

## *DVB-H mobile digital TV*

### *Overview*

Television has come a long way since the black-and-white broadcasts of the 1940s. We've seen innovations in quality with color and digital broadcasts as well as improvements in delivery methods, including cable, satellite and HD. Each of these technologies has increased the popularity of TV and brought more content and programming to consumers. Now TV is taking the next step: digital broadcasting to mobile phones.

Mobile broadcast digital Television (DTV) integrates two of the most popular consumer products ever: television and the mobile phone. Television is expected to be a key ingredient driving demand for the next generation of wireless mobile phones by providing communication and entertainment in a single device.

Carriers, handset providers, infrastructure owners, content providers, broadcasters and semiconductor suppliers are increasing their efforts at every level of the mobile DTV value chain – and for good reason. According to industry analyst Informa, by 2011 there will be 210-million mobile TV subscribers, with 10 percent of all mobile handsets sold will have a broadcast TV receiver.



## W H I T E P A P E R

### *Mobile DTV landscape worldwide*

Mobile TV is taking many forms around the world and can be delivered over a variety of radio networks, each utilizing different delivery schemes known as unicast, multicast and broadcast. While each delivery scheme has inherent value, it is the combination of these schemes that provides the best experience to the consumer.

- Unicast services primarily send small video files or streaming content (e.g., television programming) over a cellular network to one handset subscriber. This technology can be used to drive higher average revenue per user (ARPU), but if unicast services become too widespread the cellular network is likely to suffer performance issues when there is high unicast demand. These

video services are available today from multiple service providers and have helped consumers become more comfortable with viewing live commercial programming on their handsets.

- Multicast services utilize the cellular network as well but offer a one-to-many service in which the same content is being sent to multiple subscribers at the same time. This is a more efficient use of bandwidth but multicast remains costly in terms of network bandwidth consumption.
- Broadcast services, which are the focus of this white paper, employ a separate radio network to carry broadcast television content. This same content can be received and displayed by every subscriber with a broadcast-capable handset with zero impact to the capacity of the operator's network. There are several standards around the world for broadcast TV services, and all are in trials or starting to deploy to consumers today.
- The ultimate consumer experience and cellular operator opportunity comes from the integration of the three schemes. For the vast subscriber population, the carrier can deliver broadcast television (typically around 20 channels). Handset applications are already being designed that will allow subscribers to retrieve specialized programming on demand using the more conventional unicast method. Interactive advertisements permit subscribers to use the handset's browser to purchase or investigate an item they just viewed on a television broadcast. Features such as personal video recording (PVR) could be used to download and store large amounts of audio and video during periods of low cellular system usage, such as nighttime.

### *Broadcast mobile DTV standards*

As with many new technologies, several different standards exist for broadcast mobile television around the world. These include three primary open standards developed by industry associations:

- DMB (digital multimedia broadcasting) was derived from the digital audio broadcasting (DAB) standard for digital radio and was originally a satellite broadcast service. DMB is now transitioning to a terrestrial antenna tower broadcast service in Korea known as T-DMB. DMB services are commercially deployed in Korea today and are trialing in Europe and in other parts of Asia (where DAB networks typically already exist).

- DVB-H (digital video broadcast-handheld) is derived from the DVB standards used in Europe for cable, satellite and terrestrial TV services. DVB-H offers a low-power mode for battery-powered devices as well as improved radio performance when used in mobile devices. DVB-H has been commercially deployed in Europe with additional trials being held around the world.
- ISDB-T (integrated services digital broadcast-terrestrial) is the digital TV standard for Japan, and it includes a mode for handheld devices to maximize battery life. Trials of ISDB-T services for mobile phones have started in Japan.

There are other technologies that have been developed for mobile DTV that do not fall within the open standards category. FLO™ is one example in the North American market today. China is considering open standards similar to DVB-H and DMB as well as proprietary technologies that may be designated as China's mobile television standard.

	<i>DVB-H</i>	<i>ISDB-T</i>	<i>DMB</i>	<i>FLO™</i>
<b>Regions</b>	Europe, US Taiwan, China, (tba) Australia, Singapore	Japan, Brazil (tbd)	South Korea, France, UK, Germany, China (tba)	U.S.
<b>Test Trials</b>	37 cities worldwide 2004 to Now Europe 1Q 2006 U.S.	2H 2005-1Q 2006	1Q 2006 Europe	2Q 2006
<b>Type of Service and Commercial Availability</b>	Subscriber 2H 2006 Europe; Italy (TIM) June 2006; 4Q 2006 U.S.	Free and Subscriber April 2006	S-DMB Subscriber May 2005; T-DMB Free October 2005	Late 2006
<b>Trial Handsets</b>	Nokia, Samsung, LG, Siemens, Motorola	NEC, PMC, Sharp, Sanyo	Samsung, LG, Pantech	Samsung, LG
<b>Industry Support</b>	100+ Companies	20+ Companies	10+ Companies	FLO Forum 30+
<b>Broadcasters</b>	Modeo, Hi-Wire, Digita, MTV3, Abertis, KPN, Swisscom Brd, Canal+, TF1, France Tele, Arquiva, BBC, Eurosport, ITV	TV-Ashi, Fuji-TV TBS, NTV, TV-Tokyo, TV-Chiba	TU-Media, KBS, SBS, MBC, BBC, TF1, T-Systems	MediaFLO
<b>Operators</b>	3 Italia, TeleSonera, Vodafone, T-Mobile, Bouygues, Swisscom, SFR, Orange, Telefonica Moviles, O2	NTT DoCoMO, Vodafone, KDDI	SKT, Debitel	Verizon

