
CBC TECHNOLOGY REVIEW

Issue 2 - June 2006

www.cbc.radio-canada.ca

What Is DMB?

By François O. Gauthier, Eng. & Pascal Marcoux, Eng.
CBC Technology

INTRODUCTION

T-DMB stands for Terrestrial Digital Multimedia Broadcasting. It is often referred to simply as DMB. DMB is a digital transmission standard based on the DAB (Digital Audio Broadcasting) Eureka-147 standard. It is a multiplexed system capable of delivering audio, video, IP and other data files. DMB is an ETSI standard (TS 102 427 and TS 102 428).

How It Works

The basic Eureka-147 DAB transmission system has the following characteristics:

Frequency Band	VHF III (channel 7-13 TV) <i>not in Canada</i> L-Band (1452-1492 MHz)
Modulation	COFDM (Coded Orthogonal Frequency Division Multiplexing)
Channel Bandwidth	1.536 MHz
Bit Rate	Around 1.1 Mbps (depending on the protection)
Audio Codec	MPEG 1 & 2 Layer II (Musicam)

Table 1: Eureka-147 DAB transmission system characteristics

DMB uses MPEG-4 Part-10 (H264) for video and MPEG-4 Part 3 BSAC for audio. The video stream is encapsulated in an MPEG-2 transport stream with Reed-Solomon (RS) encoding before being inserted into a DAB Ensemble multiplexer in stream mode. Finally, the DMB stream is Viterbi-encoded and multiplexed with the other audio or data services.

The typical BER improvement in using RS and Viterbi encoding from a single Viterbi is a factor of about 1000, which is required for the broadcast of mobile video (mobile audio, using error concealment, requires less protection to achieve a similar service availability).

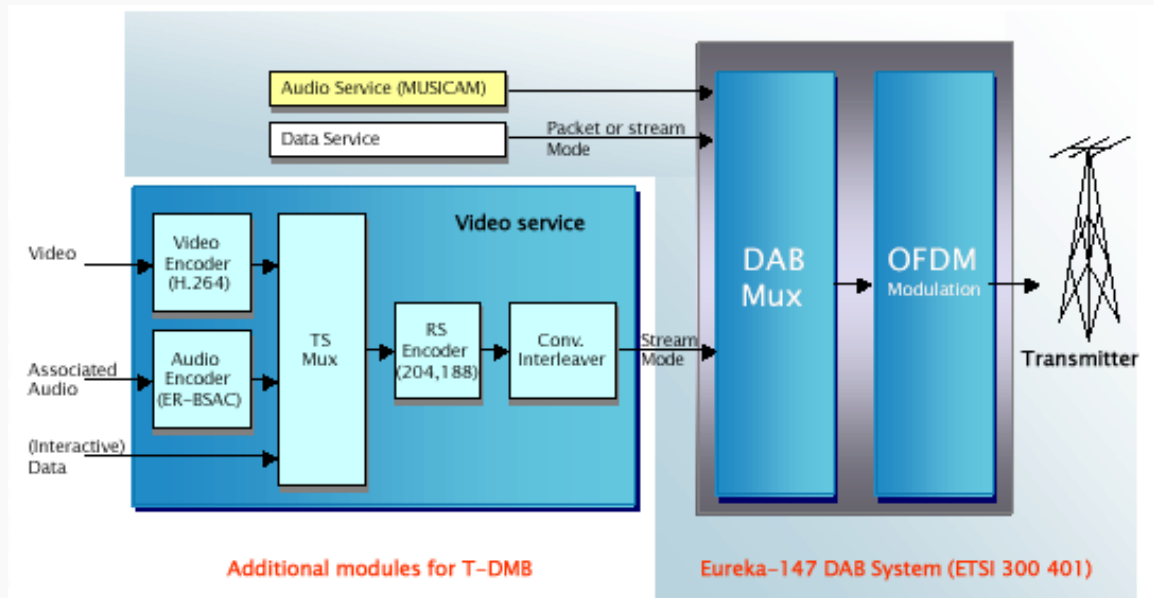


Figure 1: DMB system architecture (Source: Dr. Yong Han Kim, TTA, S-Korea)

The typical bit rate of the video service is from 384 kbps to 512 kbps, with a resolution of 240 X 320 pixels and a frame rate of up to 30 frames per second. This is optimized for small portable devices such as cellular phones.

