Development of digital television technology

Digital TV broadcasting and HDTV

Introduction

While Gugliemo Marconi is known as the inventor of wireless telegraphy in 1897 (Winston, 1998, p. 70), the inventor of television becomes a little more complicated as it entailed an evolution of over ten years to move from its concept to an actual picture transmission and reception. The patent for the electronic scanning tube, termed iconoscope, was held by Vladimir Zworykin, an Russian born inventor who worked for Westinghouse in 1923, however, Westinghouse did not see the utility in his invention and ordered Zworykin onto other projects (Bogart, 1956, p. 8, 348). Philo Farnsworth (Horvitz, 2002. p. 9, 92) advanced the concept, and it was John Logie Baird who accomplished the first transmissions of face shapes in 1924, who is also credited with the first television broadcast in 1926 (Horvitz, 2002, p. 101). From there, the development of television escalated with analog broadcasting representing the transmission method utilized in television until 2000 began the age of digital television and radio broadcasting (Huff, 2001, pp. 4, 8, 69).

To understand digital television, one needs a basic understanding of the manner in with analog television works. In the analog system a video camera takes pictures at 30 frames per second, which are then rasterized into rows of individual dots, termed pixels that are assigned specific color and intensity (howstuffworks. com, 2007a). Next, these pixel rows are then combined with synchronization signals termed horizontal and vertical sync, which permits the receiving television set understand how these rows should be displayed (howstuffworks. com, 2007a). The final signal that contains the preceding

represents the composite video signal, which is separate from the sound (howstuffworks. com, 2007a). The difference between analog television and digital is that the analog system as a 4: 3 aspect ration, which means the television screen is four units wide by three units high, thus a 25 inch analog television measured diagonally is 15 inches in height by 20 inches in width, with the aspect ratio for a digital television is represented by a 16: 9 aspect ratio (Metallinos, 1996, pp. 27, 206 – 207).

Digital broadcasting, as is the case in all broadcast formats, including radio, utilize part of the electromagnetic spectrum (Montgomery and Powell, 1985, pp. 20, 237). Electromagnetic wave frequencies consist of radio, infrared, light that is visible, ultraviolet, x-ray, gamma and then cosmic rays, in order of the lowest to the highest (Weber, 1961, pp. 105, 184). In reality, digital television broadcasting is a subset ofdigital radio broadcasting, under the ‘ one-way digital radio standards’, which not only includes digital radio and television broadcasting, but digital terrestrial television, DVB-T, ISDB-t, ATSC, T-DMB, mobile TV, Satellite TV, radio pagers, as well as the Eureka 147 standard (DAB) to name a few (Levy, 2001, pp. 7, 10, 11, 33). This examination shall delve into an understanding of digital television broadcasting, DAB, DVB-T, HDTV, and its deployment in Europe as well as the United States.

Television’s New Age

The advantages of digital television is that it offers a broader array of viewing options for both the consumer as well as broadcast stations in that it provides a clear picture and sharper sound, along with the ability of

broadcasters to offer multiple sub-channels as a result of its formats (Levy, 2001, p. 71).

The three formats, consisting of 1. 480i, which is 704X480 pixels that is broadcast at 60 interlaced frames a second representing 30 complete frames each second, and 480p which is 704X480 pixels that is broadcast at 60 complete frames each second, 2. 720p, whereby the picture is at 1280X720 pixels that is broadcast at 60 complete frames a second, and thirdly, 1080i where the picture is at 1920X1080 pixels that is sent at 60 interlaced frames each second representing 30 complete frames each second, and 1080p whereby the picture is broadcast at 1920X1080 pixels that is broadcast at 60 complete frames each second (howstuffworks. com, 2007b).

Note: The above indicates the 525 horizontal line scans whereby each contains approximately 680 pixels. Each pixel represents one element of the picture and contains three areas of red, green and blue phosphor, which may be either rectangular or dots. The electron gun send out electron beams that strike the phosphors causing them to glow, with electromagnets located near the guns directing the beams in sequence to each pixel, with the broadcast signal providing information on how bright the phosphors should be made, at what time and in what sequence.

As digital television broadcasting and digital audio broadcasting, DAB, are both based upon the electromagnetic wave principle, they work in the same manner, with DAB providing a broader range of digital channels that are not available on FM, as well as less hiss and interference, tuning to a station

format or name and the support of scrolling radio text, MP3 playback and pause and rewind features (Scott, 1998, p. 9, 210).

DVB-T represents the Euopean standard for broadcast of digital terrestrial television. DVB-T, or Digital Video Broadcasting – Terrestrial, is a new system whereby the digital audio and video data stream is compressed by use of a OFDM modulation that utilizes concatenated channel coding (Levy, 2001, pp. 3-21). Al-Askary et al (2005) advise that OFDM utilizes convolutional coding that does not have capability to adapt to variations of fading properties of individual sub-channels, thus providing clear distortion freer signals and reception. In the DVB-T method when utilized by broadcasters the signals transmitted are sent from one aerial antenna to another using a signal blaster to the home receivers (White, 2007). The broadcast is transmitted utilizing a digital audio-video stream that is compressed, based on the MPEG-2 standard, which is the result of the combination of one or more ‘ Pactetised Elementary Streams’ (Chiariglione, 2000).

