SLOVENSKI STANDARD
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Digital Audio Broadcasting system - Specification of the Receiver Data Interface (RDI)

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Digitales Tonrundfunk-System - Spezifikation für die Empfänger- Datenschnittstelle (RDI)

Système de radiodiffusion sonore numérique (DAB) - Spécification de l'interface de données du récepteur (RDI)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This European Standard was prepared by Eureka 147 Working Group D "RDI Task Force" and transferred to the Technical Committee CENELEC TC 206, Broadcast receiving equipment.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50255 on 1997-10-01.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1998-09-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1998-09-01

Contents

1. Introduction and general considerations

1.1 Introduction

The Eureka 147 Digital Audio Broadcasting System [1] is able to transmit data rates of up 1.8432 Mbit/s. This data rate occurs if an EEP with a coderate of 0.8 is selected. Audio receivers generally will be capable to decode one or several MSC Subchannels, but will not contain decoders for all possible data services. Therefore, the source for the data to be carried on the Receiver Data Interface (RDI) 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 intention of specifying the RDI is to provide a common interface for this purpose fulfilling the following requirements:

(1) It should be able to carry the full information obtained by the DAB receiver, i.e. the maximum data rate of the MSC, plus the FIC and information on the received transmitters (TII) in a suitable format.
(2) It should be able to carry data in the format of the output format of recently developed channel decoders and input format of audio source and data decoder ICs (the so-called DAB 3 interface, see Annex A).
(3) The RDI specification should be independent of any physical interfaces. Interfaces commonly used in consumer electronics should be supported.
(4) It should be possible to connect several decoders to a receiver
(5) It should be possible to implement a return channel for receiver control from an application terminal.
(6) It should be possible to connect the DAB receiver to a data network.

This first issue of the RDI specification provides a basic approach to these requirements. A generic coding structure for the data to be carried by the RDI based on a 24 bit RDI frame structure has been developed. All requirements have been met by this coding scheme. Two modes of the RDI have been defined to fulfil requirements (1) and (2). The mode fulfilling requirement (1) is called the "high capacity mode", the mode fulfilling requirement (2) only is called the "low capacity mode" of the RDI. With respect to requirement (3), only the IEC 958 physical layer is supported by now. The mapping of RDI frames onto other physical interfaces including networks (requirement (6)) and the development of a command language for the return channel (requirement (5)) are under consideration in the RDI Task Force of WG D.

1.2 Architecture of the receiving system

The RDI interface specified below is intended to be used for the direct connection of one or more data application decoders to DAB receivers ("stand-alone solution"). The architectures envisaged

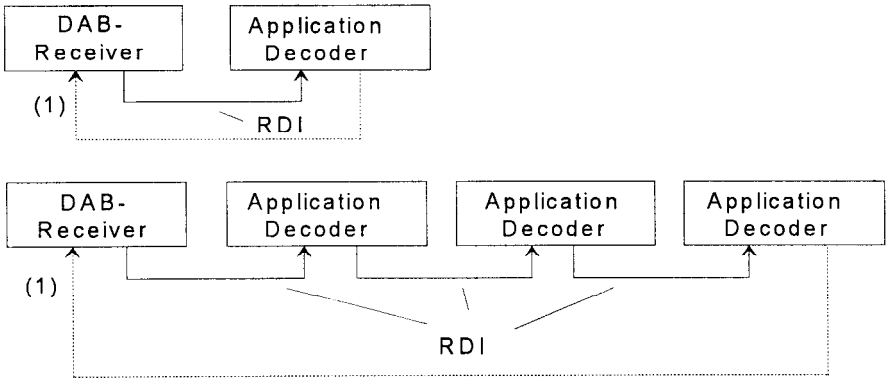

Fig.1 : Architectures for connecting application decoders to a DAB receiver.

NOTES:

(1) Back channel is under consideration

are described in Fig.1. If two or more application decoders are to be connected to a DAB receiver, each application decoder (except the last one) is required to have an input and output connector for the interface. In this case, the received RDI data stream is relayed directly to the output interface.