DAB Ensemble Capabilities

Programs in DAB are multiplexed, allowing versatility in the ensemble (one DAB channel). As defined above, a DAB ensemble can broadcast from 1.0 to 1.5 Mbps of data. Typical forward error correction use allows for the broadcast of 1.1 Mbps when targeting a BER of 10^{-4} for audio services, and 10^{-8} for video services.

Figure 2, below, highlights typical and potential ensemble usage (in bit rate per second).

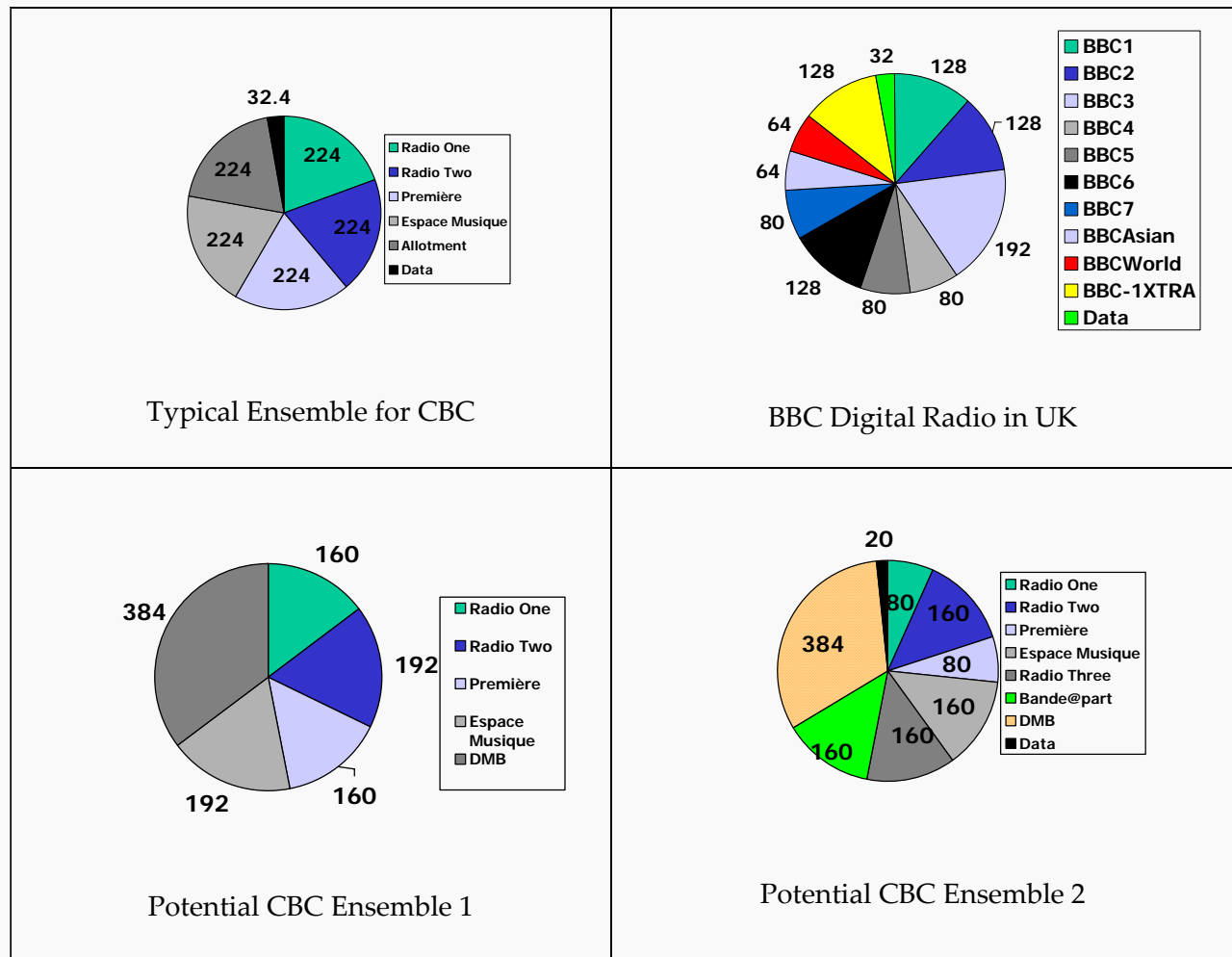


Figure 2: Typical and potential DAB Ensemble usage

Also note that a DAB ensemble can be reconfigured every 6 seconds. In practical terms, this means that during prime hours, split feeds with additional programming could be used and then be recombined during off-hours to allow for more data capacity or special concerts in surround.

The current audio codec limitation of DAB (Musicam) is currently being reviewed. The Australian government is proposing a "DAB version 2," in which the basic audio codec is replaced with state-of-the-art audio codec (like MPEG-4 AAC). Although the proposal is not

finalized, this could be implemented easily in countries where the current DAB deployment is minimal (such as in Canada). Also, since the DMB standard already includes a new audio codec, it's conceivable that a DMB-capable receiver could also decode a lower bit rate audio service. This would allow compression of a stereo audio service to bit rates in the range of 64-80 kbps for near CD quality, allowing for new services to be inserted in each DAB ensemble. No other current technology allows for the transmission of potentially 12 local radio services and one TV service per channel (with 8 to 12 channels usable in each major market) with a similar bandwidth.

DMB Worldwide Deployment

Korea is currently the world leader in DMB. Samsung, LG and Perstel have marketed nearly a dozen DMB receivers already. Approximately 16 multimedia/mobile TV channels are already available to the Korean population.

Elsewhere, interest in DMB has certainly been strong. The Chinese government has ordered half a million DMB receivers in preparation for their rollout in China. The European Telecommunications Standards Institute (ETSI) has adopted the DMB standard as one of the mobile multimedia standards for Europe; various trials are currently underway, such as the one in Germany for the 2006 Soccer World Cup. Other countries currently evaluating the DMB technology includes the Netherlands, France, the United Kingdom, Taiwan, Australia, Japan, Slovenia, and the CBC here in Canada.

