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Digital radio

Nowadays, digital technology can increase the quality of sound produced with conventional techniques by 50%, but this increase will not reach 100% until the broadcast is also digital. This is an important challenge for the radio broadcasters given that the listener, who presently takes compact disc digital sound quality as a reference, is starting to demand the same quality in radio sound.

Broadcasting with analogue technology suffers signal degradation problems, accumulating noise and distortions during each one of the phases that it goes through. On the other hand, with digital technology, the signal suffers less degradation, since error correction methods are included to correct distortions that can alter the information. Thus, digital information is easily transportable and storable, also using up less space.

Another advantage of digital broadcasting is given by the nature of the digital information itself: the information can be processed. This characteristic allows receivers to act like small computers that can process the information, and this not only affects the sound but all the data that the radio broadcaster wants to send in order to give added value to the service offered. Examples of this can be: song titles, lyrics, weather maps, traffic information, stock market data, etc.

All in all, digital technology improves broadcasting and reception qualities, allows the development of new production techniques and offers a greater variety of services than analogue technology. And this benefits both broadcasters and audience.

History of DAB

What is known at present as the **DAB** (*Digital Audio Broadcasting*) European standard is the digital broadcasting system developed by the European Community Eureka 147 project, prompted by the EBU (European Broadcasting Union). The objective was to specify a valid digital broadcasting system for terrestrial and satellite communications.

In 1995, the *European Telecommunication Standard Institute* (ETSI) adopted the **DAB** system as the only European standard (ETS 300 401). On a world level, the 1114th Recommendation of the *International Telecommunications Union* (ITU) recommends DAB as a terrestrial and satellite broadcasting system.

At present, **DAB** is entering the implementation phase in various European countries and there are many projects in motion, both in Europe and in other parts of the world.

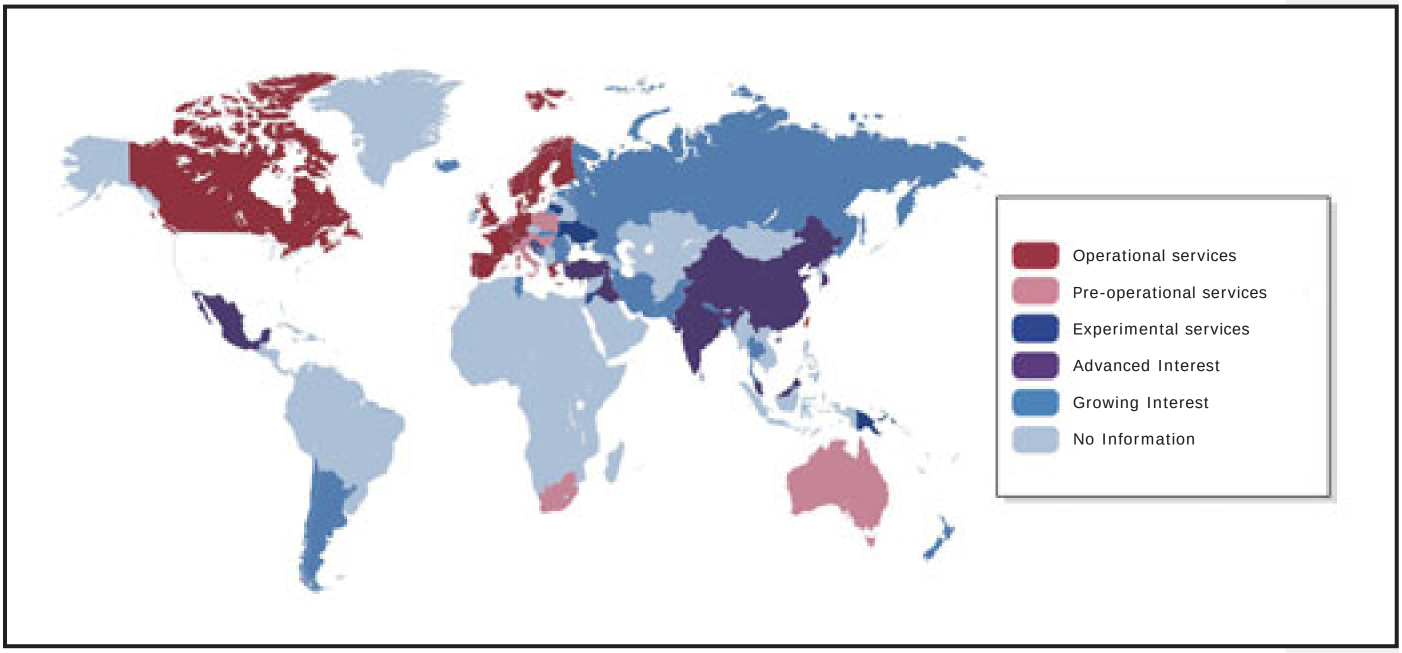

Figure 1: *Situation of **DAB** development in different countries of the world. (Source: WorldDAB Forum)*

OFDM technique

DAB provides a great technical novelty to broadcasting that may possibly be more important than the digital audio quality and the great channel capacity that it provides. This novelty consists in the use of a technology called **OFDM** (*Orthogonal Frequency Division Multiplex*) that allows unique frequency networks to be established and eliminates practically the entire problem of interferences suffered by conventional broadcasts.

