MOBILE TV: MULTIMEDIA CONTENT DELIVERY ON THE MOVE

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ABSTRACT

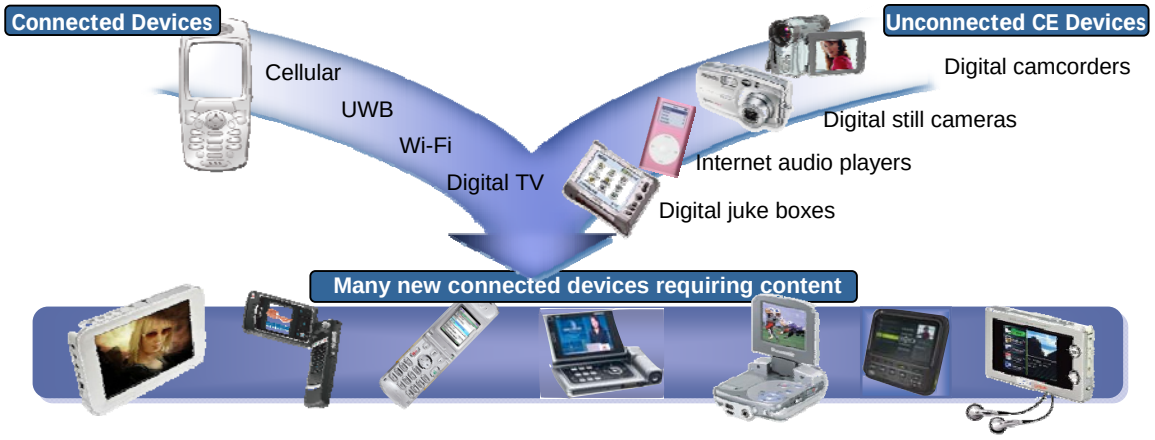
This paper will be a discussion of the content delivery options and business models available on Mobile TV networks. We will examine the new opportunities these networks bring to broadcasters and content delivery companies to enter this new space and the impact on infrastructure requirements. There will be a review the various Mobile TV standards; compare implementation and the impact on Spectrum, Bandwidth Requirements, Space Planning, Transmission Systems and the relative costs. This discussion is based on real world experience with projects Harris has been involved with around the world, and in the Asia region.

INTRODUCTION

Consumers increasingly demand the content they want, delivered when they want it, on their favourite devices, in a location of their choosing. While this is a sizable challenge for those that deliver content, the developments in mobile television make this a reality with a wide range of implementation choices. We will examine some fundamentals of this emerging market, some of the various architectures, spectrum use, business models and implementation solutions, and their impact on a system selection process. Upon reviewing these factors one should be better able to evaluate the various approaches to delivering multimedia content to consumers on the move, and determin which approach best matches their market requirements.

RICH MEDIA MARKET

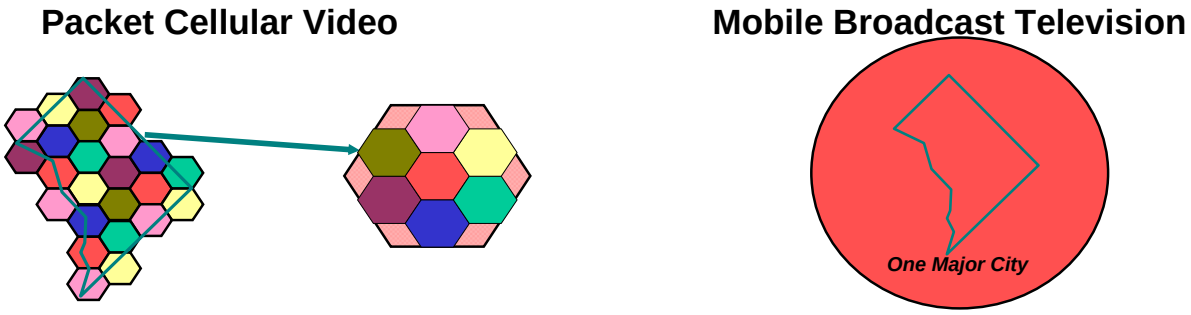
Consumer electronics manufactures, driven by consumer demand have been launching an increasing number of new devices that support the personal consumption of multimedia content. These devices range from personal media players, cameras and portable games to connected devices like mobile phones, digital radios and personal navigation devices. This proliferation of new devices drives a growing business that monetises the delivery of content to the mobile device, such as a mobile phone. The growth of mobile phone device sales is widely celebrated and documented. Some estimates put the adoption at two billion mobile phones in use around the world, or about 1 in 3 people. Network operators have already started to take advantage of this wide adoption with the sale of personalized rich media content such as ring tones, and video clips and are posting about five billion US dollars in revenue per year.



