of users increases. They obey Reed's Law which states that the value of the network that comes from supporting the formation and sharing of information among persistent groups (group-forming networks) grows exponentially in the number of elements.

The important factor in the context of mobile TV is the observation that the dominant value in a typical network tends to shift from Sarnoff to Metcalfe to Reed as the scale of the network increases.

4. POLICY AND REGULATORY REQUIREMENTS

One of the major challenges facing all players wishing to enter the mobile broadcast TV market is the complex, and in some cases uncertain, regulatory and licensing environment. In some countries regulations and licensing could prove major barriers to the rapid and universal adoption of mobile broadcast TV services.

The key regulatory issues facing this nascent market can be broken down into four areas:

1. Regulation of converging industries and markets – in some countries uncertainties exist as to which regulatory body has responsibility for these new services.
2. Competition policy – how many mobile broadcast network operators will be licensed? Some countries might allocate DVB-T⁴ and DVB-H licences to broadcasters:
 - o Will new platform provider licences be issued and what will be their role be?
 - o Who is allowed to broadcast to mobile devices?
 - o What restrictions on service provision and reselling broadcast capacity will be imposed?
3. Technology specific licensing – which, if any, technologies will be mandated for use in certain countries?
4. Spectrum availability, allocation and licensing – what spectrum is suitable and when will it be available for use? How will spectrum be allocated, i.e. who will own the spectrum and how might it be valued?

Coordination of policy and harmonisation of spectrum bands has helped Mobile to become a global ecosystem with major benefits to industry, government, operators and end users. It follows that mobile TV harmonisation of regulation, services and technologies regionally and where possible globally will enable mobile TV to join voice and data services in the mobile ecosystem.

Regulation of Converging Industries and Markets

Governments and regulators should ensure the alignment of sufficient spectrum bands across Europe to support the success of mobile TV. This is necessary to deliver economies of scale, prevent fragmentation and lead to lower prices for the end user.

Mobile broadcast TV also involves a unique spectrum allocation and licensing issue. Broadcast channels are traditionally owned by broadcast operators while the interactive or return channels are owned by cellular operators. In some countries, broadcast operators are currently prohibited from simultaneously transmitting broadcast programmes over mobile channels.

Television is a highly regulated industry and the considerable cost of implementing the regulations is borne by the broadcasters. Regulators need to ensure that sector specific broadcasting regulation is not applied to mobile content. Mobile devices should not be subject to mandatory fees (broadcasting licences or equivalent fees payable by levies on end users) to finance public broadcasters.

⁴ Digital Video Broadcast – Terrestrial

These challenges need to be addressed by the regulatory authorities, whether regulations are converged or not. Without greater certainty in individual markets, and greater coordination and standardisation across international markets, vendors, operators and broadcasters will be unwilling to commit the investments necessary to make mobile TV a successful business.

Ideally, services, networks, and content should be separately regulated allowing any service (whether it be voice, on-demand data, or broadcast data) to be delivered over any wired or wireless network. The emphasis should be on creating a level playing field for all players that encourages innovation and investment, and in so doing contributes to improved public services and economic value.

Competition Policy

Given the strict regulatory and competitive licensing framework for cellular services in many countries, what will these new converged cellular-broadcast services mean for competition?

Some of the key issues are similar to those that arose in the debate regarding cellular licensing.

- Should competition be encouraged at the broadcast network operator level (i.e. the owner of broadcast spectrum and infrastructure) or at the service provider level (i.e. the retailer of mobile broadcast TV services to end users)?
- Should the regulator award a limited number of broadcast network operator licences to encourage investment or should it let the market decide?
- Should broadcast network operators be required to sell wholesale services to all cellular operators to avoid providing an unfair competitive advantage to broadcast or cellular operators?

Competition in the broadcast TV-to-the-home market in most developed markets is relatively high. Typically, consumers have a choice of free-to-air terrestrial TV (analogue and digital), cable TV, and satellite TV. Each broadcast operator competes on service (channel breadth and mix) and price. There is no reason to believe that a similar level of competition cannot be supported in mobile broadcast TV.

Regulatory policy regarding competition in mobile broadcast appears to encourage competition at the broadcast network operator level. We believe the market in most countries may support a small number of mobile broadcast network operators. But regulators must provide a clear and consistent regulatory framework for this market to encourage new services market entry by operators, content providers, and vendors.

Broadcast network operators will be looking for mobile TV market entry opportunities, Operators at technology choices and spectrum needs, while vendors will be looking for consistency and certainty regarding technology licensing in order to achieve scale economies.

Technology Specific Licensing

There is a clear trend towards technology neutral licensing, recognising that regulatory policy cannot keep pace with technology innovation. Although in markets such as Japan and Korea there are already local market specific technologies in operation, it seems possible that multiple technology standards may be deployed in some markets.

Technology neutral licensing policies need careful consideration. Especially the inclusion of mechanisms, including co-existence studies, are in place that ensures that interference is not introduced to existing bands, is in the best interests of both industry and consumer protection. A technology neutral regulatory framework for mobile TV could stimulate innovation, but the market for such innovations can only develop if there is assurance of associated harmonised spectrum.

Spectrum Availability, Allocation and Licensing

There is no global allocation or identification of radio frequencies specifically for mobile broadcast TV. However, steps are being taken at regional and national levels to develop a frequency plan for future digital services, including mobile broadcast TV.

It is estimated that terrestrial TV switchover from analogue to digital transmission will enable existing terrestrial TV services to be delivered with typically between a third and a half of the existing spectrum requirement. Thus, significant amounts of spectrum will be released for reassignment for new uses: the “digital dividend.” Some of the spectrum released by switchover is expected to be made available for mobile broadcast services.

The spectrum made available from switchover could be used in a number of other ways, too:

- Provision of additional terrestrial TV channels, for example regional TV
- Introduction of new convergent multimedia services
- Reallocating spectrum to new applications, such as 3G mobile

Therefore, in countries such as those in the EU as well as Japan, Korea, and most of Asia and Africa, spectrum for mobile broadcast TV is likely to come from existing analogue TV spectrum, probably in the UHF band (Figure 2).

