

## Digital Audio Broadcasting (DAB); Guide to DAB standards; Guidelines and Bibliography

European Broadcasting Union



Union Européenne de Radio-Télévision

EBU-UER

**DAB**  
Digital Audio Broadcasting



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**Reference**

DTR/JTC-DAB-20

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**Keywords**

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**ETSI**

650 Route des Lucioles  
F-06921 Sophia Antipolis Cedex - FRANCE

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Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C  
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## Foreword

This Technical Report (TR) 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)(Broadcast).

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.

European Broadcasting Union  
CH-1218 GRAND SACONNEX (Geneva)  
Switzerland  
Tel: +41 22 717 21 11  
Fax: +41 22 717 24 81

### Digital Audio Broadcasting (DAB) Eureka Project 147

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, EN 300 401 [1], for DAB (note 2) which now has world-wide acceptance. The members of the Eureka Project 147 are drawn from broadcasting organizations and telecommunication providers together with companies from the professional and consumer electronics industry.

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

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# 1 Scope

The present document provides brief explanations about the many different standards and guidelines for Digital Audio Broadcasting (DAB), what they cover and how they interrelate. The so-called 'main DAB standard' EN 300 401 [1] is explained first and the remaining documents are grouped into standards/documents related to DAB-receivers, DAB-networks along with transmitters and data transmission via DAB. Finally a brief overview of general literature about DAB is also given.

NOTE: The present document includes Technical Specifications, which will later be standardized unchanged as ETSI Standards (ES). The relevant documents are referred to with their final ES numbers and their TS number in brackets. The documents concerned are ES 201 735 (TS 101 735) [15], ES 201 736 (TS 101 736) [16], ES 201 737 (TS 101 737) [17] and ES 201 755 (TS 101 500) [24].

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# 2 References

For the purposes of this Technical Report (TR) the following references apply:

- [1] ETSI EN 300 401: "Radio broadcasting systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers".
- [2] ETSI TR 101 496: "Digital Audio Broadcasting (DAB); Guidelines and Rules for Implementation and Operation".
- [3] ETSI TS 101 756: "Digital Audio Broadcasting (DAB); Registered Tables".
- [4] EN 50248: "Characteristics of DAB receivers".
- [5] EACEM TR-004: "Application of the EMC Directive 89/336/EEC for Digital Audio Broadcast receivers".
- [6] EN 50255: "Digital Audio Broadcasting system - Specification of the Receiver Data Interface (RDI)".
- [7] EN 50320: "Digital audio broadcasting system - Specification of the DAB command set for receivers (DCSR)".
- [8] ETSI EN 300 797: "Digital Audio Broadcasting (DAB); Distribution interfaces; Service Transport Interface (STI)".
- [9] ETSI EN 300 798: "Digital Audio Broadcasting (DAB); Distribution interfaces; Digital baseband In-phase and Quadrature (DIQ) interface".
- [10] ETSI ETS 300 799: "Digital Audio Broadcasting (DAB); Distribution interfaces; Ensemble Transport Interface (ETI)".
- [11] Eureka Project 147: "Minimum Transmitter Requirements".
- [12] EBU BPN 003: "Technical Bases for T-DAB services network planning and compatibility with existing Broadcasting Services".
- [13] ETSI EN 301 234: "Digital Audio Broadcasting (DAB); Multimedia Object Transfer (MOT) protocol".
- [14] ETSI TR 101 497: "Digital Audio Broadcasting (DAB); Rules of Operation for Multimedia Object Transfer (MOT)".
- [15] ETSI ES 201 735 (TS 101 735): "Digital Audio Broadcasting (DAB); Internet Protocol (IP) Datagram Tunnelling".
- [16] ETSI ES 201 736 (TS 101 736): "Digital Audio Broadcasting (DAB); Network Independent Protocols for Interactive Services".