It is no surprise that this early activity in to the market and the associated consumer interest has provided the fuel for operators to evaluate extended services. Many of the first extended services offered have been via existing and new mobile phone networks, which allows for the delivery of content now with existing technology, and creates awareness of new services. These new services are often formatted streams of existing content that may be available over other networks, now offered on the move for consumer use. However the content on these networks is not solely limited to reuse of existing programs. New programs or events are now being offered directly to mobile users, an example is in France with telcom operators acquiring the rights for popular football games.

While mobile TV over a telcom network is often a quick way to introduce services to consumers, it may not be the most optimum implementation of a mobile service. As the demand and awareness of mobile content grows, existing systems that utilize point to point connectivity such as unicast or 3G networks will become clogged with traffic. This network congestion is driven by the point to point nature of the telcom system which requires a dedicated connection for each user, something which is required for a two way phone conversation with a friend, but not needed to watch TV. Telcom networks additionally are designed with a large number of low power transmitters or cells interwoven to create total area coverage for a city, region or country. This design is due in part to the need for the even lower power handheld device with a limited range to transmit your side of the conversation back to the tower. The solution to address this network congestion and the large number of cell sites required, is to create a broadcast based mobile TV network to deliver real time rich unidirectional media streams, and leave bidirectional interactivity to the mobile phone network. ***With this complementary approach, operators can reach an unlimited number of users with rich media content, and preserve the capacity on the mobile phone network***.

The hallmark of a broadcast approach is one that supports unlimited consumers, and typically a large coverage area from a single, or small number of transmitter sites. By leveraging the broadcast approach the cost to deliver per user drops dramatically as what could be 100's of sites become one.



In addition to the unicast approach, there are others who offer mobile services via satellite systems such as DVB-SH and S-DMB. These various approaches can be categorized in three major areas outlined in the chart below.

Mobile Satellite TV	Unicast TV over 3G	Mobile Broadcast TV
DVB-SH (Alcatel-Lucent) • Hybrid satellite terrestrial system • 45 channels • Terrestrial part to start in 2008	*Cellular Operator Branded Services* • Orange • Vodafone • 3 • Verizon • Etc.	*UHF* DVB-H • 20-25 channels • More than 10 full services launched worldwide • About 45 trials worldwide • HiWire in USA - trial stage
DMB Satellite *S-DMB*  • Focused satellite beam, best for dense populations • 500,000 Korean subscribers; planned in Japan	*Multiple Carriers* mobiTV • 30 channels low bit rate • Available on Sprint, Cingular, Rogers, Orange UK	*DAB (VHF: 200 MHz)* *T-DMB* • 8 S. Korea providers with 10-15 channels in 5 MHz • Commercial services in Beijing • To be launched in France
USA satellite TV to mobile  • DirecTV – 125 TV channels • Sirius – 130 radio and 3 back seat TV channels	*Content Branded Services* ESPN MOBILE • ESPN branded service launched February 2006 • Sprint EVDO network (Early 2006: 64 cities)	*700 MHz (UHF Channel 55)* MediaFLO™ FLO • 20 broadcast TV channels plus additional audio and video clips • Included in Verizon VCAST • Tested worldwide

FORMATS & SPECTRUM

There is no shortage of options one has when selecting a mobile TV broadcast standard for their network implementation. While each standard offers benefits and drawbacks, they generally can be categorized in two segments, purpose designed solutions that were crafted solely for mobile multimedia delivery, and others that are enhancements or modifications of existing digital standards to delver mobile TV.

Mobile standards that have evolved from other broadcast standards include DVB-H, T-DMB, ATSC-MPH and ISDB-T. DVB-H is an outgrowth of the very popular DVB-T terrestrial standard for digital television, and has been adapted to be more mobile friendly with lower hand set power consumption as well as other optimisation for mobile reception. In markets where DVB-T is the standard in operation for digital TV, many feel DVB-H is a natural choice, and in fact is favoured in the EU. One of the main drawbacks of DVB-H is the availability of UHF spectrum in parts of Europe until the completion of the digital switch over. T-DMB is derived from the DAB, Eureka 147 family of standards originally launched to support digital radio applications. T-DMB is ideally suited for reception on the move due to it roots in the very first portable electronic media, radio.

