

Modern digital technologies alternatively used beside Digital Audio Broadcasting system

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Abstract. Digital Audio Broadcasting system (DAB) is the most mentioned audio broadcasting system nowadays. In actual fact, this system has already been overcome by new technologies. This article describes and compares these new technologies to DAB and gives unquestionable evidence of their usage.

1 Introduction

DAB was developed in the late-1980s by the EUREKA 147/DAB project. In 1990 was decided which technologies would be used with DAB. It is obvious that the new technology brings many advantages such as the high quality of services (comparable with CD quality), it also allows to use a single frequency network (SFN), moreover, DAB is able to transmit a program associated data and multiplex of other data services (e.g. travel, traffic, weather situation etc.). [1], [3]

2 DAB's problems

Obviously, the used technologies have been developed since 1990. It is mainly seen in audio compressing technologies. One DAB multiplex, with capacity of 1,152 kbps, can be practically shared by “only” 4 - 6 radio stations with the sound quality of just better than is the present FM reception. This is due to an old audio compressing technology MPEG (Movie Picture Experts Group) Audio Layer 2 (MP2). [1]

Table 1. Relation between audio quality, bit rate and number of stations per DAB multiplex

Audio Quality Level	Relation to FM-quality	MP2 Bit Rate kbps	Numbers of Radio Stations per DAB Multiplex
CD-quality	Better than FM	256	4
Very good quality	FM - good reception	224	5
Good quality	FM – average reception	192	6

Another problem can be linked with the frequency bands which DAB uses (in Europe): Band III (174,928 – 239,968 MHz) and L-band (1452,192 – 1467,424 MHz). Band III is still for DAB more or less blocked by present analogue TV transmitters, which are used by majority of European countries. On the other hand, broadcasting in L-band is expensive due to the number of transmitters which are needed to cover an area. Furthermore, the required power is high. These problems have been known for several years. Research groups all around the world trying developed new systems which would sort them out.

3 New audio coding technologies

This paragraph shortly describes other alternative technologies beside DAB. Most of them are based on new digital compressing methods using the Advanced Audio Coding (AAC) and MPEG-4 High Efficiency AAC v.2 profile (HE-AAC v.2).

HE-AAC (also known as “aacPlus v.2”) is the combination of three technologies:

- Advanced Audio Coding (AAC)
- Spectral Band Replication (SBR)
- Parametric Stereo (PS)

All three technologies are currently being specified in ISO/IEC 14496-3 and combined in the HE-AAC v.2 profile, which is referred to in ISO/IEC 14496-3:2001/Amd.4. SBR is a unique bandwidth extension technique that enables audio codecs to deliver the same listening experience at around half the bit rate. As a result, HE-AAC delivers excellent quality stereo signal at 32Kbps, CD-quality stereo at 48Kbps and 5.1 channel surround sound at 128Kbps that is furthermore efficient than well known MP3 (MPEG-1 Layer 3). This level of efficiency is ideal for Internet content delivery and fundamentally enables new applications in the markets of mobile and digital broadcasting. The availability low-power and high-quality decoders for HE AAC, enables the standard to run in mobile and portable device applications. As a result, this new powerful codec makes DAB multiplex accessible for more radio stations. This article can not follow AAC principles up to the point as here is no room for it, so follow links [6], [2] and [4].

4 Advanced digital audio systems

4.1 Digital Radio Mondiale

Digital Radio in the Broadcasting bands bellow 30MHz called Digital Radio Mondiale (DRM) is the most perspective alternative of DAB. The DRM standard [ES 201980] was first published as a European Telecommunications Standard and has been approved by ITU-R and IEC. In March 2005 was announced that in 2007 would be finished a new standard called DRM Plus which would be expected to work at

frequencies up to 120 MHz! It means that this system could replace not only present LW, MW and SW systems, but also FM. Currently, DRM uses narrow bandwidth channels with maximum bit rate between 20 and 25 kbps which using AAC represents an audio quality comparable to FM. DRM can deliver audio from mono to very good quality stereo in bandwidths from 4.5, 9, 10 to 20 kHz. Just for comparison to DAB, there is considered a 50 kHz bandwidth, which will provide CD-quality radio stations using 128 kbps AAC as is shown in Table 2.