- [17] ETSI ES 201 737 (TS 101 737): "Digital Audio Broadcasting (DAB); Interaction channel through Global System for Mobile communications (GSM) the Public switched Telecommunications System (PSTN); Integrated Services Digital Network (ISDN) and Digital Enhanced Cordless Telecommunications (DECT)".
- [18] ETSI EN 301 700: "Digital Audio Broadcasting (DAB); VHF/FM Broadcasting; cross-referencing to simulcast DAB services by RDS-ODA 147".
- [19] EN 50067: "Specification of the radio data system (RDS) for VHF/FM sound broadcasting in the frequency range from 87,5 to 108,0 MHz".
- [20] ETSI TS 101 498: "Digital Audio Broadcasting (DAB); Broadcast Website".
- [21] ETSI TS 101 499: "Digital Audio Broadcasting (DAB); Slide Show Application;".
- [22] ETSI TS 101 759: "Digital Audio Broadcasting (DAB); Data Broadcasting - Transparent Data Channel".
- [23] ETSI TR 101 758: "Digital Audio Broadcasting (DAB); Signal strengths and receiver parameters; Targets for typical operation".
- [24] ETSI ES 201 755/TS 101 500: "Digital Audio Broadcasting (DAB) Multichannel Audio Extension".
- [25] ETSI TS 101 757: "Digital Audio Broadcasting (DAB) Conformance testing for DAB Audio".
- [26] ISO 13818-3: "Information technology - Programming languages - Generic packages of real and complex type declarations and basic operations for Ada (including vector and matrix types)".
- [27] EN 55013: "Limits and methods of measurement of radio disturbance characteristics of broadcast receivers and associated equipment".
- [28] EN 55020: "Electromagnetic immunity of broadcast receivers and associated equipment".

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### 3 Abbreviations

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

DAB	Digital Audio Broadcasting
EACEM	European Association of Consumer Electronics Manufacturers
EBU	European Broadcasting Union
EMC	Electro Magnetic Compatibility
FM	Frequency Modulation
GHz	Giga ( $10^9$ ) Hertz
HTML	Hyper Text Markup Language
HuMIDAB	Human Machine Interfaces for DAB
Mbit/s	Mega ( $10^6$ ) bits per second
MHEG	Multimedia and Hypermedia information coding Experts Group
MHz	Mega ( $10^6$ ) Hertz
SFN	Single Frequency Network
T-DAB	Terrestrial DAB

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## 4 DAB system standards and guidelines

### 4.1 EN 300 401: Radio broadcasting systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers

EN 300 401 [1] is the so-called 'main DAB' standard. It describes 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 frequency bands from 30 MHz to 3 GHz. The DAB system is designed to provide spectrum and power efficient techniques in terrestrial transmitter network planning, known as the Single Frequency Network (SFN). The DAB system is suitable for satellite as well as hybrid/mixed terrestrial/satellite broadcasting.

EN 300 401 [1] 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 EN 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. EN 300 401 [1] describes the nominal characteristics of the emitted DAB signal. The aspects related to the receiver design are outside the scope of the present document. Hardware implementation considerations are not covered.

### 4.2 TR 101 496: DAB; Guidelines and Rules of Implementation and Operation (DAB-GRIO)

TR 101 496 [2] is the main guideline document, developed by the Eureka Project 147, as the major companion document to EN 300 401 [1]. Originally TR 101 496 was developed in three volumes, covering: Outline and Features; Broadcast Network; and System Features, giving considerable detail and explanations to help to implement DAB systems and develop conformant equipment. It is now a single Technical Specification document, in three parts.

### 4.3 TS 101 756: DAB; Registered tables (DAB-RT)

TS 101 756 [3] entitled "DAB; Registered tables (DAB-RT)" contains the current tables for use in the implementation of the Digital Audio Broadcasting (DAB), system as given in the 'main DAB standard' EN 300 401 [1] and the MOT standard EN 301 234 [13]. The tables in the above mentioned standards can be seen as examples for possible values of these tables and represent a valid subset of values. The complete up-to-date set of values is always given in the "Registered tables" document.