The implementation of a unique frequency network is very important for mobile reception. It involves the use of the same frequency for broadcasting one same program by all the transmitters of a network, in all their coverage area. Thus, for example, a car in motion does not need to tune in the frequency constantly to continue listening to the same program. Likewise, better advantage can be taken of the spectrum by using the unique frequency.

The majority of the interferences produced during mobile reception are caused by multiple-propagation. Multiple-propagation means that the signal received by the antenna is a superposition of the transmitted signal and its reflections on buildings or other objects in its path. This superposition causes an interference that is called "frequency dependent".

By means of **OFDM** multiplexing, the information to be transmitted is distributed over a great number of carriers, 1536 to be precise, distributed over a 1.5MHz bandwidth. These carriers are intertwined in time and frequency and are redundantly codified. This means that the interference only affects some of the carriers, the majority being received free of noise. With the information redundancy and the incorporation of digital error correction techniques it is possible to reconstruct the sequence of bits in the receiver

Audio compression

A digital stereo signal, such as that of a CD, requires a 1.4Mbit/s capacity. Nevertheless, **DAB** uses an existing audio compression technology, called **MPEG** Audio Layer 2 (also known as **Musicam**), which provides a capacity reduction factor of 7, needing only 192 Kbit/s.

The **MPEG** Audio Layer 2 system compresses sound considering the human ear psychoacoustic characteristics. To be precise, it is based on the knowledge of the masking phenomena and of the perception of signals in the presence of weak frequencies, allowing the information quantification level to be significantly reduced, without modifying the quality of the final reception. This way, the frequencies that are irrelevant or redundant to the ear are reduced by elimination.

This compression capacity provides **DAB** with the ability to fit up to 6 stereo music programs in the bandwidth of just one channel (1.5 MHz). Also, this capacity is flexible so that, if stereo quality is not needed in a program, the space can be divided to fit, for example, two monophonic quality programs.