Open standards offer advantages over proprietary technologies and networks controlled by a single company. With an open mobile DTV market, all layers of the value chain benefit from additional revenue opportunities from an untapped TV market. Consumers ultimately are rewarded with innovative and lower cost products.

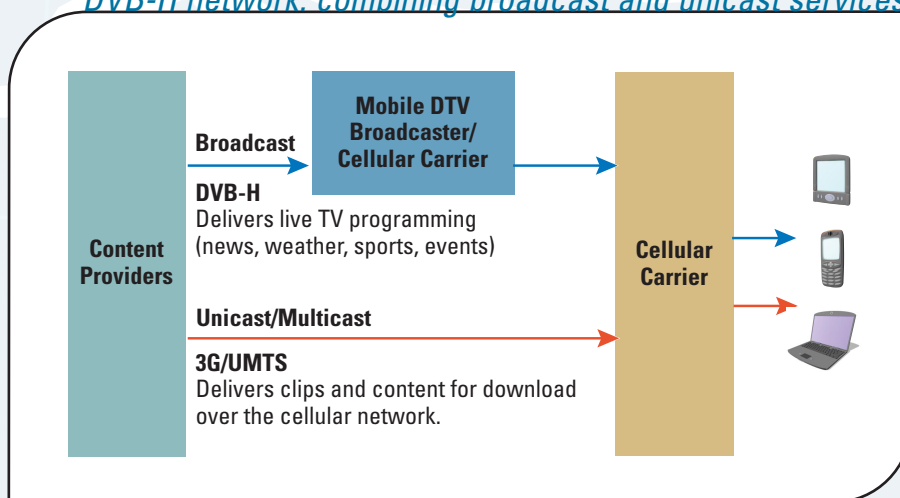
Of the many standards in the mobile DTV market, DVB-H has the most market acceptance and support around the world with hundreds of companies developing services, devices, hardware and software for the standard. The main advantages of DVB-H include:

- **Openness** – Working in an open ecosystem built on open standards is ultimately better for the industry and consumers than working in a proprietary environment where a few players dominate the majority of the value chain. This limits players in their ability to participate in and generate revenue from that value chain.
- **Trials** – DVB-H is commercially deployed in Italy, and more than 35 cities around the world have started or completed trials. These trials are perfecting the technology for mass market deployment. Additionally, the trials are contributing invaluable market information such as viewing habits (duration and location), popular content and acceptable monthly service pricing.
- **Proven Technology** – DVB-H is derived from a proven global standard used in Europe for terrestrial and satellite DTV transmission with a low-power mode for battery-powered devices. This heritage is a key reason why industry analysts expect DVB-H to be the predominant mobile DTV standard in the marketplace.
- **OFDM** – DVB-H uses orthogonal frequency division multiplexing (OFDM) air interface technology and includes a technique for power reduction in the tuner. DVB-H uses time-slicing so that the tuner can be switched off most of the time and is only on during short transmission bursts. This allows the tuner to operate over a reduced input bandwidth, and it also conserves power. OFDM is a very good choice for a mobile TV air interface. It offers good spectral efficiency, immunity to multi-path and good mobile performance, plus it works well in single-frequency networks such as those planned for mobile TV.

## DVB-H value chain

Because DVB-H is an open standard, it is available to everyone throughout the market to use, develop and deploy mobile DTV products and services. It also offers flexibility of business models, additional revenue opportunities and lower costs for consumers, which moves the technology to mass market faster. At a glance, the DVB-H value chain is what you would expect, with content providers, broadcasters, infrastructure companies, carriers, handset OEMs, silicon vendors and software third parties. But closer examination reveals it is not that simple: Cross-pollination is taking place within these player categories, and that's another benefit of the openness of DVB-H as a whole.

### DVB-H network: combining broadcast and unicast services



An open standard like DVB-H offers the market a mobile DTV implementation alternative and financial benefits through scale of operations across the value chain.