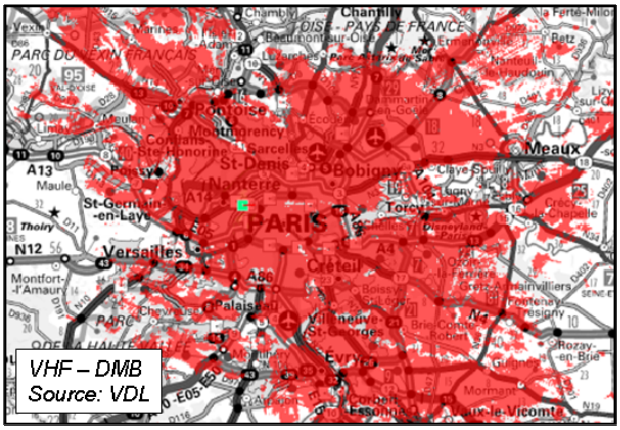
Launched in a wide array of countries around the globe, T-DMB has most notably been selected in what has been called the world's most successful mobile TV market, Korea, to power the free-to-air services. MPH is the mobile TV standard proposed for use with ATSC digital television popular in the Americas. MPH offers broadcasters the ability to add several local mobile channels to their existing digital television broadcast, "in band", along with enhanced multimedia content to create a rich user experience. Like MPH, ISDB-T is designed to support both mobile and terrestrial broadcasts over the same infrastructure. Currently ISDB-T is implemented in Japan where it was developed, and a variant ISDB-Tb is operating in Brazil.

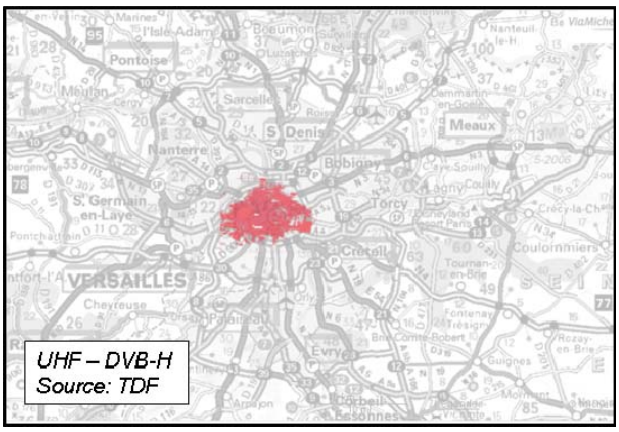
Solutions that have been crafted specifically for mobile operation include FLO, and China's CMMB system. FLO has been developed by mobile phone industry giant QUALCOMM to offer a compelling user experience on the move. Extensvie trials have been conducted around the world, including Asia, Europe and the Americas. In addition to providing the technology, QUALCOMM also has launched a commercial service in the United States delivering several channels of content with a nationwide footprint. CMMB is a standard developed in China to delivery multimedia content over a wide range of spectrum choices. CMMB has been tested in several cities in China, and is slated for commercial launch to coincide with the 2008 summer Olympic Games. The table below summarize several of the key features of each system.

	Source Coding	Channel Coding	Transport Stream	Modulation	Channel Size	RF Band	# Video Channel	Local Content	Power Reduction
DVB-H	H.264 or VC1	Convolution & Reed Solomon	MPEG2	QPSK/ 16QAM COFDM	5/6/7/8	VHF-UHF	15	Requires Mixed SFN/MFN	Time-Slicing
FLO	H.264	Turbo & Reed Solomon	MPEG2	Layered 16QAM COFDM	5/6/7/8	VHF-UHF-Lband	20	Yes, SFN	Time-Slicing
T-DMB	H.264	Convolution & Reed Solomon	MPEG2	Differential QPSK COFDM	1.5	VHF - Lband	5	Requires Mixed SFN/MFN	Bandwidth Shrinking
CMMB	H.264	Convolution & Reed Solomon	MPEG2	BPSK/ QPSK/ 16QAM COFDM	2/8	VHF-UHF-Lband-Sband	Variable	Supports SFN/MFN	Time-Slicing
ATSC - MPH	H.264	CRC & Reed Solomon	MPEG2	8-VSB	6	VHF-UHF	Up to 8 plus ATSC	Supports SFN/MFN	Time-Slicing
ISDB-T	H.264	Convolution & Reed Solomon	MPEG2	QPSK 16QAM 64QAM COFDM	6/7/8	VHF-UHF	Variable	Supports SFN/MFN	Time-Slicing