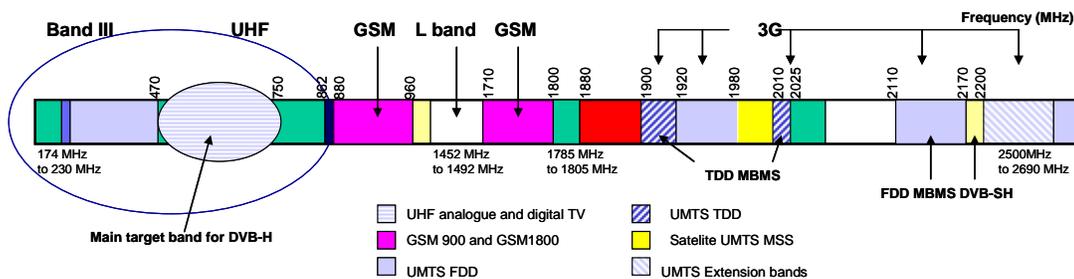


Figure 2: Main frequency bands for mobile broadcasting in Europe

Harmonisation of frequency bands will undoubtedly help create scale economies to the benefit of vendors, operators and users.

Although it is unlikely that broadcast spectrum will attract such high payments as the UMTS auctions in Europe, the cost of scarce spectrum resources should reflect the opportunity cost of the resource. To encourage efficient use of spectrum, and to hasten the switchover from analogue to digital broadcast transmission, it is likely that spectrum auctions, and possibly some form of spectrum trading will be adopted in certain markets.

The amount of spectrum, the frequency ranges, and the timing of its availability, however, vary considerably between countries. This has significant implications for scale economies, etc. For example, chip vendors and handset vendors will have to make decisions regarding what combination of cellular/mobile broadcast standards and frequencies to support.

Inevitably those combinations of standards and frequencies that are expected to be most widely deployed will be the first to be developed and thus enjoy most rapid reductions in ex-factory cost. This will probably be to the detriment of those markets with unusual combinations of standards and frequencies.

Having a single device support several cellular standards as well as broadcasting and still fully comply with SIM Security and Authentication as experienced today in 3G networks at an affordable price for the user is a challenge that is resolved by the volume scale effect of harmonisation.

Furthermore, to accomplish free circulation of devices in a roaming environment, there should be no new levies on handsets or taxation on devices that have capabilities to support mobile TV or enhanced multimedia services. As an integral part of rich and widespread mobile content, no new taxation regimes should be introduced for content such as music, mobile publishing and TV programming.

5. OUTLINE OF CURRENT TECHNOLOGIES

Wireless networks were originally designed for point-to-point communications to serve users individually within the unicast paradigm. The concept of transmitting the same information to multiple users (multicast paradigm) has been standardised using multicast technologies. Multiple scalable broadcast technologies exist today and can deliver broadcast type applications to multiple users simultaneously (broadcast paradigm).

As live streaming of movies and multimedia content and capabilities grow, the average size of the content itself increases. As a result, the optimisation capabilities of broadcast and multicast technologies become commercially attractive. In particular, the increasing focus on high quality video and audio content encourages mobile operators to optimise delivery over the air interfaces that leverage the use of scarce spectrum resources. The goal of these technologies is to use the network capacity required to deliver the same content to multiple recipients in more efficient ways. Without such technologies the number of simultaneous sessions sustainable in a cellular network is limited by the local serving cell capacity and so mass events that demand high bandwidth peaks are difficult to manage.

Services that benefit from live streaming technologies include news updates, stock alerts, goal flashes, mobile TV, customer marketing, software and configuration updates. From a cellular perspective, the applications may be regional or more broadly spread, allowing additional benefits from core and backbone network efficiencies. A particularly attractive commercial opportunity is to efficiently enable services for large numbers of users with shared interests gathered in a small area such as at sports or music events, trade shows, or shopping centres.

Such applications are expected to be widely deployed with a focus on high quality multimedia content. Some service providers are already offering video clips and sport

event highlights, applications that are mostly implemented by mobile operators, Internet Service Providers (ISPs) and content providers.

Mobile operators providing multimedia services have to cope with the constraints imposed by scarce radio resources. Spectral optimisation is therefore a main concern of regulators as well as mobile operators especially with the increased bandwidth requirements of multimedia applications.

Whilst wireless networks were mostly designed to transport traffic in a unicast fashion, the concept of transmitting the same information to many users is being developed allowing broadcasting techniques that enable resource to be shared on the network

A variety of technologies exist today that can deliver multimedia applications to multiple users simultaneously; the sections below focus on the differences between some of the available technologies.

Unicast and Video on Demand

'On-net' streaming or unicast (one-to-one) is how most mobile operators currently deliver mobile TV over their 3G networks. Unicast can deliver scheduled (and live) streaming (TV/multimedia) services as well as Video on Demand (VoD). Unicast is further enhanced by the introduction of HSDPA (High Speed Downlink Packet Access) technology which provides lower latency and increased downlink bandwidth for UMTS networks. Unicast is not optimised for high numbers of users located in the same geographical area – a situation where many users are watching the same few TV programmes at the same time. With increasing mass audience uptake of mobile TV the top TV programmes will have to be broadcast by an overlay infrastructure (Figure 3).

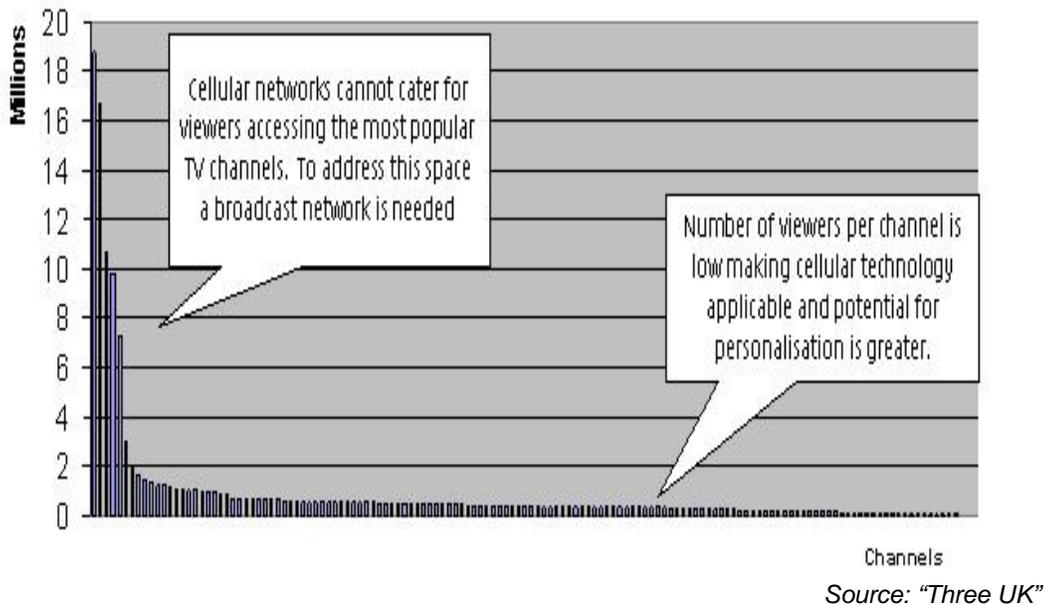


Figure 3: Different technologies support mainstream channels and niche channels

VoD is a point-to-point service which can be provided through download of a video file over a point-to-point bearer based on background quality of service (i.e. overnight file transfer). Such services are typically delivered over a mobile operator's high speed HSDPA network.