DMB Receivers

As previously stated, Samsung, LG and Perstel have marketed many DMB receivers already. As can be seen in *Figure 3*, these come in various formats for use in cell phones, laptops, portable multimedia devices (~ 3" x 5" screens). Initially, only Band III versions of these devices were designed and marketed, but now L-Band (the frequency band used in Canada for DAB/DMB) versions of these products are starting to become available.



Figure 3: Some DMB Receivers available - February 2006

Other Mobile Video Systems

BT Mobio: The British Telecom Mobio (formerly Livetime) system is very similar to a T-DMB system. It uses the DAB frame in data streaming mode with the addition of the enhanced packet mode feature (EPM). It differs from DMB in that it uses Windows Media 9 encoder instead of the MPEG-4 H.264/BSAC encoding scheme. It is reported to be better for circumstances where the delivery of data is bursty or if the data rate of the stream is relatively low. Deployment and tests of this system have been limited so far to the U.K.

S-DMB: Contrary to what one might think, Satellite-DMB is quite different from T-DMB. It uses the *MB Sat* satellite that was launched in 2004 by a Japanese/Korean consortium for pay multimedia broadcast service in their respective countries. It is based on a modified CDMA modulation, like the one used by Bell in Canada, whereas T-DMB is based on DAB and COFDM modulation. Its worldwide deployment is limited because the system uses a frequency band that is not available elsewhere.

DVB-H: The Digital Video Broadcast-Handheld standard is derived from the DVB-T standard, which is the adopted European terrestrial digital television system (as opposed to ATSC in Canada and the USA). This standard also uses OFDM modulation, but uses 5 to 8 MHz channels, allowing 5 to 11 Mbps of capacity as opposed to 1.1 Mbps capacity per channel for a typical T-DMB configuration. Even though picking up speed, the deployment of DVB-H has not yet begun and no receivers are commercially available. Trials have been taking place in Europe and in the U.S. where Crown Castle purchased the spectrum to deploy DVB-H.