The tables in TS 101 756 are maintained by the WorldDAB Information and Registration Centre (WorldDAB IRC), Wyvil Court, Wyvil Road, London SW8 2TG, England. They apply an easy procedure for registering new values, to ensure that they may be used without the need to change the so-called 'main DAB standard' EN 300 401 [1] and the MOT standard EN 301 234 [13]. The procedure for registering a new value in an existing table or the registration of a new table is described in clause 4 of TS 101 756 [3].

Additionally there are two annexes contain translations of Programme Type Codes and Announcement Type Codes.

### 4.4 ES 201 755 (TS 101 500): DAB; Multichannel Audio

ES 201 755 [24] describes an extension of the Eureka 147 Digital Audio Broadcasting (DAB) system to include MPEG-2 Layer II multi-channel audio coding. It defines adaptations of ISO 13818-3 [26] applying to the use inside the DAB context. These include a restriction of the parameters of the bit stream and additional methods for Unequal Error Protection (UEP), error detection and Dynamic Range Control and how to transmit multichannel audio in DAB.

## 4.5 TS 101 757: DAB; Conformance Testing for DAB Audio

TS 101 757 [25] specifies a test procedure and defines test bitstreams which can be used to verify whether bitstreams and decoders meet the requirements as specified in EN 300 401 [1]. These tests can be used for various purposes such as:

- manufacturers of encoders, and their customers, can use the tests to verify whether the encoder produces valid bitstreams;
- manufacturers of decoders and their customers can use the tests to verify whether the decoder meets the requirements specified in EN 300 401 [1] for the claimed decoder capabilities.

## 4.6 EN 301 700: DAB; VHF/FM Broadcasting: cross-referencing to simulcast DAB services by RDS-ODA 147

EN 301 700 [18], describes a standard method for signalling DAB service information to a receiver tuned to a FM-RDS service. The RDS Open Data Application (RDS-ODA) system which is used is specified in the so called 'main RDS standard' [17].

Since some DAB services are simulcasts of existing FM services, usually with RDS, it is possible for receivers able to receive both DAB and FM services to present the listener with the DAB service, but it can fall back to the FM service outside the DAB coverage area. DAB provides the signalling, through the service following information in the Fast Information Channel, to enable a receiver to find the equivalent service on FM. EN 301 700 [18] describes the characteristics of an RDS-ODA for providing frequency information for DAB ensembles. Additionally the ODA can signal various Service Information attributes of DAB services thus allowing a receiver to find an equivalent DAB service.

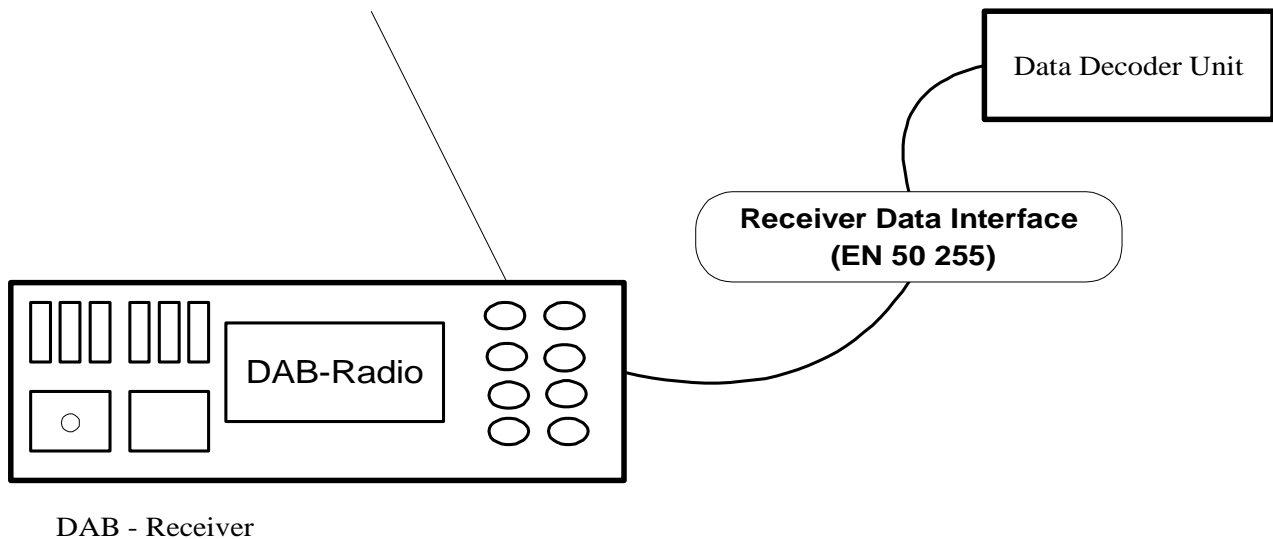
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# 5 DAB receiver standards and documents

