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

Full standard
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Foreword

This European Standard (EN) has been produced by Joint Technical Committee (JTC) Broadcast of the European Broadcasting Union (EBU), Comité Européen de Normalisation ELECTrotechnique (CENELEC) and the European Telecommunications Standards Institute (ETSI).

NOTE 1: The EBU/ETSI JTC Broadcast was established in 1990 to co-ordinate the drafting of standards in the specific field of broadcasting and related fields. Since 1995 the JTC Broadcast became a tripartite body by including in the Memorandum of Understanding also CENELEC, which is responsible for the standardization of radio and television receivers. The EBU is a professional association of broadcasting organizations whose work includes the 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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The Eureka Project 147 was established in 1987, with funding from the European Commission, to develop a system for the broadcasting of audio and data to fixed, portable or mobile receivers. Their work resulted in the publication of European Standard, ETSI ETS 300 401 [i.1], for DAB (see note 2) which now has worldwide acceptance.

NOTE 2: DAB is a registered trademark owned by one of the Eureka Project 147 partners.

The DAB family of standards is supported by WorldDAB, an organization with members drawn from broadcasting organizations and telecommunication providers together with companies from the professional and consumer electronics industry.

With respect to the previous version of ETSI EN 300 401 published in June 2006, the present document contains several refinements to the DAB system. These refinements were performed and agreed by the WorldDAB Forum and include the following areas:

- additional rules and guidance on use of certain features;
- addition of MCI and SI FIGs to enhance receiver behaviour;
- removal of some obsolete service information features;
- removal of transmission modes II, III and IV;
- DAB audio (MPEG layer II) details moved to a separate ETSI document.

National transposition dates	
Date of adoption of this EN:	9 January 2017
Date of latest announcement of this EN (doa):	30 April 2017
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 October 2017
Date of withdrawal of any conflicting National Standard (dow):	31 October 2017

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

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1 Scope

The present document establishes a broadcasting standard for the Digital Audio Broadcasting (DAB) system designed for delivery of high-quality digital audio and video programmes and data services for mobile, portable and fixed reception from terrestrial transmitters in the Very High Frequency (VHF) 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 meets the required sharing criteria with other radiocommunication services.

The present document defines the DAB transmission signal. It includes the coding algorithms for multiplexing of audio and video programmes and data services, channel coding and modulation. 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 present document provides information on the system configuration which includes information about the ensembles, services, service components and linking of them.

The present document describes the nominal characteristics of the emitted DAB signal. The aspects related to the receiver design are outside the scope of the present document.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

- [1] ETSI TS 103 466: "Digital Audio Broadcasting (DAB); DAB audio coding (MPEG Layer II)".
- [2] ETSI TS 102 563: "Digital Audio Broadcasting (DAB); Transport of Advanced Audio Coding (AAC) audio".
- [3] ETSI TS 101 756: "Digital Audio Broadcasting (DAB); Registered Tables".
- [4] ETSI TS 102 367: "Digital Audio Broadcasting (DAB); Conditional access".
- [5] ETSI TS 103 176: "Digital Audio Broadcasting (DAB); Rules of implementation; Service information features".
- [6] ETSI EN 301 234: "Digital Audio Broadcasting (DAB); Multimedia Object Transfer (MOT) protocol".
- [7] ETSI TS 102 980: "Digital Audio Broadcasting (DAB); Dynamic Label Plus (DL Plus); Application specification".
- [8] ETSI ES 201 980: "Digital Radio Mondiale (DRM); System Specification".
- [9] ETSI TS 102 386: "Digital Radio Mondiale (DRM); AM signalling system (AMSS)".
- [10] IEC 62106: "Specification of the radio data system (RDS) for VHF/FM sound broadcasting in the frequency range from 87,5 to 108,0 MHz".

- [11] Recommendation ITU-T X.25: "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".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ETSI ETS 300 401 (edition 2) (1997): "Radio broadcasting systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers".

3 Definitions, abbreviations, mathematical symbols, C-language mathematical symbols and conventions

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

Access Control System (ACS): particular set of rules for managing entitlement checking and conditional access messages

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

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

Change Event Indication (CEI): set of FIG fields with particular values to indicate a change of database content for certain service information features

Common Interleaved Frame (CIF): serial digital output from the main service multiplexer which is contained in the Main Service Channel part of the transmission frame

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

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

DAB transmission signal: transmitted radio frequency signal

database key: set of FIG fields that sub-divide a database for certain service information features

data service: service which comprises a non-audio primary service component and optionally additional secondary service components

energy dispersal: 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: transmitted signal, comprising a set of regularly and closely-spaced orthogonal carriers

NOTE: The ensemble is the entity which is received and processed. In general, it contains programme and data services.

Ensemble Identifier (EId): unique 16-bit code, allocated to an ensemble and intended to allow unambiguous world-wide identification of that ensemble

Equal Error Protection (EEP): error protection procedure which ensures a constant protection of the bit stream

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

NOTE: Its length is variable.

Fast Information Block (FIB): data burst of 256 bits

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

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

logical frame: data burst, contributing to the contents of a sub-channel, during a time interval of 24 ms

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: value of the CIF counter corresponding to the first CIF which carries data from the logical frame

Main Service Channel (MSC): channel which occupies the major part of the transmission frame and which carries all the digital audio service components, together with possible supporting and additional data service components

MSC data group: package of data used for one user application in the Main Service Channel

NOTE: MSC data groups are transported in a series of one or more packets or X-PAD data sub-fields.