1.3 Considerations on the data rates of suitable physical interfaces

The following table gives an indication on how many RDI frames are required per time to transport the relevant data: The right time scale for this approach is physical CIFs which are 22.429 ms (2153 RDI frames)

Channel	Data Capacity	RDI frames available	Remarks
DAB Main Service Channel	1.856 MBit/s (22 bit/RDI F [1]) 1.687 MBit/s (20 bit/RDI F)	≤ 2153 (2025 usable for data) [2]	in 22.429 ms
DAB FIC	Mode I,II,IV 80.2 kbit/s (22 bit/RDI F) 72.9 kbit/s (20 Bit/RDI F) Mode III 107.25 kbit/s (22 bit/RDI F) 97.5 kbit/s (20 bit/RDI F)	≤ 358 (350 usable for data) 119 (117 usable)	in 3.738 ms
TII pattern [3]	1 + NRT [4] RDI F	Mode I: 238 Mode II: 61 Mode III: 31 Mode IV: 121	
TII carrier samples	64 RDIF each received transmitter 16 RDIF each received transmitter 16 RDIF each received transmitter 32 RDIF each received transmitter	Mode I: 238 Mode II: 61 Mode III: 31 Mode IV: 121	NCP

NOTES:

(1) An RDI frame (RDIF) carries 24 bit, of which 20 or 22 are useful data (see 2.1).
(2) assuming a protocol overhead of 3 RDI frames per Subchannel/FIB.
(3) assuming evaluation of TII in the receiver (### Main + SubId). NRT = Number of received transmitters
(4) assuming evaluation of best carrier pairs per transmitter in the receiver, communication of FFT result, real and imaginary parts 16 bit each. NRT = Number of received transmitters (typ. max. 5), NCP = Number of carrier pairs (typ. max. 4)

2. RDI frames and Frame types

The RDI is based on RDI frames of 24 bit each (see Fig. 2).

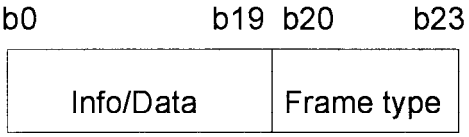

Fig. 2: Structure of an RDI frame

Each RDI frame consists of a frame type field (bits 20 ... 23) and a data field (bits 0 ... 19). The structure of the data field depends on the Frame type field and can borrow two bits (b20 and b21) from the frame type field. The following Frame types are defined:

all modes:

b20 b23
0000 : Padding

high capacity mode:

b20 b23
0001 : Header of MSC/FIC/TII data
0010 : Start and Continuation of MSC/FIC/TII data
0100 : End of MSC/FIC/TII data
0101 : RDI synchronisation
1101 : Header of extended capacity data
XX10 : Extended capacity data field;

The XX' s in the extended capacity data frame type serves as an extension of the data field, and in this way increases the width from 20 to 22 bit, which is enough for all presently discussed data rates.

low capacity mode:

b20 b23
0010 : Continuation of TII data
0100 : End of TII data
0111 : Start of TII data
1111 : window signals & data

The other codes are reserved.

The following table summarizes all above mentioned frame types

b20...23	Frame type	High capacity mode		Low capacity mode
		Extended frame	Normal frame	
0000:	Padding	+	+	+
0001:	Header of MSC/FIC/TII data		+	
0010:	All modes: data	+	+	+
0011:	Reserved			
0100:	End of data	+	+	+
0101:	RDI synchronisation	+	+	
0110:	Extended capacity data	+		
0111:	Start of TII data			+
1000:	Reserved			
1001:	Reserved			
1010:	Extended capacity data	+		
1011:	Reserved			
1100:	Reserved			
1101:	Header of extended capacity data	+		
1110:	Extended capacity data	+		
1111:	Window signals & data			+

3. Embedding of RDI into the IEC 958 interface

3.1 RDI frames and IEC 958 Subframes

RDI frames, (see 2), can be carried in the IEC 958 interface [2] according to Fig. 3.