DVB-H+: DVB-H+ is a subset of DVB-H developed for satellite multimedia broadcasting to mobile handsets. It also uses OFDM modulation, but uses Turbo codes instead of the Reed Solomon error correction scheme.

MediaFLO: MediaFLO (Forward Link Only) was developed by and is proprietary to Qualcomm. Using COFDM modulation, time slicing and Turbo coding schemes, this technology is rather similar to DVB-H. Among other things, it features a two-layer modulation in which a basic layer of information is modulated more robustly; an enhanced layer (which allows for better image quality and better frame transition) is usable in good receiving conditions only. Qualcomm is currently preparing deployment of MediaFLO in the U.S. on TV channel 55, which they purchased at a spectrum auction in 2004.

EVDO: Evolution Data Only or Evolution Data Optimized is a fast, wireless broadband access (3G) without need for WiFi hotspots. It differs from all the other Mobile Video Systems presented above in that it is a point-to-point system, not a broadcast or point-to-multipoint system. It works on the cellular companies' backbone network, and therefore becomes unsuitable when a large number of similar video downloads are requested because it requires as many transfer processes as users requesting them, thus rapidly creating network saturation. However, one of the advantages of EVDO is that it allows for bi-directional communication and is, therefore, more suited for tailor-made content requests from the user. It could also be used in conjunction with one of the broadcast mobile video systems in order to take advantage of both the capacity efficiency (broadcast) and the return channel functionality (cellular network).

To evaluate these systems, one can rely on specific criteria such as:

- Reception in mobile environment
- Spectral efficiency
- Infrastructure costs
- Power consumption of handsets
- Availability of the standards

The first aspect that was compared is presented in *Figure 4*. In interpreting this chart, note that the capacity presented does not represent spectrum efficiency. For instance, even though a DVB-H system is able to carry 5 Mbps of data in a highly mobile environment, this is done in a 5 to 8 MHz channel bandwidth, whereas DMB carries 1.1 Mbps in a 1.5 MHz channel. Therefore, both systems have roughly the same spectrum efficiency when achieving the same reception quality in a challenging mobile environment (ie: car driving at 130 km/h in Europe, for instance).

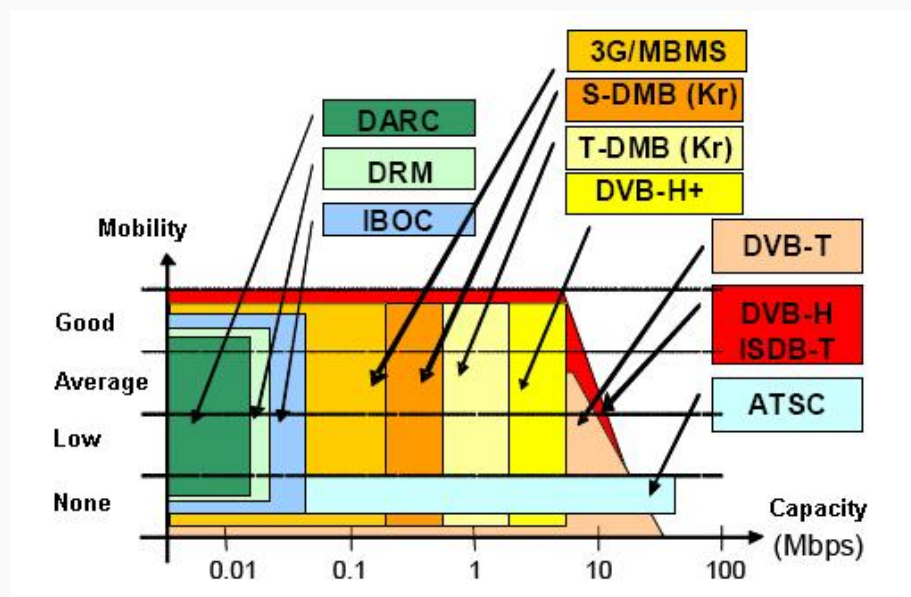


Figure 4: Comparison of the mobility of various digital broadcast technologies (Source: Alliance TICS White paper on development of mobile TV in France, January 2006)

As for infrastructure costs, the fact that DMB relies on DAB infrastructure, which is already in use here in Canada, makes its cost very low when compared to DVB-H. Moreover, deploying additional DMB transmitters will also provide new audio DAB capability in markets where it has not been deployed as of yet.