Multiplex Configuration Information (MCI): information defining the configuration of the multiplex

NOTE: It contains the current (and in the case of an imminent reconfiguration, the forthcoming) details about the services, service components and sub-channels and the linking between these entities. It is carried in the FIC in order that a receiver may interpret this information in advance of the service components carried in the Main Service Channel. It also includes identification of the ensemble itself.

N: transform length of Fast Fourier Transform (FFT)

null symbol: first Orthogonal Frequency Division Multiplex (OFDM) symbol of the transmission frame

OFDM symbol: transmitted signal for that portion of time when the modulating phase state is held constant on each of the equi-spaced, equal amplitude carriers in the ensemble

NOTE: Each carrier is four-phase differentially modulated from one symbol to another, giving a gross bit rate of two bits per carrier per symbol.

packet mode: mode of data transmission in which data are carried in addressable blocks called packets

NOTE: Packets are used to convey MSC data groups within a sub-channel.

primary service component: first and mandatory component of a service

NOTE: It can be used as a default selection in the receiver.

programme: time-slice of a programme service, corresponding to an entry in a programme schedule

Programme Associated Data (PAD): information which is related to the audio data in terms of contents and synchronization

programme item: time-slice of a programme, for example, a piece of music or a news report

programme service: service which comprises an audio primary service component and optionally additional secondary service components

protection level: level specifying the degree of protection, provided by the convolutional coding, against transmission errors

protection profile: defines the scheme of convolutional coding applied

Reserved for future addition (Rfa): bits that do not change the meaning of other parts of an information entity and so are not evaluated by receivers

NOTE: Rfa bits are always set to zero. If a new requirement is determined and specified in the future, Rfa bits may be replaced by fields with definite functions, but this will have no effect on any existing parts of the information entity.

Reserved for future use (Rfu): bits that change the meaning of other parts of an information entity and so are evaluated by receivers

NOTE: Rfu bits are always set to zero. If a new requirement is determined and specified in the future, Rfu bits may be replaced by fields with definite functions, and associated parts of the information entity may also change meaning.

secondary service component: in case a service contains more than the primary service component, the additional service components are secondary service components

service: user-selectable output which can be either a programme service or a data service

service component: part of a service which carries either audio (including PAD) or data

Service Identifier (Sid): 16-bit or 32-bit code used to identify a particular service

Service Information (SI): auxiliary information about services, such as service labels and programme type codes

service label: alphanumeric characters associated with a particular service and intended for display in a receiver

Single Frequency Network (SFN): network of DAB transmitters sharing the same radio frequency to achieve a large area coverage

stream mode: mode of data transmission within the Main Service Channel in which data are carried transparently from source to destination

sub-channel: part of the Main Service Channel which is individually convolutionally encoded and comprises an integral number of Capacity Units per Common Interleaved Frame

synchronization channel: part of the transmission frame providing a phase reference

transmission frame: actual transmitted frame, conveying the Synchronization Channel, the Fast Information Channel and the Main Service Channel

transmission mode: specific set of transmission parameters (e.g. number of carriers, OFDM symbol duration)

Unequal Error Protection (UEP): error protection procedure which allows the bit error characteristics to be matched with the bit error sensitivity of the different parts of the bit stream

User Application (UA): data application defined in a separate standard

X-PAD data group: package of data used for one user application in the Extended Programme Associated Data (X-PAD)

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

A/D	Audio/Data
ACS	Access Control System
AM	Amplitude Modulation
AMSS	Amplitude Modulation Signalling System
AppTy	Application Type
ASCTy	Audio Service Component Type
ASu	Announcement Support flags
ASw	Announcement Switching flags
AU	Access Unit
C/N	Current/Next
CA	Conditional Access
CAId	Conditional Access Identifier
CAOrg	Conditional Access Organization
CEI	Change Event Indication
CI	Contents Indicator
CIF	Common Interleaved Frame
CRC	Cyclic Redundancy Check
CU	Capacity Unit
d&t	date and time
DAB	Digital Audio Broadcasting
DFT	Discrete Fourier Transform
DG	Data Group
DL	Dynamic Label
D-QPSK	Differential QPSK
DRC	Dynamic Range Control
DRM	Digital Radio Mondiale
DSCTy	Data Service Component Type
EBU	European Broadcasting Union
ECC	Extended Country Code
EEP	Equal Error Protection
EId	Ensemble Identifier
ETS	European Telecommunication Standard
FEC	Forward Error Correction
FFT	Fast Fourier Transform
FI	Frequency Information
FIB	Fast Information Block
FIC	Fast Information Channel
FIG	Fast Information Group
FM	Frequency Modulation
F-PAD	Fixed Programme Associated Data
IEC	International Electrotechnical Commission
ILS	International Linkage Set indicator
LA	Linkage Actuator
LSb	Least Significant bit
LSI	Leap Second Indicator
LSN	Linkage Set Number
LTO	Local Time Offset
MainId	Main Identifier of a transmitter
MCI	Multiplex Configuration Information
MJD	Modified Julian Date
MOT	Multimedia Object Transfer
MPEG	Moving Pictures Expert Group
MSb	Most Significant bit
MSC	Main Service Channel
OE	Other Ensemble
OFDM	Orthogonal Frequency Division Multiplex
P/D	Programme/Data service flag