Multicast

Multicast services within UMTS networks are based on MBMS (Multimedia Broadcast Multicast Service). Available from 3GPP Release 6, MBMS is effectively an on-net broadcast service (one-to-many). It provides an alternative media delivery platform for a variety of mobile TV channel configurations in local and regional areas for applications such as concerts, sports events and public disaster alerts.

Instead of underutilising resources, MBMS allows for:

- Optimisation of radio resources: data is sent only in the cell where interested users are located and data distributed over the radio is done in a more efficient way to save resources in the cell.
- Data is sent in point-to-point (dedicated) mode to each user if the number of users in the cell is small. Power control enabled in this dedicated distribution mode saves radio resource.
- Data is sent in a point-to-multipoint mode when the number of users interested in the data increases to a level at which it is more advantageous to broadcast information than to have many dedicated radio bearers. The threshold between point-to-point and point-to-multipoint distribution can be chosen by the operator.

The multicast service optimises the delivery of services dedicated to large numbers of users as it reduces overall bandwidth consumption and load on network elements. Multicast service is also scalable. With MBMS, the greater the number of users in a particular area, the more compelling the service: data is sent only once over the radio while revenue is received many times.

Broadcast

A number of technology platforms currently exist for multimedia broadcast services to mobile handheld devices:

- DVB-H is the extension of existing DVB-T to support terrestrial broadcasting of video streams to multiple handheld mobiles (the main enhancements are savings on battery power and support of mobility with a smaller antenna). The existing TV broadcasting network is fully reusable with an upgrade to the DVB-H standard. Besides audiovisual and TV streams, DVB-H carries IP-based data including files, notifications and auxiliary data streams for additional services.
- MBMS could be used in two modes. As well as multicasting multimedia streams over a GSM or IMT-2000/3G/UMTS⁵ network to multiple mobiles subscribed to

⁵ IMT-2000/3G/UMTS networks are subsequently referred to as UMTS networks in this document for ease of reading.

the service, it could be used to broadcast to all mobiles in the geographic area covered by the base station.

- DMB (Digital Media Broadcasting) is an evolution of DAB (Digital Audio Broadcasting) technology in which mobile user's access TV content over their mobile handset and in-car terminals. As well as streaming TV, DMB can also carry IP-based data including files, notifications and auxiliary data streams for additional services. The satellite-based implementation S-DMB is restricted to Asia and in Europe the focus is on the terrestrial T-DMB.
- MediaFLO is based on the Forward Link Only (FLO) specification for "Terrestrial Mobile Multimedia Multicast" (standardised as TIA-1099). MediaFLO is an end-to end system that enables broadcasting of video streams, audio-only streams, clipcast media, and datacasting to mobile devices, including handheld receivers. The system is designed to optimise coverage, capacity and power consumption as well as overall user experience for handheld receivers using the TIA-1099 air interface standard. The system can reuse existing broadcast network infrastructure such as sites, antennas, DVB-T transmitters that are upgradeable to support the FLO modulator, and other ancillary equipments, in either a Multiple Frequency Network (MFN) or Single Frequency Network (SFN).
- TDtv (MBMS over TD-CDMA) makes use of the UTRA TDD technology, commonly known as TD-CDMA, to broadcast mobile TV streams in existing UMTS TDD licensed spectrum; it is based on the 3GPP MBMS architecture, with layer 1 enhancements to increase coverage and capacity.
- Satellite Services for Portable (DVB-SH) is a European satellite-based concept with direct-to-mobile transmission addressing coverage in rural areas and complemented with terrestrial repeaters to provide deep indoor coverage in urban areas. It uses IP-based transmission, an OFDM waveform with an improved link budget by employing codes. Several hybrid mobile satellite broadcast systems already in operation have demonstrated the efficiency of such a solution (Sirius and XM-radio systems in the USA for radio programmes only), MobaHO! in Japan and S-DMB in Korea (radio and TV programmes).
- S-TiMi is a potential Chinese standard sponsored by SARFT (State Administration of Radio Film and TV) that combines terrestrial and satellite solutions in a single frequency network. It is similar to DVB-SH in many respects but differs in frequency bands and channel coding. Concerning the spectrum bands, although today there is no official decision, the proposed band for S-TiMi operation is likely to be 2630-2655 MHz and the CCSA Frequency Working Group is still conducting studies on interference with terrestrial systems. S-TiMi uses high power transmitter towers instead of low power towers that could be co-sited with 3G base stations.

Main Differences between Broadcast Technologies

The main differences between these technologies are the following:

- Data rates:
 - a) DVB-H: 2.49 – 13.67 Mbps (coverage/capacity trade-off) in 8 MHz
 - b) DMB: 1.06 – 2.3 Mbps (coverage/capacity trade-off) in 1.712 MHz
 - c) TDtv: 3.5 – 5.0 Mbps (coverage/capacity trade-off) in 5 MHz

- d) MediaFLO: 3.7 – 14.9 Mbps (coverage/capacity trade-off) in 8 MHz
 - e) DVB-SH in the S-Band: 1.35 – 10 Mbps (coverage/capacity trade-off) in 5 MHz
 - f) MBMS in UMTS FDD: 3 – 8.5 Mbps (coverage/capacity trade-off) in 5 MHz⁶
 - g) S-TiMi: 2.7 – 10.84 Mbps (coverage/capacity trade-off) in 8 MHz
- Regulation: MBMS over FDD and TDD, as specified in 3GPP, are planned to be implemented on existing UMTS spectrum. For technologies using broadcast frequencies spectrum regulation is within the scope of the ITU based on the output of the Regional Radiocommunication Conference 2006 (RRC-06 finalised in June 2006). RRC-06 agreed to a new frequency plan for the ITU's Region 1, taking into account all national Member States requirements.
 - Network usage: when using terrestrial broadcast-based technologies, data transfer is generally over the broadcast operator network while user interaction is through the mobile network.
 - Deployment:
 - Network:
 - Two alternatives exist for the introduction of DVB-H: upgrade of an existing DVB-T infrastructure (when available) or the creation of a new dedicated DVB-H infrastructure which could reuse existing UMTS sites, or the combination of these two.
 - T-DMB requires an upgrade to an existing DAB infrastructure as the currently existing infrastructure has been planned for automotive or outdoor reception and indoor reception is consequently weak.
 - DVB-SH requires a satellite as well as terrestrial repeaters in urban areas that could be integrated in UMTS sites. Moreover, the proximity of the S-UMTS bands to the terrestrial UMTS bands allows an easy integration in existing cellular sites. The feeder and antenna systems can be reused with a simple upgrade.
 - MediaFLO can leverage existing high power broadcasting infrastructure (sites, antennas, DVB-T transmitters that are upgradeable to support FLO modulator, and other ancillary equipments) or lower power cellular infrastructure depending on the spectrum regulation.
 - Introduction of MBMS requires a software upgrade of UMTS network elements initially in hotspot areas.
 - Device: Depending on the system used for mobile broadcast service the mobile UMTS handsets require additional hardware i.e. a new receiver module and software upgrade.
 - Engineering/planning:
 - MBMS coverage area is mapped to the UMTS coverage as long as the required bit rate does not exceed a reasonable threshold.
 - TDtv coverage (with its layer one enhancements over standard Release 6 MBMS) typically requires the usage of between 33%