- **Carriers or wireless operators** are the main interface to the consumer, providing service to the mobile phone. DVB-H allows them to:
  - Increase ARPU with new service to current customers.
  - Reduce churn rate by offering a compelling application that will help retain consumers.
  - Attract new customers with competitive services and channel offerings through mobile DTV.
  - Gain additional revenues from interactive TV programming and advertising, including SMS for voting for a favorite contestant directly from the view screen. In addition, having a specific audience for advertising means you can customize links to create, for example, a teenager-focused ad for a new game or ring tone, enabling people to download the product immediately.
  - Use any additional spectrum that they might own for DVB-H broadcasting and become an infrastructure player as well.

- Make deals with content providers or aggregators on their own to deliver content to their subscribers.
- **Content providers/broadcasters** deliver the programming for the mobile phone. DVB-H also allows them to:
  - Gain additional viewers for their content with little or no investment into converting their content for the mobile phone. They can also choose to create new content tailored to the mobile audience.
  - Gain additional revenues from advertising and content as well as drive more traffic to their Web sites.
  - Play in multiple areas of the value chain as desired, including the possibility of purchasing spectrum and deploying their own broadcast network.
- **Infrastructure companies** provide the towers and transmission equipment. DVB-H also allows them to:
  - Gain additional revenues from renting equipment and infrastructure use to carriers.
  - Negotiate for content or aggregate content for carriers.
- **Handset manufacturers** develop handsets for consumers. DVB-H also allows them to:
  - Gain revenue with phone upgrades as mobile DTV increases in popularity.
  - Develop new mobile phone designs that are small but deliver the performance and screen resolution to deliver crisp, clear images.
- **Silicon vendors** develop silicon and software for mobile phones. DVB-H also allows them to:
  - Gain additional revenue from more content per mobile phone.
  - Innovate in order to deliver lower-power, smaller chips and chipsets to handset manufacturers.
- **Software third parties** deliver additional software and applications for mobile phones. DVB-H also allows them to:
  - Work with more companies on mobile DTV since there is a broad group of companies supporting DVB-H.

The consumer is the ultimate winner with DVB-H. As it is an open standard there is more competition at every level of the value chain. This creates competition and innovation, which drive the cost of mobile TV-enabled handsets and service packages lower.

## *TI's role in mobile DTV*

TI introduced the Hollywood™ single-chip tuner, receiver and demodulator for mobile DTV in October 2004. The Hollywood chip uses TI's innovative DRP™ technology to deliver a single chip with integrated RF to achieve the lowest power, smallest size and lowest cost mobile DTV solution in the industry – all key to driving DTV into mobile phones. The chip will deliver up to seven hours of TV time on one standard battery charge, more than enough to meet expected usage throughout the industry. It is believed that consumers will only watch 15 to 20 minutes at a time or “snack” on their favorite sports teams and news and catch up on events such as the Olympics or the World Cup™ using the mobile DTV broadcast network.

While the Hollywood chip marked TI's entry into mobile DTV receiver technology, the company has been involved for some time in DTV and video on mobile phones with its OMAP™ platform. Today TI's OMAP processors can be found in phones supporting DMB and DVB-H, and in high-end phones that handle video streaming. With a dedicated video-processing engine, TI's OMAP 2 processors will deliver even higher performance and enable use of additional phone applications while a user is watching TV, without degrading the performance or user experience.

TI's mobile DTV efforts are also backed by the company's expertise in OFDM, consumer electronics (CE) and digital TV. With a portfolio of OFDM technologies, CE technologies for digital set-top boxes, portable media players, digital still cameras and DLP™ HDTVs, TI is well-versed in the industry and how to merge wireless and CE into one battery-efficient, pocket-sized device.

## *Conclusion*

Mobile DTV is coming to a phone near you. It's true that the technology will likely first take off in urban centers with heavy commuters and with teenagers and the younger population. But merging a mobile phone with a TV is something that everyone can understand. And with our universal hunger for information and connectivity, mobile DTV presents the perfect opportunity for users to stay informed and up to date on what is happening in the news, with their favorite sports team and even with their favorite reality TV show or soap opera. With strong industry support around the world and with trials and prototype phones in use today, it is likely that mobile phones in the United States will be based on the DVB-H standard. The opportunities for the value chain and the expected lower costs for consumers will help propel DVB-H into the mass market and deliver even more entertainment to consumer mobile phones and users anywhere and anytime.

Statements contained in this white paper regarding the growth of the mobile DTV handset market, TI market penetration and qualification of TI products and other statements of management's beliefs, goals and expectations may be considered forward-looking statements as that term is defined in the Private Securities Litigation Reform Act of 1995, and are subject to risks and uncertainties that could cause actual results to differ materially from those expressed or implied by these statements. The following factors and the factors discussed in TI's most recent Form 10-K could cause actual results to differ materially from the statements contained in this white paper: actual market demand for mobile DTV products in general and TI semiconductor products specifically, and actual certification test results relating to TI products. TI disclaims any intention or obligation to update any forward-looking statements as a result of developments occurring after the date of this white paper.

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