DSR and DAB – digital sound broadcasting today and tomorrow

For several decades VHF FM seemed to be the only suitable method for high-quality transmission of stereo sound programs. The introduction of the digital compact disk (CD) ten years ago set new and considerably higher quality standards for audio transmissions. The advance of digital technology also had consequences for sound broadcasting and led to the development of digital audio broadcasting systems in the 80s.

DSR
DIGITAL SATELLITE RADIO

The basis of **digital satellite radio (DSR)** is a direct broadcast satellite (DBS) of the type Kopernikus or TV-SAT with sufficient output power to allow stationary reception with the aid of small dish antennas. The programs of the various broadcasters are digitally coded and sent to the uplink transmitter, where they are combined into a program multiplex with a data rate of approx. 2 x 10 Mbit/s. This data frame is QPSK-modulated and sent on the satellite uplink. Via a transponder the satellite directly broadcasts up to 16 (digital) stereo programs with a bandwidth of approx. 14 MHz and almost CD quality. At the receiver end the DSR packet is either fed to the individual satellite receiver or converted to 118 MHz and fed into cable networks for distribution to domestic receivers.

While the concept of satellite to cable network has mainly been adopted by DBP Telekom in Germany for instance, Switzerland uses direct generation of DSR packets for its networks. Programs arriving at the network headend are selected, processed and then fed into the cable network as a (local) DSR packet.

In the definition of DSR system specifications, it was decided to use the DS1 standard (digital sound 1 Mbit/s) for coding stereo signals with an audio bandwidth of 15 kHz plus program-related auxiliary information [1]. The DS1 standard can be integrated without any problems into existing networks and PCM hierarchies.

After a few teething troubles in the beginning, DSR has gained ground in the past few years and is now used in most of the cable networks. There are numerous domestic DSR receivers on the market, ranging from low-cost to high-end units with facilities for evaluating auxiliary information.

The existing DSR should not be confused with **digital audio broadcasting (DAB)**, the broadcasting system of the future where, unlike with DSR, digitally coded sound programs are broadcast

DAB
Digital Audio Broadcasting

via a terrestrial DAB transmitter network which makes mobile reception possible too (FIG). In the presently used analog VHF FM system, interference due to physical effects (eg fading, multipath reception, reflections) encountered in terrestrial transmission cannot be eliminated, so that at times the sound quality may be degraded considerably. With the new coding and modulation techniques of DAB, interfering signals are effectively suppressed so that undisturbed (mobile) reception in CD quality is obtained. In addition to CD-quality sound, DAB provides data channels for services such as digital traffic information, alarm services, electronic mailbox and electronic newspapers.

DAB is a European development project partly sponsored by the EU. In the middle of the 80s and as part of the EUREKA 147 project, renowned research institutes, broadcasting corporations and industrial companies in France, England and Germany started to develop and specify basic system functions and to test them with the aid of prototype equipment. New partners from other European countries joined the project and, since 1992, work has been progressing on refining the specifications, international standardization and setting up field trials. In large-scale pilot tests starting in Bavaria in summer 1995, real DAB programs will be broadcast to gain practical experience and to test the acceptance of the new system by the general public. Countrywide implementation of the system in Germany is planned for 1997. In several countries – and equally in Germany – DAB platforms have been created for promoting and coordinating national activities and trials.

DAB is the first system to use the bit-rate-reducing **MUSICAM coding method** (masking-pattern-adapted universal subband-integrated coding and multiplexing) [2 and articles on pp 31 and 46 in this issue] for coding program signals (eg music from CD players), which allows for the psychoacoustic response of the human ear. MUSICAM uses irrelevance and redundancy reduction so that a multiplex signal consisting of several coded audio signals can be sent in a limited bandwidth via a terrestrial transmission channel. Undisturbed mobile reception is ensured by the digital modulation method **COFDM** (coded orthogonal frequency-division multiplex). The multiplex data stream is spread over about 1500 QPSK-modulated carriers so that, in spite of the interference and drops in field strength normally encountered, the COFDM demodulator in the receiver picks up an adequate number of signal components for evaluation. With the aid of error-correction

methods and concealment strategies, the receiver eliminates all remaining disturbance or reduces it below the audible threshold. With this modulation method even the delayed signal components of multipath reception (reflections), which are so disturbing in VHF FM transmissions, can be utilized for the directly received signal.

Unlike with VHF FM, COFDM-modulated program signals are transmitted in a frequency-economic way via a common-frequency network, ie all transmitters of the network use the same transmission frequency and operate synchronously. Transmissions in the field and pilot tests are mostly in band III (channel 11/12), but even for pilot tests use of the L band (1.5 GHz) for the transmission of DAB signals will be of growing importance. Real DAB transmissions after 1997 will be in band III and the L band.

Since 1992 Rohde & Schwarz has been involved in the EUREKA 147 project and participated in various working groups of the German DAB platform. Support was provided for the field and pilot tests for example with the following: a DAB coverage test system using Field-strength Test Receiver ESVB [3], a system for generating DAB test signals, MUSICAM codecs and DAB prototype transmitters. Highly linear DAB transmitters required for country-wide coverage and equipment for COFDM modulation are at present under development.

Just in time for pilot tests in 1995, first-generation DAB radios will come onto the market in sufficient numbers so that experience can be acquired and favourably priced DAB radios be produced for the general market when the system is finally introduced in 1997. Chances are good for DAB to make its way worldwide and become the broadcasting system of the next decades, providing the listener at home or on the road with CD-quality music and with lots of extra information.

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Principle of digital audio broadcasting (DAB)