## 5.1 General

This clause describes a set of standards and recommendations which have evolved over the years to supplement the 'main DAB standard' EN 300 401 [1] covering the implementation of DAB receivers. EN 50248 [4] describes characteristics of DAB receivers and EACEM TR-004 [5] identifies the EMC parameters for DAB receivers. EN 50255 [6] (RDI) specifies the interface between DAB receivers and additional data decoders and EN 50320 [7] defines the DAB command set for receivers. TR 101 758 [23] contains general field strength and sensitivity considerations for a DAB system.





### Characteristics of DAB Receivers (EN 50 248)

#### EMC Directive (EACEM TR-004)

#### DAB Command Set for Receivers (EN 50 320)

← **Digital Audio Broadcasting to mobile, portable and fixed receivers (EN 300 401)** →

Figure 1: Conceptual DAB receiver showing related standards

## 5.2 EN 50 248: Characteristics of DAB receivers

This CENELEC standard, EN 50248 [4], describes DAB receiver characteristics for consumer equipment intended for terrestrial and cable reception operating in Band III and L-Band and for satellite reception in L-Band. Topics such as basic implementation and functional performance requirements, interfaces, recommended centre frequencies for DAB receivers and reference performance levels and measuring methods are covered in EN 50248. Dedicated receivers for specific applications are not within the scope of EN 50248 [4].

## 5.3 EACEM TR-004: Application of the EMC Directive 89/336/EEC for Digital Audio Broadcast receivers

This EACEM document [5], identifies specific references, requirements, methods and test conditions for EMC tests for DAB receivers. TR-004 [5] is intended to form the basis for future discussion and EACEM's objective is to either amend or redraft current available standards EN 55013 [27] and EN 55020 [28] to include DAB.

## 5.4 EN 50255: Receiver Data Interface (RDI)

This CENELEC standard, EN 50255 [6], describes an interface between the DAB receiver and data decoders. The maximum DAB data rate of 1,8432 Mbit/s as well as data for receiver control and information on the received transmitters of the SFN can be carried via the RDI. The source for the data to be carried on the Receiver Data Interface is the output bit stream of the channel decoder of a DAB receiver. Dedicated decoders for data applications, computers, etc., but also devices for audio postprocessing and recording can be connected to the DAB receiver through this interface.

The RDI specification is independent of any physical interfaces and interfaces commonly used in consumer electronics are supported. The use of RDI allows connection of several decoders to a single receiver and it is possible to implement a return channel for receiver control from an application terminal.

## 5.5 EN 50320: DAB; Command Set for Receiver (DCSR)

This CENELEC pre-standard, EN 50320 [7], describes a command set which allows to control DAB receivers. The command set is intended for use on different physical bus systems.

## 5.6 TR 101 758: DAB; Signal strengths and receiver parameters targets for typical operation

TR 101 758 [23] describes the general principles for deriving the necessary field strength and compatible receiver sensitivity for satisfactory operation of a DAB system.

# 6 DAB transmission and network standards and documents

## 6.1 General

A set of standards and recommendations have evolved over the years to supplement the 'main DAB standard' EN 300 401 [1] covering implementation of the requisite broadcast networking interfaces. EN 300 797 [8] describes the Service Transport Interface, EN 300 798 [9] describes the digital baseband in-phase and quadrature interface and ETS 300 799 [10] describes the Ensemble Transport Interface.