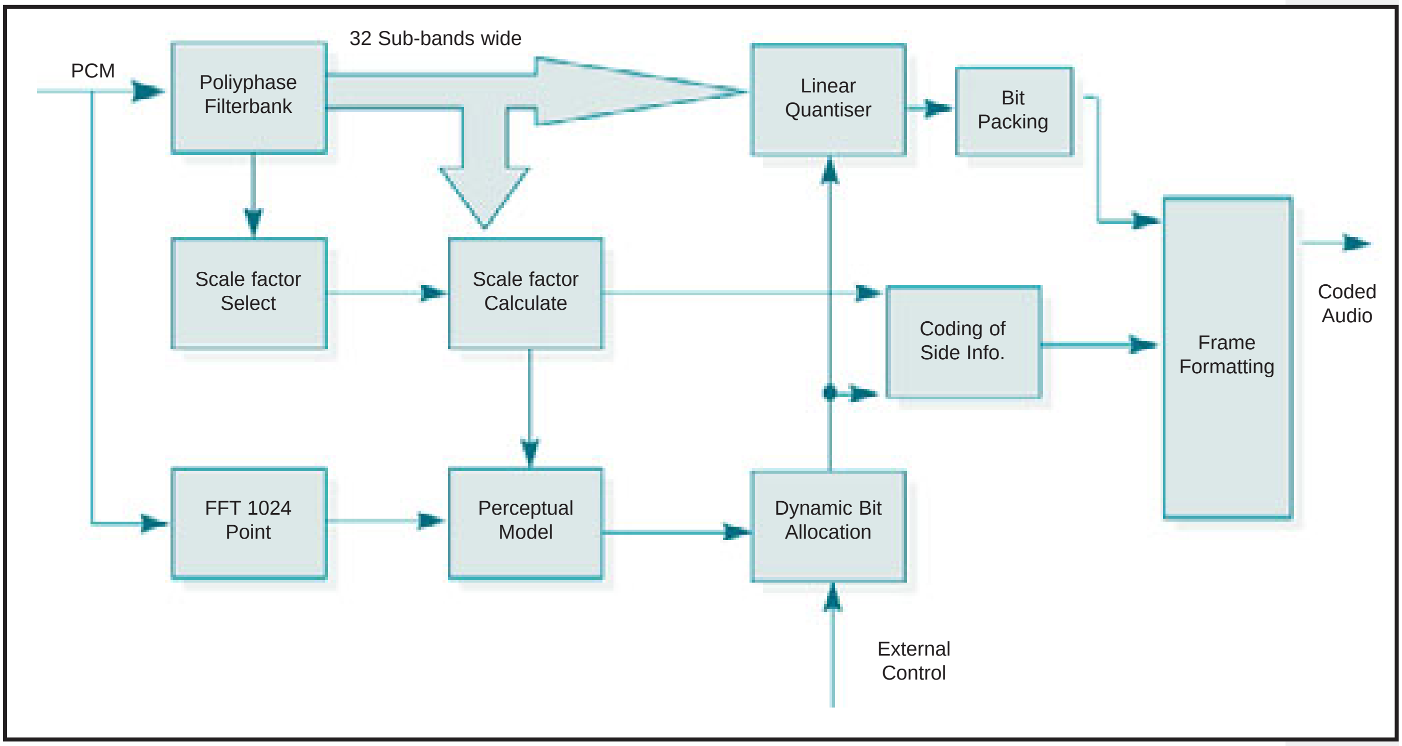

Figure 2: *Audio compression in MPEG Audio-Layer 2 format . (Source: NTL.com)*

Additional services

DAB, as a digital broadcasting system, can also transmit other types of data besides audio. Any type of information can be transmitted provided that it is in digital format and does not exceed the maximum available DAB capacity (approximately 1.7M bit /s).

At present, data associated to radio programmes is being transmitted (*Programme Associated Data*-**PAD**) which is being received by the first generation of DAB receivers. The data not associated with the programs (non-PAD) also called independent data, is presently the centre of attention for commercial applications design. This data is transmitted through the Main Service Channel (**MSC**) and can be organized in packages (*Packet Mode*) or transmitted as a continuous flow of data (*Stream Mode*) to simultaneously provide a great number of services. A specifically designed terminal is needed for the services reception. Some examples of services are electronic newspaper distribution, web page broadcasting, or the broadcasting of static images such as weather maps or traffic maps.

Because of this, "multimedia broadcasting" has started to be heard of. By means of this, any type of information can be transported by the DAB channel with the advantage over cable TV that **DAB** can be received by portable terminals and vehicles in motion.

Also, **DAB** is gifted with a **Conditional Access System**. By means of this system, services directed at paying users, services restricted to a private coverage area, individual services, etc, can be implemented.

DAB measurement with PROLINK-4/4C *Premium* equipment

The measurement equipment developed by **PROMAX**, **PROLINK-4/4C *Premium***, provides a specific module for digital radio signal measurement with **DAB** technology which allows a DAB signal to be tuned in and monitored, the parameters related to signal quality to be measured, and data and information related to the received signal to be shown.

PROLINK-4/4C *Premium* is able to tune, demodulate and decode terrestrial DAB channels (ETS 300 401).

Figure 3: *DAB signal detection*

The DAB signal parameter measurement screen shows:

SNR:
Signal/Noise Ratio. 0dB to >25.5dB scale.

CODED BER (CBER):
The level of errors detected in the received signal, indicated by means of the codified **BER** measurement in which the acceptable quality threshold level or Edge of Service (**EOS**) is defined for the selected audio component.

LOST SYNC:
This indicates the number of times that the DAB signal detection has been lost in the time specified.

Figure 4: *List of all available audio programmes for DAB channel*

Each **DAB** multiplex contains a number of services, and each service can contain a number of components.

The **PROLINK-4/4C *Premium*** equipment shows a list of all the components (audio or data) available in the multiplex. An additional information screen appears showing the multiplex information, the service and the first component.

Figure 5: *Additional information about the list of available audios.*

The data that appears is:

MULTIPLEX
Name of the multiplex and its identifier.

SERVICE
Name of the service and its identifier.

AUDIO
This includes information about identification, codification standard, bit-rate and detected audio mode.

If the supplier transmits it, a dynamic information line (DLS) appears. Like wise, the user can select the audio component to be decoded by identifying it directly by its name.

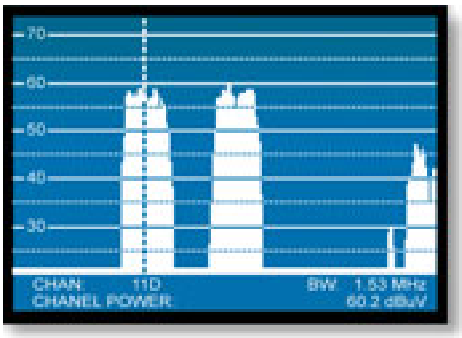

Figure 6: *Visualizing the DAB signal in the Spectrum Analyser mode.*

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