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Sistemi radiodifuzije - Digitalna zvokovna radiodifuzija (DAB) za mobilne, prenosne in fiksne sprejemnike

Radio broadcasting systems; Digital Audio Broadcasting (DAB) tomobile, portable and fixed receivers

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Radio broadcasting systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers

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Foreword

This European Telecommunication Standard (ETS) has been produced under the authority of the Joint Technical Committee (JTC) of the European Broadcasting Union (EBU) and the European Telecommunications Standards Institute (ETSI).

NOTE: This EBU/ETSI JTC was established in 1990 to co-ordinate the drafting of ETSs in the specific field of radio, television and data broadcasting.

The EBU is a professional association of broadcasting organizations whose work includes co-ordination of its Members activities in the technical, legal, programme-making and programme-exchange domains. The EBU has active members in about 60 Countries in the European Broadcasting area; its headquarters is in Geneva *.

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This ETS on Digital Audio Broadcasting (DAB)¹⁾ was prepared by the Project Team PT-20V. The work of the Project Team was based on the studies carried out by the Joint EBU/Eureka 147 Task Force on DAB System Definition. This joint industry/broadcasters group provided the necessary guidance on all relevant technical matters to the Project Team.

The Project Team consisted of members of European broadcasting organizations and the consumer electronics industry.

The ETS on DAB is based on the overall system and service requirements adopted by the ITU-R Recommendations 774 [1] and 789 [2]. The audio coding algorithm used by the DAB system has been subject to the standardization process within the ISO/Moving Pictures Expert Group (MPEG), see ISO/IEC 11172-3 [3]. The layered ISO open system interconnect model ISO 7498 [4] has been used to the extent possible, and interfacing to information technology equipment and communications networks has been taken into account where applicable.

This ETS defines the nature and content of the transmitted DAB signal with reference to the conceptual emission part. The emphasis is given to the normative elements; informative elements are included only to the extent necessary to provide interpretative guidance to the DAB system users and equipment manufacturers.

The DAB system is a novel sound broadcasting system intended to supersede the existing analogue amplitude and frequency modulation systems. It is a rugged, yet highly spectrum and power efficient sound and data broadcasting system. It has been designed for terrestrial and satellite as well as for hybrid and mixed delivery. The DAB system has been publicly demonstrated on a number of occasions during its development. It has been subject to extensive field tests and computer simulations in Europe, USA and Canada.

1) DAB is a registered trademark owned by one of the Eureka 147 partners.

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1 Scope

This European Telecommunication Standard (ETS) establishes a broadcasting standard for the Digital Audio Broadcasting (DAB) system designed for delivery of high-quality digital audio programme and data services for mobile, portable and fixed reception from terrestrial or satellite transmitters in the Very High Frequency (VHF)/Ultra High Frequency (UHF) frequency bands as well as for distribution through cable networks. The DAB system is designed to provide spectrum and power efficient techniques in terrestrial transmitter network planning, known as the Single Frequency Network (SFN) and the gap-filling technique. The DAB system is suitable for satellite as well as hybrid/mixed terrestrial/satellite broadcasting, using a simple, nearly omni-directional receiving antenna. The DAB system meets the required sharing criteria with other radiocommunication services.

This ETS defines the DAB transmission signal. It includes the coding algorithms for audio, multiplexing of audio programme and data services, channel coding and modulation. A limited range of supplementary services associated with programme services is defined. Provision is also made for transmission of additional data services which may be programme related or not, within the limit of the total system capacity. The ETS provides information on the system configuration which includes information about the ensembles, services, service components and linking of them. Provision is made for a compatible cross-reference to existing Frequency Modulation (FM) services.

This ETS describes the nominal characteristics of the emitted DAB signal. The aspects related to the receiver design are outside the scope of this ETS. Hardware implementation considerations are not covered.

2 Normative references

This ETS incorporates, by dated and undated references, provisions from other publications. These normative references are cited at the appropriated places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

- [1] ITU-R Recommendation BS.774 (March 1994): "Digital sound broadcasting to vehicular, portable and fixed receivers using terrestrial transmitters in the VHF/UHF bands".
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- [2] ITU-R Recommendation BO.789 (March 1994): "Digital sound broadcasting to vehicular, portable and fixed receivers for BSS (sound) in the frequency range 500 - 3000 MHz".
- [3] ISO/IEC 11172-3 (March 1993): "Coding of Moving Pictures and Associated Audio for Digital Storage Media at up to 1,5 Mbit/s - Audio Part".
- [4] ISO 7498 (1984): "Open Systems Interconnection (OSI) Basic Reference Model".
- [5] EN 50067 (April 1992): "Specification of the Radio Data System (RDS)".
- [6] ITU-T Recommendation X.25 (1993): "Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit".
- [7] ETS 300 250: "Television systems; ETSI/EBU Joint Technical Committee (JTC) Specification of the D2-MAC/packet".
- [8] ETS 300 174 (1992): "Network Aspects (NA); Digital coding of component television signals for contribution quality applications in the range 34-45 Mbits/s".
- [9] ISO 3901 (1986): "International Standard Recording Code (ISRC)".