The Eureka Project 147 document 'Minimum Transmitter Requirements' recommends a minimum set of requirements for terrestrial DAB transmitters and the EBU document BPN 003 [12] may serve as a basis for DAB network planning.

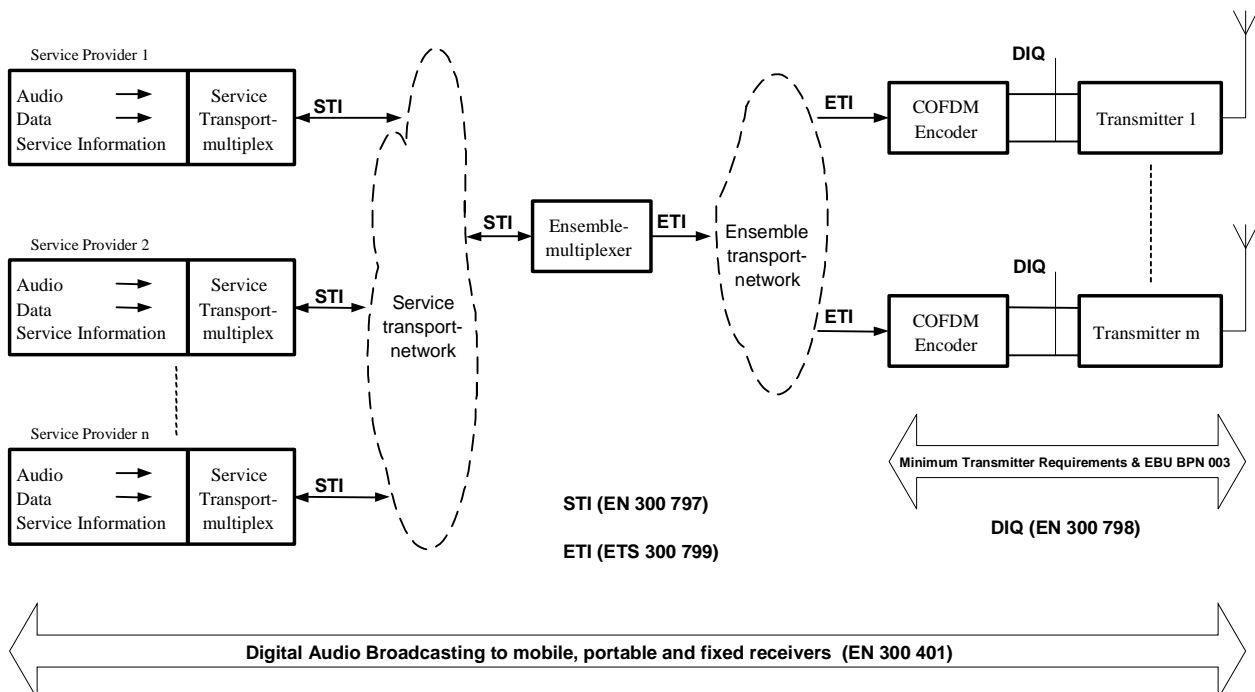


Figure 2: Conceptual DAB transmission network and related standards

## 6.2 EN 300 797: DAB; Distribution interfaces, Service Transport Interface (STI)

EN 300 797 [8] has been defined to provide a standardized way of transporting DAB service components, service information and control information in a DAB collection network. The collection network connects the studios of the various Service providers to the Ensemble provider's ensemble multiplexer.

The STI consists of two parts: the data part, STI-D, which carries data intended for broadcast, and the control part, STI-C, which carries data for control and monitoring purposes and is not intended for broadcast. STI-D is unidirectional in nature, whereas STI-C is bidirectional in nature. EN 300 797 [8] specifies first the logical interface for STI-D and STI-C, and then defines various physical implementations for them.

The STI interface is suitable for use on a number of different physical media and telecommunication networks. Provision is made for the inclusion of appropriate error detection and correction and for the management of network transit delay.