The RF band that one would select is based partly on the standard support for a band, availability of the spectrum, and the availability of receivers for the standard chosen. For example while spectrum may be available in L Band in a particular country and is supported in FLO, L Band FLO receivers are not available, so one may select T-DMB as a solution since those receivers are readily available at low price points. In addition when one evaluates spectrum for a mobile network, some tried and true rules from analogue broadcast remain in force such as the higher the frequency the greater the power needed for equivalent coverage. When comparing T-DMB in VHF band III to DVB-H in UHF for example one would need to operate the UHF system at approximately six times the power level as required in the VHF system to cover the same area. This is based on US Federal Communications Commission 50:90 digital television coverage tables. While one could make this kind of power increase from a single site comparing VHF to UHF, the effect is compounded when

comparing UHF to L-Band in that certain power limits per transmitter site require the deployment of multiple L band transmitters to match the coverage of one UHF transmitter in a given city. We can see the effect of frequency on coverage when we compare two different trials operated in Paris, one with DMB on VHF Band III, and the other on UHF with DVB-H. While this example is not scientific, it depicts the principle.

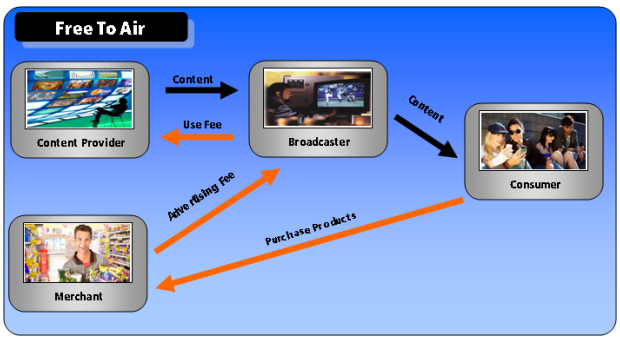


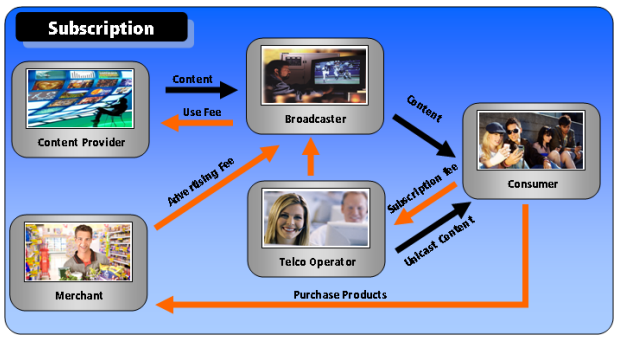


The effect of frequency used in a network can have a large impact on the cost, not only on initial deployment, but more importantly the ongoing operating cost to deliver content.

BUSINESS MODELS

The technology we have discussed moves from the interesting to the relevant category once a business case has been developed and supported by a solid model for profits. Like any new venture, mobile TV certainly has excellent opportunity for growth and profit, but limited track record in delivering financial returns. This being stated, most media business employ one or some combination of two identified business models, and mobile TV does as well. Services can be *subscription based* with users paying some fee for monthly service in addition to what they may be purchasing for other communications services like a mobile phone, or the *free-to-air*, advertising supported model. Each model has its own strengths and drawbacks and must be carefully matched to the prevailing market conditions in the area chosen to launch service. Selecting a business model without full understanding of the market can result in a failure of the mobile service. The free-to-air model mimics that of broadcast radio and television in most of the world, and consumers have traditionally been receptive to such approaches. This allows operators to offer services free to end users, and collect advertising support in order to deliver such content. This approach is also in concert with many of the offerings of the internet, where services are offered free to end users, and are supported by some form of advertising, pop up ads, click through revenue as so forth. A simple graph of the content and revenue is outlined in the graphs below.