⁶ Current vendor proposals in 3GPP could extend the maximum theoretical bit rates to 40 Mbps as of 2010 under ideal radio conditions.

and 50%(Source – IP Wireless) of existing UMTS FDD cell sites in the hotspot areas within which it is likely to be deployed.

- Many DVB-T networks are planned so that reception is based on fixed rooftop directive antennas. If mobile broadcast technologies were deployed in such a network and frequency planning configuration, additional transmitters or gap-fillers would be required to provide enhanced indoor coverage for portable handheld devices.
- User interactivity: TDtv and MBMS service include an uplink channel, not available in DVB-H, T-DMB or MediaFLO which opens the possibility for user interaction. To get user interaction with DVB-H, DMB or MediaFLO a point-to-point bi-directional channel has to be established between each user and the broadcast service through the mobile network.
- Timeframe: DVB-H and T-DMB standards were finalised at the beginning of 2004 and field trials were performed mid-2005 to mid-2006 in several countries. DVB-SH is currently being standardised and will be finalised before the end of 2006. The MediaFLO air interface specification was standardised in July 2006 and is now published as TIA-1099. MediaFLO is currently being trialled in the UK. MBMS standardisation was finalised at the end of 2004 but some Change Requests remain to be done on Stage 3 specifications. MBMS field trials are foreseen in 2007. TDtv is currently in a field trial stage in the UK.

The choice of a specific technology platform ultimately depends on applications, development and deployment costs, and the regulatory climate. Broadcast-based distribution (DVB-H, T-DMB, MediaFLO) and mobile-based distribution (unicast streaming, MBMS or its CDMA counterpart BCMCS⁷) are complementary, not competitive.

Content Protection Technologies

Service protection and content protection are two of the fundamental roles for security systems in the context of mobile TV. The terms service protection and content protection are often used interchangeably although they do have specific areas of applicability.

Service protection refers to controlling consumer access to content on a service provider's network. It's a subscription management role that grants access to a service, for example access to a defined set of audiovisual multimedia data for a specified length of time. Service protection protects the pipe and prevents theft of service. It does not define what happens to content once delivered to the client.

Content protection deals with post-delivery usage rights which specify how content can be used according to permissions and constraints. It has the purpose of securing the individual pieces at the content level. Note that content delivered via free-to-air does not use any kind of content protection.

Content protection and service protection play a key role in the development and growth of digital content for mobile multimedia platforms. They reside at the convergence point where content providers, service carriers and platform makers are aligning to develop digital entertainment. Technical solutions for content protection

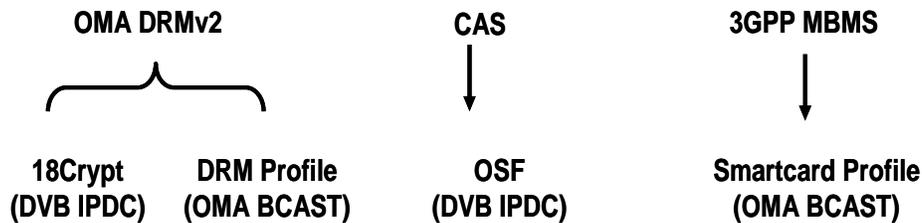
⁷ Being introduced before the end of 2006 by KDDI in Japan.

and service protection will therefore significantly influence if not determine the future of the digital content business.

The management of audiovisual rights – designed to protect the copyright owners – is very complex. Such rights may be difficult to apply if broadcast or mobile networks carry user generated content on a large scale. Rights management should not impede content access and usability by the user balanced with ensuring that the users are aware of their responsibilities whenever protected material is copied.

Several technologies for service and content protection have been or are being standardised as illustrated in Figure 4 and described in more detail in the following sections. The main difference between the mentioned technologies is the level of standardisation coverage for the solution. While OMA DRMv2 based and 3GPP MBMS based methods are fully standardised and do not contain proprietary, non-standard parts, the Conditional Access Solution (OSF) only defines a common signalling framework while the rest is proprietary.

Following a standards specified route has proven successful for the mobile industry. It has enabled a global market, interoperability, roaming and economies of scale.



BCAST-Broadcast

CAS= Conditional Access System

IPDC= IP Data Casting

MBMS=Multimedia Broadcast / Multicast Service

Figure 4: Technologies for service and content protection

DRM-Based Technologies

Content protection is traditionally focused on the protection of the multimedia content itself. Digital Rights Management (DRM) is often used as a synonym for content protection. DRM was created within the internet environment where the pipe is unprotected so the content has to be encrypted. DRM features a complex set of rights and defines permissible uses.

The use of DRM technologies to protect content has been widely adopted and a variety of solutions are available in the marketplace. Both device-based and SIM-

based approaches exist. Most operators require a SIM-based solution since it offers full control over the content by offering device independent end-to-end security.

There are several implementations of standardised technologies from organisations such as the Open Mobile Alliance (OMA), from several vendors of Conditional Access Systems (CAS), as well as from pure mobile phone manufacturers. Today the dominant technologies used are the OMA DRM 1.0 and its enhanced version OMA DRM 2.0 as well as Windows DRM (a proprietary system widely adopted in the PC environment). The advanced technologies not only provide a means to protect the content but also provide means to preview and utilise super distribution⁸, thus enhancing the business opportunities.

The OMA DRM technologies are optimised for file handling. Broadcast and streamed services need enhancements to these technologies as they cannot be treated as individual files.