- [10] Norwegian Telecom, Issue 2 (July 20, 1989): "NR - MSK Access Control System".
- [11] EN 50094 (1992): "Access control system for the MAC/packet family: Eurocrypt".
- [12] IEC 958 (1989), Amendment 1 (1993)(AES/EBU): "Digital Audio Interface".
- [13] CCIR Recommendation 562-3 ITU Radiocommunications Sector, Volume X, (1990): "Subjective assessment of sound quality".
- [14] ISO/IEC DIS 13818-3 (March 1994): "Generic coding of moving pictures and associated audio - Audio part".
- [15] prEN 797: "Bar coding - Symbology specifications Universal Product Code/European Article Number (UPC/EAN)".

3 Definitions, abbreviations, symbols and conventions

3.1 Definitions

For the purposes of this ETS, the following definitions apply:

Alias component: Mirrored signal component resulting from sub-Nyquist sampling.

Announcement cluster: A group of services which share the same announcement interruption privileges.

Audio bit stream: A sequence of consecutive audio frames.

Audio frame: A frame of 24 ms duration which contains information of an ISO/IEC 11172-3 [3] Layer II encoded audio signal, corresponding to 1 152 consecutive audio samples at a 48 kHz sampling frequency. It is the smallest part of the audio bit stream which is decodable on its own.

Audio mode: The audio coding system, provides single channel, dual channel, stereo and joint stereo audio modes. In each mode, the complete audio signal is encoded as one audio bit stream.

Auxiliary Information Channel (AIC): All or part of sub-channel 63, used to carry information redirected from the Fast Information Channel.

Bark: See "Critical band".

Bit Allocation (BAI): A time-varying assignment of bits to samples in different sub-bands according to a psychoacoustic model.

Bound: The lowest sub-band in which Intensity stereo coding is used, in the case of Joint stereo mode.

Capacity Unit (CU): The smallest addressable unit (64 bits) of the Common Interleaved Frame (CIF).

Common Interleaved Frame (CIF): The serial digital output from the main service multiplexer which is contained in the Main Service Channel part of the transmission frame. It is common to all transmission modes and contains 55 296 bits (i.e. 864 CUs).

Conditional Access (CA): A mechanism by which the user access to service components can be restricted.

Convolutional coding: The coding procedure which generates redundancy in the transmitted data stream in order to provide ruggedness against transmission distortions.

Critical band: A psychoacoustic measure in the frequency domain which corresponds to the frequency selectivity of the human ear. The unit of this psychoacoustic measure is called Bark. The Bark scale is a non-linear mapping of the frequency scale over the entire audio frequency range.

DAB audio frame: The same as audio frame, but includes all specific DAB audio-related information.

DAB transmission signal: The transmitted radio frequency signal.

Data service: A service which comprises a non-audio Primary service component and optionally additional Secondary service components.

Dual channel mode: The audio mode, in which two audio channels with independent programme contents (e.g. bilingual) are encoded within one audio bit stream. The coding process is the same as for the Stereo mode.

Energy dispersal: An operation involving deterministic selective complementing of bits in the Logical frame, intended to reduce the possibility that systematic patterns result in unwanted regularity in the transmitted signal.

Ensemble: The transmitted signal, comprising a set of regularly and closely-spaced orthogonal carriers. The ensemble is the entity which is received and processed. In general, it contains programme and data services.

Ensemble Identifier (Eid): A unique 16-bit code, allocated to an ensemble and intended to allow unambiguous world-wide identification of that ensemble. The individual bits of the code are not individually interpretable.

Extended Programme Associated Data (X-PAD): The extended part of the PAD carried towards the end of the DAB audio frame, immediately before the Scale Factor Cyclic Redundancy Check (CRC). Its length is variable.

Fast Information Block (FIB): A data burst of 256 bits. The sequence of FIBs is carried by the Fast Information Channel. The structure of the FIB is common to all transmission modes.

Fast Information Channel (FIC): A part of the transmission frame, comprising the Fast Information Blocks, which contains the multiplex configuration information together with optional service Information and data service components.

Fast Information Data Channel (FIDC): The dedicated part of the Fast Information Channel which is available for non-audio related data services, such as paging.

Fast Information Group (FIG): A package of data used for one application in the Fast Information Channel. Eight different types are available to provide a classification of the applications.

Fixed Programme Associated Data (F-PAD): The fixed part of the PAD contained in the last two bytes of the DAB audio frame.

Intensity stereo coding: A method of exploiting stereo irrelevance or redundancy in stereophonic audio programmes. It is based on retaining only the energy envelope of the right and left channels at high frequencies. At low frequencies, the fine structure of the left and right channel of a stereophonic signal is retained.

Joint stereo mode: The audio mode in which two channels forming a stereo pair (left and right) are encoded within one bit stream and for which stereophonic irrelevance or redundancy is exploited for further bit reduction. The method used in the DAB system is Intensity stereo coding.

Logical frame: A data burst, contributing to the contents of a sub-channel, during a time interval of 24 ms. For example, data bursts at the output of an audio encoder, a Conditional Access scrambler and a convolutional encoder are referred to as Logical frames. The number of bits contained in a specific Logical frame depends on the stage in the encoding process and the bit rate associated with the sub-channel.

Logical frame count: The value of the CIF counter corresponding to the first CIF which carries data from the Logical frame.