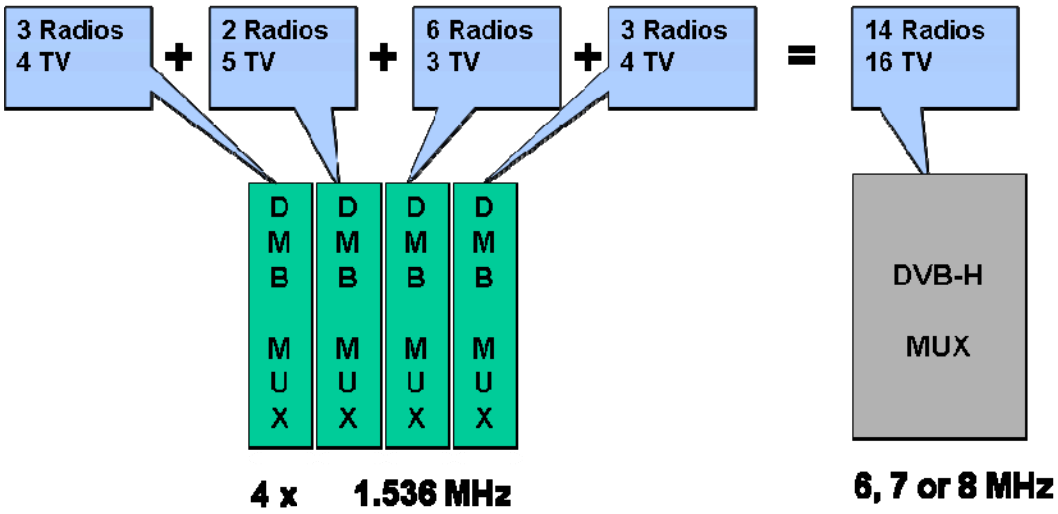


TRANSMISSION PLANING

One of the major factors in developing a mobile content delivery network is actually constructing the transmission facilities to deliver the content, and in many cases is the major driver of upfront construction costs. We discussed earlier some of the difference of the systems, and impact of both frequency of operation, and the standard selected. The evaluation process should also review power consumption, as transmitter systems with higher efficiency cost less to operate over the long run. The physical transmitter size, required power and cooling systems will impact the amount of space needed at a transmitter site. The need to either install a new antenna system, or participate in an existing community antenna system will impact your start up costs and ongoing operation. Given that mobile system should be designed with either vertical or circular polarization for best in field coverage, this may limit the number of existing community antenna systems that are applicable for mobile networks. In the chart below we have outlined the estimated costs for a mobile transmission implementation, it is important to note that not only is cost per site important, but also the number of sites needed to cover a given market or geographical area. In this case the costs are significantly lower for a VHF system like T-DMB than L band for similar coverage.

	VHF	UHF	L-Band
Power Level	10 kW ERP	50 kW ERP	2 kW ERP
Mobile Transmitter	$60,000	$200,000	$120,000
Mask Filter & RF System	$10,000	$28,000	$12,000
Power Conditioning	$1,000	$2,000	$1,000
Antenna & Line	$40,000	$70,000	$6,000
Transmitter Installation	$10,000	$10,000	$4,000
Other Install Costs	$20,000	$40,000	$17,000
Total Site Costs	$141,000	$350,000	$160,000
Sites per typical market	1	1	6
Total Market Costs	$ 141,000	$ 350,000	$ 960,000

Also worth noting in this consideration is the most common system in VHF is the T-DMB solution which uses less bandwidth per multiplex (refer to chart below), offering a building block approach to deploying systems. One can however implement four multiplexes of T-DMB in the same space as one DVB-H system but spread the cost out over time and implement only the capacity needed, but to be certain, T-DMB delivers the same number of channels for a given bandwidth as the other solutions. The total cost for 4 multiplexes of T-DMB in VHF is about $335K USD, so somewhat less than the equivalent UHF system.



SELECTION CONSIDERATIONS & CONCLUSIONS

Deciding which approach is best for each deployment of mobile TV takes careful study and time; however there are a few key points to consider.

- Government rules, local benefit and political balance in each country differ
- Careful network strategy development includes a wide range of considerations including availability and cost of receivers – a network with no receivers is a failed network
- Spectrum availability, site requirements and regulatory requirements will impact the selection of the spectrum
- Understand the trade off between frequency and power requirements for coverage
- Technology works today for VHF, UHF and L-Band, and there are optimized product configurations available in all frequency bands
- Local content insertion requirements may drive system design
- Standard preferences (DVB-H, FLO, MPH, ISDB-T, T-DMB, CMMB)

It is important to note that while we have examined many of the considerations of building a mobile TV network, most importantly, one must understand the local market buying habits, business model preference, and insure that the network covers the consumers and delivers the content they desire when they want to consume it. Remember the content is king.

REFFERENCES & ACKNOWLEDGEMENTS

World DMB Forum web site and literature- worlddab.org

Digital Broadcasting Experts Group - dibeg.org

Federal Communications Commission – fcc.gov

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