Standardisation bodies have therefore defined extensions to OMA DRM such as 18Crypt from DVB/ETSI and the OMA BCAST DRM profile. These two standards are almost identical and cover both service protection and content protection for broadcast and streamed services.

18Crypt is versatile. It is not limited to broadcast audiovisual material but can be applied to any IP-based content. 18Crypt may be seen as a broadcast extension to DRM. The secrets management of 18Crypt uses OMA DRM 2.0 technology in which specified Rights Objects (RO) are used to deliver keys and entitlements. So terminal design follows OMA design principles where keys are stored and processed in a secure area inside the terminal. This allows the design of 18Crypt terminals which do not need a SIM or a return channel (Pocket TV, Car TV) although the most common use for 18Crypt is expected to be mobile handheld terminals with an interaction channel.

The OMA BCAST DRM profile is extensively inspired by 18Crypt and displays very similar features.

OMA BCAST Smartcard Profile

The OMA BCAST Smartcard Profile on the other hand leverages the secrets management of MBMS (defined by 3GPP) and BCMCS (defined by 3GPP2) to provide service protection and content protection. It also generalises these mechanisms to support other broadcast networks such as DVB-H. It relies on a specific USIM design and access to a mobile network for acquiring rights. Shared secrets are processed and stored inside the (U)SIM which provides unequalled security levels.

The OMA BCAST Smartcard Profile also provides extensions to MBMS and BCMCS key management to provide DRM functionality for content protection. It is also possible to use the Smartcard Profile for service protection and OMA DRMv2 or another solution for content protection.

⁸ Super Distribution is a new way of marketing content or products through the use of an individual's social networks.

Conditional Access Systems

Conditional access systems are used extensively today by providers of digital TV over broadcast, satellite, cable and DSL networks to protect access to the service. They support business models well known in the TV context such as subscription to individual channels for a certain period of time, preview, pay-per-view and parental control.

Conditional access systems are being used in the first deployments of DVB-H services in Italy and South Africa and are being tested in countries such as Spain and France.

Although conditional access systems are traditionally proprietary, the DVB Forum has specified an Open Security Framework (OSF) which defines a set of common rules and architecture (DVB Simulcrypt) to allow interoperability and roaming across OSF compliant networks.

Service protection and content protection are key elements necessary for the development of a viable ecosystem for broadcast services. The three families of technologies described above offer the market the necessary functionality but the existence of several standards involves the risk of fragmentation. Establishing a level of harmonisation of mainstream technologies could significantly help to reduce problems of interoperability, roaming, and cost increase that result from fragmentation. Interoperability and roaming problems can also be reduced – but not avoided – via common head-end architectures, appropriate signalling and common encryption algorithms.

6. SPECTRUM

Radio spectrum is a key resource vital to the commercial success of mobile TV. Unless suitable and sufficient spectrum is made available mobile TV will be unable to provide the services that consumers will most value. This will inhibit economic activity and stunt the growth of new content, new advertising models and new revenues for media to invest. Governments and regulators have a key role to play in ensuring that spectrum is made available in a timely way.

In the broadcasting or multicasting worlds, the more spectrum allocated the more radio frequency channels can be contained. Depending on the segmentation of the market for mobile TV, this single factor could determine the overall viability and economic success of the service.

Spectrum availability can have a significant cost impact on handsets over and above the influence of frequency on device antennas. Allocating a large number of narrow and fragmented bands for mobile TV usage could have expensive consequences. Handset vendors would need to make handsets either capable of operating on all the bands – at an added complexity and cost – or exclusively specified and developed for a single operator at a smaller quantity – again driving up the costs as economies of scale would not be achieved.

One of the possible sources of spectrum for mobile TV is that released by the switchover from analogue to digital broadcasting. This cleared spectrum – the so-called digital dividend – could offer opportunities for wireless innovations and potential for new services.

The exact amount of spectrum released will vary from country to country, as will the date from which it is available. The timings vary across Europe and the world, ranging typically from the years 2007 to 2015. The Geneva-06 Agreement at the ITU-R's RRC-06 conference specified the year 2015 as the agreed date for the end of the transition period in the UHF band in Europe.

From the mobile industry's viewpoint the particular frequency band and the amount of spectrum, as well as its degree of harmonisation, will have a major impact on the business opportunity that mobile TV presents. Suitable spectrum decisions will ultimately translate into lower costs of deploying networks, increased variety of content offerings, and in reduced cost of terminals. Spectrum decisions are crucial in a number of ways:

- The allocated frequency band can have a major impact on the cost of deploying radio networks. Lower frequency bands imply larger cells (all other things being equal) and hence lower costs of deployment. The savings can be significant, which is of exceptional importance when deploying in remote and sparsely populated areas.
- The availability of suitable spectrum, in large enough markets can promote wider deployment. This is because the cost of equipment, especially handsets, can be reduced through economies of scale. The presence of harmonised bands for mobile TV could drive the market faster and further as upfront fixed costs, in developing terminals, can be spread over many more users.
- Significant technical constraints to the frequency planning could arise to ensure coexistence of broadcasting networks intended for fixed rooftop

reception and mobile TV networks intended for indoor portable reception. This may be minimised by harmonising a sub-band for mobile applications allowing for improved terminal performance and reduced network costs. Technical feasibility could be further assessed in organisations such as CEPT. Other countries have already anticipated studies for the lower 700 MHz band (in the USA and currently under consideration by MIC in Japan).

The time-line with which mobile TV spectrum is made available will impact on the technology choices that are open to operators. For example in the short term it is likely that only a mobile operator's existing mobile spectrum could be used by an operator to provide mobile TV; using FDD and TDD bands (commercially in most jurisdictions). On the other hand, DVB-H technology can be deployed over existing broadcast bands. If mobile TV were commercially successful it is likely that a mobile operator's FDD/TDD bands could quickly become overloaded. If this were to happen before analogue TV spectrum were widely available, then other spectrum would need to be found as an interim solution. One possibility might be the use of the L-Band (if it were available before analogue TV spectrum) for terrestrial services. Another option could be the use of a harmonised UHF sub-band consequent to a technical feasibility assessment. This might give rise, without any order of priority, to the following possible scenario of spectrum use:

- 3G FDD (900/1800 MHz);
- 3G FDD and TDD bands (2 GHz, 2.5 – 2.6 GHz);
- L-Band (1.4 GHz);
- UHF band (470 – 862 MHz or harmonised sub-band).

Possible Frequency Bands for Mobile TV

174 – 230 MHz (Analogue TV VHF channels, Band III)

Availability of this band needs to be further studied and understood. It is not clear if this is widely used for analogue TV, and if it would be available after the switch-off. There may be issues with terminal size due to the large handset antennas required in this band and the man-made noise level. Hence apart from existing DAB radio and DMB mobile TV trial and commercial use in some countries, this band is limited for use as a harmonised mobile TV broadcast service.