Table 2. Bandwidth required for a CD-quality radio station

System	Audio Codec	Bit Rate required for CD-quality Kbps	Bandwidth required for a CD-quality Radio Station kHz
DAB	MP2	256	428
DRM	AAC	128	50

From this point of view, DRM can fit 8 CD-quality stations into the same amount of bandwidth as DAB would require for just one CD-quality station and there is still room for another 20 kHz DRM channel left. It is obvious that the Table 2. clearly shows why DRM transmitters would be far cheaper than DAB. In addition, as you might imagine Digital Radio Mondiale just cannot be launched and broadcast from day to day, it will have to coexist with analogue transmissions for some time. Also broadcasters may not be able to afford new transmitters for technical or financial reasons and listeners will have to be convinced that adopting DRM is worthwhile and so the concept of simulcasting has been developed. Simulcasting means that the analogue and digital components are transmitted at the same time within the same bandwidth. In spite of DRM being a new standard, it is already being transmitted in more than 30 different countries. It has to be said that this technology (DRM Plus) has not been finished yet and is still being worked on. As a result the given information is not complete. [2], [3], [5]

4.2 Digital Video Broadcasting –Transmission System for Handheld Terminals

Digital Video Broadcasting – Transmission System for Handheld Terminals (DVB-H, before also called DVB-M or DVB-X) is another example of more advanced technologies comparing to DAB. DVB-H again uses “mature” HE AAC audio codes. This technology was mainly designed for transmitting multimedia (audio, video) data streams to handheld terminals such as PDA and GSM/UMTS phone (often called pocket TV). This text just analyses the audio quality of DVB-H against DAB.

DVB-H uses 5, 6, 7 or 8 MHz-wide channel bandwidth, however, only 7 MHz bandwidth channel is planned due to Band III which it uses.

Table 3. Number of DAB multiplexes* and bandwidth** required to provide equivalent numbers of radio stations as a 7 MHz DVB-H multiplex

System	Modulation	Code Rate	Bandwidth MHz	Number of Good Audio Quality Radio stations per Multiplex	Number of DAB Multiplexes*	DAB Bandwidth required** MHz
DAB	QPSK	1/2	1.536	6	-	-
DVB-H	QPSK	2/3	7	68	12	21
DVB-H	16-QAM	1/2	7	102	17	30
DVB-H	16-QAM	2/3	7	136	23	40

You can easily see from Table 3. how beneficial DVB-H technology is, not only from the economic side (less transmitters = less consumed/transmitted energy) but also from the side of saving bandwidth frequencies. It also will be cheaper for broadcasters/radio stations to pay one shared DVB-H multiplex than 12, 17 or 23 DAB multiplexes. Moreover, DVB-H can work in a Single Frequency Network (SFN) as DAB or DVB. It enables DVB-H to cover a large area by one frequency. [1]

Recently, new mobile phones which support DVB-H technology were launched on the market. A big increase in sale of DVB-H terminals was registered thanks to The World Football Cup in Germany.

4.3 Digital Multimedia Broadcasting

Digital Multimedia Broadcasting (DMB) is a technology which uses DAB transmitter networks and is nothing else than DAB with ability to use HE AAC audio coding scheme. It is used for mobile video broadcasting with a data stream of 384 kbps and an audio signal of 64 kbps. This means that DMB can use DAB networks with better efficiency than DAB as it can fill a DAB multiplex with more stations. To convert the DAB multiplex to a DMB multiplex all that is needed are new HE AAC encoders and a DMB processor. DMB uses identical 1.536 MHz channel bandwidth. [4] However, DMB is not intent to be a substitutive technology, it can be considered as an additive technology to DAB. DMB provides a parallel service as DVB-H does.

It remains to be seen whether DMB or DVB-H will be the major standard that is adopted for mobile audio/video services.

Table 4. Overall performance of modern digital systems relative to DAB

System	Spectrum Required for a Good Audio Quality Radio Station kHz	Performance Relative to DAB
DAB	285	1.0
DMB	71	4.0
DVB-H	52	5.5
DRM	33	8.6

Table 4. clearly shows the massive improvement in performance of optional technologies since DAB was designed.

5 Conclusion

The modern digital broadcasting technologies DRM, DVB-H and DMB, which are here roughly introduced, have slowly become important. It cannot be said that these technologies will overtake the position of DAB, nevertheless they can be seen as complementary technologies.

Contemporary problems linked with these technologies are caused by increasing demand for receivers which are now missing on the market or are just presented by narrow choice which is often expensive.

Some indicate that these technologies may be used in different countries around the world. Accordingly, many chip manufacturers who are addressing this market are catering for them and developing systems that will be able to switch between the varieties of bands that will be used around the globe.

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