Note: In summary, the source coding are multiplexed into programme streams, with one or more of these joined to create a MPEG-2 Transpot Stream that is transmitted to set top boxes in the home. It can accommodate six to eightMHz wide channels.

Digital Audio Broadcasting (DAB), which is also termed ‘ Eureka 147’ represents the technology employed for the broadcasting of audio through the use of digital radio transmmision (Huff, 2001, pp. 67-78). In order to achieve the sound reproduction quality attributable to DAB, the bit rate levels must be high enough for the audio codec in the MPEG Layer 2 to

provide the quality inherent in the system, as well as high enough to enable the error correction coding (digitalradiotech. co. uk, 2007). Both the DAB as well as the DVB-T systems utilize ‘ orthogonal frequency division multiplexing’ (OFDM) modulation, with each system being able to handle 1536 sub-carriers (digitalradiotech. co. uk, 2007). The DAB and DVB-T also use the QPSK singal constellation to modulate the subcarriers, and also use 2 bits per symbol which the signal constellations can transmit on each of the subcarriers (digitalradiotech. co. uk, 2007).

DAB (Digital Audio Broadcasting) is particularly suited to utilization in multimedia transmission systems, such as sound, moving pictures and text along with data (Levy, 2001, p. 177). As a radio frequency signal, DAB’s ability in being picked up by radio receivers represents an advantage over DVB-T, whose mobile reception signal “… is significantly affected by …” the fast changing nature of the transmission channel, thus it is needed to utilize two antennas on the received along with a more complex and “… elaborate signal processing for … channel tracking” (Lauterjung, 1999). And while DVB-T was developed orginally for stationary reception utilizing a roof-top directional antenna as well as a non-directional antenna contained on a portable receiver, it has been adapted for moble reception as indicated (Lauterjung, 1999). Recent developments in tests conducted in Germany as well as Singapore have shown that DBV-T can be utilized in mobile reception, however the drawback is battery life as a result of power consumption (dvb. org, 2004).

HDTV, high-definition television, utilizes approximaetly ten times the amount of pixels as a standard analog television set, representing a high end 1920 X

1080 pixels, against an analog television set’s 704 X 480 pixels (Huf, 2001, pp. 140-141).

The high resolution of HDTV requires greater bandwidth thus making broadcast operators make a major financial commitment to deploy the new standard (Brown and Picard, 2005, pp. 47-49). The deployment problem means that in order to make the system work with their current infrastructure, operators would have to reduce the number of channels being offered, a marketing and customer problem in that operators have built their competitive systems on offering a greater number of channel selections. Brown and Picard (2005, p. 336) advise “ The significance of the SDTV/HDTV issue is that, because the transmission of HDTV requires much more spectrum than SDTV, a trade-off is involved for any DTV system between a greater number of SDTV channels and a smaller number of HDTV channels (currently 4 to 6 SDTV channels can be transmitted within the amount of spectrum required for one HDTV channel)”.

In addition to the foregoing, there is a lack of uniform standards in “ Standardization, compatibility, interoperability and application portability are essential pillars in the erection of a successful and competitive European digital television system” (Nolan, 1997, p. 610). The National Association of Broadcasters’ estimate that the cost of the new equipment to carry HDTV and retain the number of stations will be between $10 to $40 million based on the station size (Pommier, 1995). Deployment will represent a problem in that the wider TV format will be cut off on standard square type televisions thus necessitating consumers to switch to wide screen television receivers in addition to the special HDTV receiver need to watch high definition

broadcasts which can be received over cable or satellite (Brown and Picard, 2005, pp. 110-115). The HD receiver being sold at £299 by UK broadcaster BSkyB, along with an added £10 for the service on top of the basic subscription charge are another example of the inhibiting factors in deployment O'Brien, 2006).

HDTV basically represents what Dietrich Westerkamp who is the worldwide director of broadcast standards at the electronics giant Thomson, which is the largest European manufacturer of HD satellite receivers, calls "... a chicken and egg situation" (O'Brien, 2006). The situation has been the case with HDTV in the United States as well as Europe, with broadcasters waiting to see enough purchasers of the new television sets before making the financial commitment concerning equipment changes, and consumers waiting to see stations available before making the financial commitment for the new HDTV sets. The answer could be coming from television manufacturers who are starting to turn out HD compatible sets. One such example is Samsung, who has announced that two-thirds of its flat panel production will be HD compatible (O'Brien, 2006). Something will be needed to help jump-start the HDTV situation as presently the size of the potential viewing audience is to small to justify the conversion expense, explains Rudi Kuffner, spokesperson for Germany's largest broadcaster ARD (O'Brien, 2006).

Conclusion

Since the first television broadcast of face shapes by John Baird in 1924, and the first television broadcast in 1926 (Horvitz, 2002, p. 101) television has come a long way. The introduction of digital television and radio

broadcasting in 2000 has increased the viewing experience in providing a broader array of channels, signal clarity and sound as well as giving broadcasters an expanded marketing option of more to offer consumers in a highly competitive market. The new flat panel television sets and digital broadcasting have expanded the ways in which consumers as well as broadcasters view the market. With mobile television systems and the new digital radio channels offering playback and other features, entertainment is getting another big boost. With the biggest new development, that has been around for over four years set to enhance broadcasting and viewing pleasure, when the financial justifications reach the investment levels. HDTV represents the next quantum leap in television despite all of its problems. Technology keeps improving the sphere of entertainment, and it is ultimately consumers who benefit.

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