470 – 862 MHz (Analogue TV UHF channels, Band IV/V)

This spectrum is currently used for analogue TV in countries worldwide. The expected digital dividend from these bands is likely to be made available from 2008 to 2012 in various countries. Thus, it is anticipated that spectrum might be made available for services other than terrestrial broadcasting to rooftop and portable reception after analogue to digital switchover. This is prime spectrum because of its sizable bandwidth, together with its beneficial propagation characteristics. This means that fewer cell sites are needed to cover and provide services within a given geographic area, as well as providing better in-building coverage than higher frequency bands.

This band also offers the possibility of identifying harmonised mobile TV sub-bands. This possibility coupled with the band's propagation characteristics make this band attractive for the future use of mobile TV. The harmonisation of a sub-band in Europe for mobile TV is under discussion in Europe.

In addition, this frequency band is under consideration for IMT-2000 within the context of Agenda Item 1.4 of the next World Radiocommunication Conference (WRC-07). It would be beneficial to have a harmonised sub-band for IMT-2000. A possible scenario is shown in Figure 5.

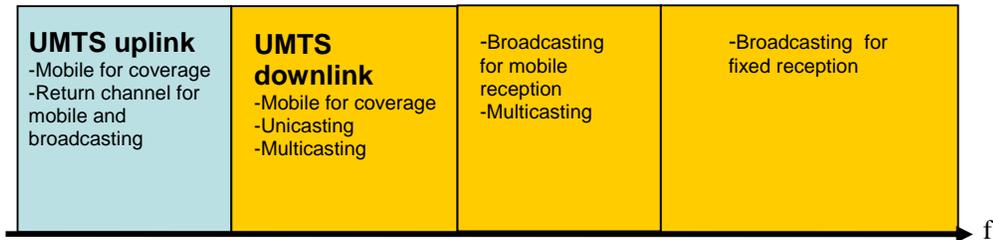


Figure 5: Possible illustrative frequency segmentation for the UHF band 470 – 862 MHz

A study was undertaken for WRC-07 to assess interference between UMTS/3G and broadcasting systems in Bands IV/V between 470 and 862 MHz. In ITU-R WP8F, results of sharing studies presented to date based on low and medium power broadcasting transmitters show feasibilities for coexistence between IMT and broadcasting systems including DVB-T, DVB-H and ATSC (Advanced TV Systems Committee) with band segmentation, which may require frequency rearrangement also taking into account geographical separations.

1452 – 1492 MHz (Digital Audio Broadcasting, L-Band)

This is the planned band for terrestrial and satellite digital radio broadcasting, but currently only with very limited usage for DAB in Europe and elsewhere. The band can also be used for DMB, the mobile TV variant of DAB, in many countries. It is expected that the L-Band could be available much earlier for mobile TV use in Europe than the analogue TV bands. This has given rise to the possibility of using DMB in the L-Band for initially launching mobile TV services, and implementing flexibility in the L-Band to allow other technologies such as DVB-H.(when extra capacity is required). However the propagation characteristics are not as attractive as the analogue TV band (although antennas in the L-Band may be more efficient, offsetting some of this disadvantage).

This solution could be considered as a secondary choice if analogue TV spectrum is not made available soon enough to meet growing demand.

1920 – 1980 MHz paired with 2110 – 2170 MHz (IMT-2000 core bands)

These UMTS FDD bands are globally harmonised. In FDD, separate paired bands are used for transmitting and receiving. There have been major deployments of IMT-2000 technologies on a global basis in these bands representing a significant market success. These 3G deployments cater primarily for voice and data services but can also provide mobile TV through unicasting. However, such unicasting mobile TV services can utilise a significant part of the available capacity in a mobile network when used to deliver high quality mobile TV. Unicast services have become very successful in some networks and have highlighted the need for additional spectrum in other bands to provide extra capacity for mass-market mobile TV services.

New improvements have been developed to UMTS systems, such as HSDPA and MBMS to facilitate broadcasting services for UMTS and therefore carry mobile TV content more efficiently. The MBMS service offers users the ability to watch mobile TV

content on their mobile terminals providing general live broadcasting, re-broadcast of existing TV programme channels or pre-recorded content, or alternatively content accessible from the mobile network. The mobile terminal is used both as a TV screen and a remote control.

1900 – 1920 MHz and 2010 – 2025 MHz (IMT-2000 core bands)

The UMTS TDD band at 1900 – 1920 MHz is harmonised across Europe and parts of Asia: it is channelled into four 5 MHz channels, typically distributed among the mobile operators in any given market. The UMTS TDD band at 2010 – 2025 MHz is channelled into 5 MHz channels and allocated to UMTS TDD in most regions. In Europe the first channel is a licensed channel and the other two were intended for unlicensed operations. With a few exceptions, in most European countries the 2010 – 2025 MHz band is currently unused.

1980 – 2010 MHz paired with 2170 – 2200 MHz (IMT-2000 satellite bands)

This 30 MHz spectrum band is allocated to Mobile Satellite Systems (MSS). It is currently available in Europe and Asia, and the 2 GHz band is planned to be used by two MSS systems including an Ancillary Terrestrial Component (ATC) in the USA although the band use in USA and Europe are different. This band is adjacent to the UMTS FDD downlink band (2110 – 2170 MHz) which enables potential benefits from technology and implementation synergies with UMTS/3G technologies (common antennas and feeders, shared equipment practice for repeaters and UMTS/3G transmitters).

2500 – 2690 MHz (IMT-2000 extension band)

These bands have been identified by the ITU for IMT-2000. A CEPT decision has been developed in which the extension band is divided in three sub-bands: two times 70 MHz for UMTS FDD and 50 MHz for UMTS TDD or FDD downlink. The band is large, some 190 MHz, but the very high frequency would make cell sizes very small in range limited coverage areas. Such bands could be used to provide a larger selection of mobile TV channels in city centres. This spectrum is planned to be made available in Europe as of the year 2008, which, in several countries, might be before the availability of UHF analogue TV spectrum.

Based on the text above, Table 1 provides a summary of spectrum bands and technologies within these bands with some remarks.