## 6.3 EN 300 798: DAB; Distribution interfaces, Digital baseband in-phase and Quadrature (DIQ) interface

EN 300 798 [9] is applicable to DAB channel coding equipment typically located at each of the transmitter sites in a DAB SFN. The norm describes the characteristics of a suitable interface for the connection of the two major elements of the DAB OFDM generator; the baseband processing equipment and the RF modulator. The interface provides an interconnection between a single source (the baseband processor) and a single destination (the RF modulator). The standard does not cover the generation of the digital I/Q baseband signals since this is covered in EN 300 401 [1].

The digital baseband I/Q interface is unidirectional and does not cover the provision of status nor control information in the reverse direction (i.e. from the modulator back to the baseband processing section of the equipment).

## 6.4 ETS 300 799: DAB; Distribution Interfaces, Ensemble Transport Interface (ETI)

ETS 300 799 [10] establishes a method for the distribution of DAB signals between the ensemble multiplexer, and DAB modulation equipment located at the different transmission sites of an SFN. The data flow of the ETI is unidirectional by nature and the standard specifies first the logical interface the ETI, and then defines various physical implementations for it.

The interface is suitable for use on a number of different physical media including standard 2 Mbit/s switched telecommunication networks. Provision is made for the inclusion of appropriate error detection and correction and for the management of network transit delay. Limited capacity is also made available for signalling from the ensemble multiplexer to other equipment in the distribution network. ETS 300 799 [10] does not cover the provision of status nor control information in the reverse direction (i.e. from transmitters back to the Ensemble provider).

## 6.5 Minimum Transmitter Requirements

This Eureka Project 147 document [11] recommends a minimum set of requirements for terrestrial DAB transmitters according to EN 300 401 [1]. A transmitter comprises all the functions of a chain starting with the input of an ETI signal and ending with the power output of the DAB signal (including power filter if applicable). Retransmitters receiving RF DAB signals are not under the scope of the document. Required performance, minimum functionality as well as control and monitoring of transmitters in a single frequency network (SFN) or multiple frequency network (MFN) are considered in the document.

The antenna system is not subject to this recommendation, as the local situation may often require individual solutions. However, it is assumed that the deviations of the radiated signal from the power-amplified signal can be derived by taking into account the properties of the antenna system.

## 6.6 EBU BPN 003: Technical Bases for T-DAB services network planning and compatibility with existing Broadcasting Services

This EBU document, BPN 003 [12], considers network concepts and the main parameters to be taken into account for planning of terrestrial DAB (T-DAB) networks. Parameters such as re-use and separation distances for various SFN and single transmitter configurations, SFN gain and minimum wanted field strength are covered in BPN 003 [12].

Protection ratios for T-DAB emissions interfered with by television or VHF/FM sound broadcasting emissions and vice versa are also given in the document as well as co-ordination parameters for networks.

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## 7 Additional DAB standards and documents for data transmission

### 7.1 General

The Multimedia Object Transfer (MOT) standard and its associated Rules of Operation allow broadcasting of data via DAB in a very convenient way. Two possible DAB data applications are described in the Documents entitled "Broadcast Web Site Application" and "Slide Show Application". How to deliver data transparently in the DAB system is described in TS 101 759 [22].

DAB is by definition ideally suited for mobile applications. However, in today's information society, a mobile Internet is being asked for and a combination of DAB as high bitrate downlink and already existing low bitrate communication technologies as return path can achieve this goal. Three further specifications were therefore developed by the Eureka Project 147 specify: 'DAB; IP Datagram Tunnelling', 'DAB; Network Independent Protocols for Interactive Services' and 'DAB; Interaction Channel through GSM/PSTN/ISDN/DECT'. They are the answer to the above requirement and show that DAB is very well suited for mobile Internet applications.

### 7.2 EN 301 234: DAB; Multimedia Object Transfer (MOT) protocol

EN 301 234 [13] describes the MOT protocol which allows broadcasting of various kinds of data using the DAB system. It is tailored to the needs of Multimedia services and the specific constraints given by the broadcasting characteristics of the DAB system. MOT ensures interoperability between different data services and application types as well as equipment from different manufacturers.