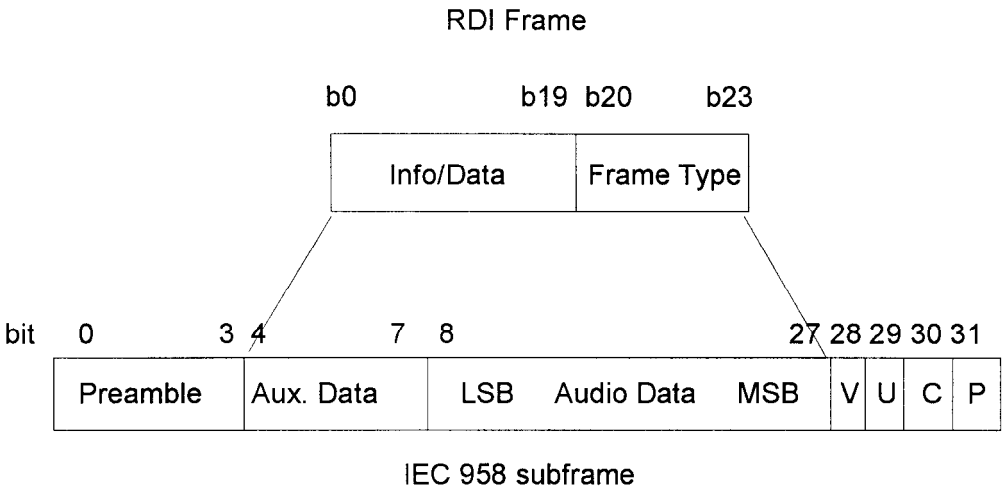

Fig. 3: Embedding RDI frames into IEC 958 subframes

If the RDI is embedded into the IEC 958 structure, the Validity bit (V) shall be set to high in order to protect audio devices from converting RDI data to audio if erroneously connected to an RDI. For the Channel Status data, the consumer format shall be used. Byte 0 bit 1 of the Channel Status data shall be set to "non-audio". "Copyright" shall be asserted (Byte 0 / bit 2 = 0). Byte 0 / bits 3-4-5 shall be set to "000". The bits 6 & 7 of Byte 0 shall be set to Mode 0 (= 00).

The category code 001 for Broadcast reception of digital audio shall be used (Byte 1 / bit 0-1-2 = 001).The generation status bit shall be set to "original" (Byte 1 / bit 7 = 0).

In Byte 2 the source number and channel number shall be "unspecified" (Byte 2 = 00000000).

The sampling frequency shall be 48 kHz (Byte 3 / bit 0-1-2-3 = 0100). The clock accuracy of ±1000 ppm shall be "Level II" (Byte 3 / bit 4-5 = 00).

The following table shows how the first four Bytes of the Channel Status shall be set:

Byte #	b0 .....b7
0	0 1 0 0 0 0 0 0
1*)	0 0 1 0 0 1 0 0
2	0 0 0 0 0 0 0 0
3	0 1 0 0 0 0 0 0

*) see 3.2

NOTE: RDI synchronisation (see 4.2) is not related to the IEC 958 block structure.

NOTE: If the low capacity format (see 5.) is used on an IEC 958 interface, the frames of Type 1111 shall be carried in the "Channel A" subframes and TII, if any, shall be carried in the "Channel B" subframes.

3.2 Proposed Amendments to IEC 958

The proposed amendments refer to the coding of the Channel Status bits, as follows:

An entry "DAB" should be defined in the category "Broadcast reception" (Byte 1 / bits 3-4-5-6, proposal: 0010).

3.3 Programme Associated Data

The IEC 958 user bit channel may be applied to carry Programme Associated Data of the selected Audio Service Component.

NOTE: Details are under discussion. The following protocol elements will be defined:
- bit stream synchronisation
- order of bits and bytes
- header bytes containing length