On the other hand, even though DVB-H receivers are not in the commercialization phase yet, the theoretical potential for power savings at the chipset level is 10% more than what can be achieved by a DMB chipset. But since power consumption of the chipset accounts for approximately only 5% of the total power consumption of a receiver and the LCD accounts for as much as 80% of that consumption, gains on the chipset power consumption are of minor impact. The result is that the systems are comparable as far as power consumption is concerned.

While both DVB-H and DMB are open standards, companies like Qualcomm and Crown Castle tend to implement these systems with some degree of proprietorship as these standards are still in evolution. With time, both standards should mature and become more open.

DMB for CBC/Radio-Canada?

The CBC is already operating DAB transmitters in Montréal, Ottawa, Toronto and Vancouver, covering approximately 40% of the Canadian population. The transmission costs of implementing one DMB service in each city will be minimal, consisting only of adding the DMB encoder into each DAB multiplex.

Also, in the CRTC Notice of Public Hearing 2006-1, the CRTC stated that it is seeking information on how standard radio can make the transition to digital radio. CBC/Radio-Canada was invited to comment to the CRTC specifically regarding this question. The CBC submission included the use of DAB as an expansion band (not a replacement) to allow for new radio services. It also included the possibility of added flexibility, allowing for split feed programs, DMB programs and IP video and multimedia downloads.

CBC's Delivery Systems and Spectrum Engineering group is currently testing DMB implementations from the Communication Research Centre (CRC) in Ottawa, a research laboratory under Industry Canada. The test transmission started in May 2006 and is broadcast in Montréal from the rooftop of the Maison de Radio-Canada. This test transmission is different from CBC's normal DAB transmission from Mont-Royal.

CBC's Strategy & Planning and Business Development groups are presently investigating a potential technical and commercial trial with cellular operators. This trial will include the use of commercial DMB encoders as well as the use of our real transmission facilities. The cellular operators will provide integrated DMB cell phones and the initial test will take place in Montréal. Subsequent tests could also be done in Toronto.



François Gauthier graduated with an electrical engineering degree from the University of Sherbrooke (Québec) in 1995. From 1995 to 1998, he worked as a research engineer at the Communications Research Centre (CRC) in Ottawa in the field of Digital Audio Broadcasting (DAB). He joined CBC/Radio-Canada in 1998 where he is now director for the Delivery Systems and Spectrum Engineering group of CBC Technology. His work at the CBC also includes spectrum analyses and measurements, investigation of video and audio advanced codecs, new IP-based delivery technologies for datacasting over radio and TV, and new media and wireless studies. He has presented many technical papers and seminars in Canada, the U.S., the U.K., Tunisia, Poland and at the IBC in Amsterdam, and frequently represents the CBC and Canada at the ITU and NABA. He is responsible for frequency planning and coordination, including advanced delivery systems such as DAB, DTV and Emergency Systems.



Pascal Marcoux graduated with first class honors with an electrical engineering degree from the Royal Military College in Kingston, ON in 1997. From 1997 to 2002 he worked as an electronics and telecommunications officer in the Canadian Forces, working with various encryption systems and RF communication systems. In 2003 he completed a master's degree in electrical engineering and designed a multiband fractal antenna. He joined CBC/Radio-Canada in 2003 where he is now senior engineer for the Delivery Systems & Spectrum Engineering group within CBC Technology. His work at the CBC involves AM, FM, TV, DTV, DAB and Sirius frequency planning. He was also involved in the development of spectrum analysis software and with various DAB designs such as indoor DAB repeaters and DMB tests.