Spectrum	Technology	Radio Path Loss	Low Number of sites	Spectrum Availability	Other remarks
Band III 174-200 MHz	T-DMB	Low	Yes	Today (DAB)	- Limited TV channel capacity via DAB infra - Requires external antenna on mobile devices
Band IV / V 470-862 MHz	DVB-H IMT-2000/3G/UMTS UMTS/MBMS MediaFLO	Medium	Yes	Near future in most countries	- Potential synergies with DVB-T infra. - The band segmentation to fixed BC reception, mobile BC reception and IMT-2000 would improve the spectrum efficiency and facilitate harmonisation - The coexistence between IMT-2000 and broadcast systems in rural areas is feasible with band segmentation
FDD UMTS 900/1800 MHz	IMT-2000/3G/UMTS UMTS/MBMS IMT-2000/3G/UMTS/LTE	Low/ Medium	No	Today used by 2G operators, early availability for 3G	<i>Potential for harmonised European Spectrum.</i> - The near term roll-out of IMT-2000/3G/UMTS at 900 MHz in rural areas will complement the Mobile TV offering on IMT-2000/3G/UMTS at 2 GHz in dense urban areas.
L-Band 1.5 GHz	DVB-H T-DMB MediaFLO	High	No	2007 in some individual countries	<i>Not harmonised across Europe, Limited economies of scale and costly devices.</i> - Narrow channels and uneconomic designs
TDD UMTS/3G 2.0 GHz	TD-tv	High	Re-use of sites and antennas	Today as part of UMTS/3G	- Synergies for UMTS/3G devices and network infrastructure
FDD UMTS 2.0 GHz	IMT-2000/3G/UMTS UMTS/MBMS IMT-2000/3G/UMTS/LTE	High	No	Used by IMT-200/3G/UMTS operators	- Synergies for UMTS/3G devices - MBMS in FDD spectrum provides easy integration with interactive services.
Satellite Bands 2.2 GHz	DVB-SH	High	Re-use of sites and antennas	Available Europe-wide	- Economic for outdoor coverage, - Building enhanced indoor coverage for DVB-SH is as expensive as building indoor coverage for systems operating at GHz frequencies.
FDD UMTS/3G 2.5 GHz	IMT-2000/3G/UMTS UMTS/MBMS IMT-2000/3G/UMTS/LTE	High	No	Available in Europe as of 2008 onwards	- Unicasting over FDD - MBMS in FDD spectrum provides easy integration with interactive services

Table 1: Summary of spectrum bands and technologies

7. CRITICAL SUCCESS FACTORS

To the end user, the success of mobile TV is very much dependent on coverage, choice of multimedia channels, quality of content, ease of navigation, attractive pricing and wide commercial availability. These parameters can be listed as follows:

- Wide population coverage
- Good in-building performance
- Good picture and sound quality
- Availability of affordable terminals
- Wide terminal choice
- Large number of channels and content formats
- Quality of content programming
- Fast channel switching time
- Intuitive Electronic Programme Guide (EPG)
- Ease of access and navigation
- Interactivity with low latency and click-through access
- Secure authentication
- Transparent and trustable billing system
- Roaming of content

If any of these requirements are compromised, the perceived value to the end user will be reduced.

Due to the scarcity of widespread commercial mobile TV unicast or multicast services, commercial surveys are not yet fully conclusive indicators of user satisfaction levels. The industry must continually strive to enhance service capabilities and quality levels.

To be capable of delivering the most demanding mobile TV content, new mobile device screen formats, codec technologies and higher bit rates need to be introduced. This would result in a “Higher Definition mobile TV” experience similar to the approach used by terrestrial broadcasters who introduced HD services for special content.

The “HD like” mobile TV service quality level will evolve with handset technologies such as Battery life enhancements, H.264 codecs, faster frame rates and new screen formats. HD like mobile TV-enabled mobile devices will need to support much higher bit rates than today. To be effective this should be in line with a standardised approach through existing industry bodies and standards fora.

Terminals and Coverage

Personalised services require individual interaction between the user and the multimedia service provider. Mobile terminals at reasonable prices are required to increase the uptake of these services. This can only be achieved by establishing economies of scale as a result of a globally harmonised approach. Today, in some markets, mobile operators subsidise handsets to enlarge the subscriber base and encourage usage of services. For mobile TV, subsidised handsets enabled for TV and interactive multimedia might also be needed to accelerate mobile TV take up. The mobile will be the only device that enables individual user interaction through the return channel.

For much of the time users watch mobile TV at home with some trials indicating home usage levels as high as 50-70%. Mobile TV services are therefore challenged by

customer demands for affordable terminals with an acceptable form factor which may have limited radio sensitivity but are often used indoors. These constraints impose demanding coverage requirements on the mobile TV service to provide acceptable levels of service quality and reliability. Mobile TV coverage reliability will need to match the design parameters of a cellular radio network including the delivery of in-building coverage.

Important trade-offs will have to be made regarding the sensitivity of the TV receiver in the device as well the minimum quality of service of the video content shown on the device screen, especially for highly dynamic content such as soccer games.

Regardless of the broadcast technology, there is a very strong dependency between the (radio) sensitivity of a mobile TV handset receiver and the overall cost of the broadcasting network. Typically a 3 dB difference in device sensitivity, depending on topology can imply a doubling of the rollout costs for the broadcast network assuming a similar quality of service level.

Network costs increase more than linearly with radio frequency, a consequence of the laws of physics. The radio propagation loss increases at least with the square of the frequency. As a result, the frequency range over which networks are deployed imposes significant constraints on device antenna design.

- At low VHF frequencies (300 MHz or less) external device antennas are required due to the long wavelengths.
- At higher frequencies (300 – 1500 MHz) with consequently shorter wavelengths the physical size of the antenna becomes smaller enabling it to be embedded into the device.
- At frequencies above 2 GHz embedding multiple antennas and receivers (MIMO) into the device becomes feasible, improving device sensitivity and partly mitigating the increased propagation loss at higher frequencies.

Assuming sufficient economies of scale, the integration of broadcast receiver functionality in mobile devices represents an extra cost per device. Until such economies of scale are reached the additional cost per device could be an order of magnitude higher.

Electronic Service Guides

Electronic Service Guides (ESGs) or Electronic Programme Guides (EPGs) are on-screen guides to scheduled broadcast TV programmes, allowing a user to navigate, select and discover content by channel, time, title or programme format.

The development of ESGs is an area where individual service providers can successfully differentiate their service offering. They allow operators, providers and third party companies to differentiate their services by offering multi-platform ESGs that provide a list including both broadcast and on-net unicasting service elements.

ESGs resemble mobile portals in that they are entry points to a wealth of information and value-added services where users can quickly find what they need. They should be personalised and deliver content according to the characteristics of the terminal device and the needs of the user. The reason behind their strategic importance is that, like portals, ESGs are primary contact points and so a key part of the provider-customer relationship. This holds particularly true in the mobile TV environment where

users want instant access to content with few clicks. The ESG is also a template page that allows for branding and operator controlled advertising or 3rd party applications.