EN 301 234 [13] defines the transport specific encoding for data types not specified in EN 300 401 [1] according to the transport mechanisms provided by DAB. It allows a flexible utilization of the data channels incorporated in the DAB system, as well as methods to manage and maintain a reliable transmission in a uni-directional broadcast environment. Provisions are also made for the creation and presentation of advanced Multimedia services using formats such as Hyper Text Markup Language (HTML) or Multimedia and Hypermedia information coding Experts Group (MHEG ISO).

Aspects related to the further decoding and processing of the data objects carried are outside the scope of the present document. Hardware or software implementation considerations are not covered.

### 7.3 TR 101 497: DAB; MOT Rules of Operation

TR 101 497 [14] is the main guideline document, developed by the Eureka Project 147, as a companion document to EN 301 234 [13]. It gives additional information and explanations regarding the use of the MOT protocol.

## 7.4 TS 101 498: DAB; Broadcast Web Site Application

TS 101 498 [20] describes the DAB Broadcast Web Site application which gives the opportunity to use HTML as a content format to support information services. This concept allows a service provider to deliver an entire web site to a receiver using only the broadcast channel of DAB and without the need for any form of return channel.

## 7.5 TS 101 499: DAB; Slide Show Application

TS 101 499 [21] describes the techniques required to deliver a sequence of slides which carry information in the form of images. The main use for this user application will be in context with a programme service component. Examples are: news programme items complemented by photos from the reported events and programme items with popular songs accompanied by photographs of the performers or the covers of their issued CDs. Once activated the Slide Show Application is service provider driven and does not require any interaction from the end-user of the corresponding service component. Each slide appears automatically on the display and will be replaced under the control of the service provider according to the needs of his service.

## 7.6 TS 101 759: DAB; Transparent Data Channel

TS 101 759 [22], developed by the Eureka Project 147, describes the techniques required to deliver data transparently within a DAB transmission, where the data concerned does not need to be related to any other parameters of the particular bearer DAB transmission.

## 7.7 ES 201 735 (TS 101 735): DAB; IP Datagram Tunnelling

ES 201 735 [15] developed by the Eureka Project 147, describes how to transport Internet Protocol (IP) datagrams in a Digital Audio Broadcasting (DAB) packet mode service component, a technique described as 'IP tunnelling'.

The use of IP tunnelling provides DAB with a mechanism for the adaptation of Internet services to DAB and is also a key component for DAB services using two-way interaction with personal DAB. The use of IP tunnelling enables the use of IP as a common network layer protocol, end-to-end, for DAB data services. IP tunnelling through DAB is unidirectional. The tunnel is created from the packet mode encoder on the transmitting side, to the packet mode decoder on the receiving side, of the DAB system.

## 7.8 ES 201 736 (TS 101 736): DAB; Network Independent Protocols for Interactive Services

ES 201 736 [16], developed by the Eureka Project 147, describes the protocol stacks to be used for the different types of services that are defined, as local interactive, one-way interactive and two-way interactive service. The specification also defines a protocol PSSC (Personal DAB Service Session Control) which allows the set up of personal DAB service sessions and functionalities like handover between DAB cells, etc. It also defines the message format to be used and allows for further future extensions.

## 7.9 ES 201 737 (TS 101 737): DAB; Interaction Channel through GSM/PSTN/ISDN/DECT

ES 201 737 [17], developed by the Eureka Project 147, describes the Interaction Channels through Global System for Mobile communication (GSM), the Public Switched Telecommunications System (PSTN), Integrated Services Digital Network (ISDN), Digital Enhanced Cordless Telecommunications (DECT). It describes low level network management and basically references relevant telecommunication standards and describes how the implementation of low level interaction is handled.

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## Annex A: DAB Bibliography

The cited references may be considered as a starting point for the interested reader to find more useful information on many different aspects of DAB.

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### A.1 General descriptions on DAB topics

EBU Technical Review, Autumn 1995: "Digital Audio Broadcasting - radio now and for the future", Kozamernik, F.

Franzisz Verlag, 1996: "Digital Audio Broadcasting: Grundlagen, Anwendungen und Einführung von DAB", Lauterbach, T.

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