In some countries or market areas ESGs can be subject to regulatory conditions; this aspect needs further study to better understand the opportunities presented by ESGs.

Roaming

Roaming will be a key feature in the mobile TV environment. Mobile TV technology in combination with additional streaming services could enable viewers to access their favourite broadcast services when located abroad. However, this scenario requires adaptation of content licensing schemes to better accommodate service distribution across borders.

There are two principal scenarios for a roaming user. Both provide a different and valuable user experience:

- a) **Mobile TV Broadcast Roaming:** This allows subscribers to a (local) mobile TV broadcast service to access the (local) mobile TV broadcast services of a visited country. The channels available in the visited country will be for the most part local as each country will prioritise their home market channels over those from other countries given the limitations of overall channel availability.
- b) **Alternative Access to Mobile TV Content:** This allows a subscriber of a (local) mobile TV broadcast service to have access to their home country content while roaming in another country. Access would be over another transport mechanism – for example 3G streaming – while roaming in the visited country.

Regional Roaming Scenario (Example-Europe)

For mobile TV in the context of the European Union, roaming could be one of the most important service visions. Consumers could have their favourite programmes from their home countries forwarded to them wherever they travel in Europe. A practical way to forward such video would be over the 3G HSDPA network.

The difficulty with this vision lies with the rights issues rather than the technology since content owners traditionally fragment their rights along national lines. A mobile TV programme in Germany cannot be shown in France or the UK unless additional rights are purchased for those markets. Clearly work needs to be done to help lower this barrier and support the free movement of mobile TV roaming around Europe.

8. CONCLUSIONS

Several technological options are available to broadcasters and mobile operators implementing broadcast or multicast technologies. Their choice will be determined by the type of application, development and deployment costs, availability and decisions from regulatory bodies.

Broadcast-based and cellular-based technologies should not be regarded as competitive. On the contrary, advantage should be taken of their complementary characteristics to create optimum end-to-end systems for each type of application:

- DVB-H (both terrestrial and satellite), T-DMB and MediaFLO are foreseen for the broadcast of audiovisual services with auxiliary data, highly scalable file delivery services and datacasting.
- UMTS technology (or its evolution) enables support for user interaction and roaming. UMTS technology complements mobile broadcast technologies to ensure interactivity between the user and the service provider – a feature essential to the success of mobile multimedia applications.
- Combining mobile broadcast technologies (downlink-only) and UMTS will allow personal recording, televoting and e-commerce services directly on mobile terminals. Revenue generation in this area is likely to grow as the customer experience becomes more interactive.

Hybrid architectures will benefit from the combination of high quality multimedia services provided through broadcast networks with the interactive component handled through the UMTS network (or its evolution). In addition, the distribution of selected multimedia services to specific localities, particularly areas where large numbers of people congregate, can be optimised through localised service components using MBMS.

Implementing a standards-based philosophy has proven successful for the mobile industry. It has enabled a global market, interoperability, roaming and economies of scale. The adoption of proprietary systems should be resisted as they could fragment the entire mobile TV market and reduce its potential.

Availability of harmonised spectrum, in particular UHF sub-bands, is an essential element in this standards-based approach. UHF sub-band harmonisation and segmentation for terrestrial fixed and portable broadcast, mobile broadcast and mobile services may require frequency reshuffling. This would lead to a more optimal and efficient use of the UHF band.

9. APPENDIX

Acronyms

3GPP	Third Generation Partnership Project
ARPU	Average Revenue per User
ATC	Ancillary Terrestrial Component
ATSC	Advanced TV Systems Committee
BCAST	Broadcast
BCMCS	Broadcast and Multicast Services
CAS	Conditional Access System
CCSA	China Communication Standards Association
CDMA	Code Division Multiple Access
CEPT	Conférence Européenne des administrations des Postes et des Télécommunications (European Conference of Postal and Telecommunications Administrations)
DAB	Digital Audio Broadcasting
DMB	Digital Media Broadcasting
DRM	Digital Rights Management
DVB	Digital Video Broadcasting
DVB-H	DVB – Handheld
DVB-SH	DVB – Satellite services for Handhelds
DVB-T	DVB – Terrestrial
EPG	Electronic Programme Guide
ESG	Electronic Service Guide
ETSI	European Telecommunications Standards Institute
EU	European Union
FDD	Frequency Division Duplex
FLO	Forward Link Only
GSM	Global System for Mobile communications
HSDPA	High Speed Downlink Packet Access
HD	High density
IMT-2000	International Mobile Telecommunications-2000
IP	Internet Protocol
IPDC	IP DataCast
IPR	Intellectual Property Rights
IPTV	IP Television
ISP	Internet Service Provider
ITU	International Telecommunication Union
ITU-R	ITU Radiocommunication Sector
LTE	Long Term Evolution
MBMS	Multimedia Broadcast Multicast Service
MFN	Multiple Frequency Network
MIC	Ministry of Information and Communications
MIMO	Multiple Input Multiple Output
MSS	Mobile Satellite Systems
OFDM	Orthogonal Frequency Division Multiplexing
OMA	Open Mobile Alliance
OSF	Open Security Framework
RRC-06	Regional Radiocommunication Conference 2006
RO	Rights Objects
QVGA	Quarter Video Graphics Array

SARFT	State Administration of Radio Film and TV
S-DMB	Satellite DMB
SFN	Single Frequency Network
SIM	Subscriber Identity Module
S-TiMi	Satellite Terrestrial Interactive Multi-service Infrastructure
T-DMB	Terrestrial DMB
TD-CDMA	Time Division-Code Division Multiple Access
TDD	Time Division Duplex
TIA	Telecommunications Industry Association
TIMI	Terrestrial Interactive Multimedia Infrastructure
TV	Television
WRC-07	World Radiocommunication Conference 2007
UHF	Ultra High Frequency
UMTS	Universal Mobile Telecommunication System
USIM	Universal Subscriber Identity Module
UTRA	Universal Terrestrial Radio Access
VAT	Value Added Tax
VHF	Very High Frequency
VoD	Video on Demand

Further Reading

- (1) “Compatibility Study between DVB-H and UMTS operating in Frequency bands IV (470-582 MHz) and band V (582-862 MHz)”, Doc. 136: Contribution from UMTS Forum to ITU-R WP8F Meeting in Biarritz, France, 3-10 May 2006.
- (2) UMTS Forum Report No.38:”Coverage Extension Bands for UMTS/IMT-2000 in the bands between 470-600 MHz “, December 2004.