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Digitalna videoradiodifuzija (DVB) – Vmesniki DVB do omrežij pleziohrone digitalne hierarhije (PDH)

Digital Video Broadcasting (DVB); DVB interfaces to Plesiochronous Digital Hierarchy (PDH) networks

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Foreword

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

NOTE: The EBU/ETSI JTC was established in 1990 to co-ordinate the drafting of standards in the specific field of broadcasting and related fields. Since 1995 the JTC 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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Digital Video Broadcasting (DVB) Project

Founded in September 1993, the DVB Project is a market-led consortium of public and private sector organizations in the television industry. Its aim is to establish the framework for the introduction of MPEG-2 based digital television services. Now comprising over 200 organizations from more than 25 countries around the world, DVB fosters market-led systems, which meet the real needs, and economic circumstances, of the consumer electronics and the broadcast industry.

Transposition dates	
Date of adoption:	21 November 1997
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1 Scope

This European Telecommunication Standard (ETS) specifies the transmission of MPEG-2 Transport Streams (TS) between two DVB interfaces as defined in EN 50083-9 [7] within Plesiochronous Digital Hierarchy (PDH) networks working at the ITU-T Recommendation G.702 [8] hierarchical bit-rates of 1 544 kbit/s, 2 048 kbit/s, 6 312 kbit/s, 8 448 kbit/s, 34 368 kbit/s, 44 736 kbit/s and 139 264 kbit/s. The use of any of these bit rates is optional, if however one or more rates are selected the complete specification applies. The definition of the network aspects of the transmission of MPEG-2-TSs is based to the maximum extent on existing international and European standards.

The equipment considered in this ETS is the Network Adapter performing the adaptation between MPEG-2-TSs and the interfaces of PDH networks.

2 Normative references

This ETS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate 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] ETS 300 417-1-1: "Transmission and Multiplexing (TM); generic functional requirements for Synchronous Digital Hierarchy (SDH) equipment; Part 1: Generic processes and performance".

[2] ETS 300 417-2-1: "Transmission and Multiplexing (TM); generic requirements of transport functionality of equipment; Part 2-1: SDH and PDH physical section layer functions".

[3] prETS 300 417-5-1: "Transmission and Multiplexing (TM); generic requirements of transport functionality of equipment; Part 5-1: Plesiochronous Digital Hierarchy (PDH) path layer functions".

[4] EN 300 421: "Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for 11/12 GHz satellite services".

[5] EN 300 429: "Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for cable systems".

[6] ETR 290: "Digital Video Broadcasting (DVB); Measurement guidelines for DVB systems".

[7] EN 50083-9: "Interfaces for CATV/SMATV headends and similar professional equipment".

[8] ITU-T Recommendation G.702: "Digital hierarchy bit rates".

[9] ITU-T Recommendation G.703: "Physical/electrical characteristics of hierarchical digital interfaces".

[10] ITU-T Recommendation G.704: "Synchronous frame structures used at 1544, 6312, 2048, 8 488 and 44 736 kbit/s hierarchical levels".

[11] ITU-T Recommendation G.706: "Frame alignment and caclic redundancy check (CRC) procedures relating to basic frame structures defined in ITU-T Recommendation G.704".

[12] ITU-T Recommendation G.707: "Network node interface for the synchronous digital hierarchy".

[13] ITU-T Recommendation G.783: "Characteristics of Synchronous Digital Hierarchy (SDH) equipment functional blocks".

[14] ITU-T Recommendation G.804: "ATM cell mapping into plesiochronous digital hierarchy (PDH)".

[15] ITU-T Recommendation G.823: "The control of jitter and wander within digital networks which are based on the 2 048 kbit/s hierarchy".

[16] ITU-T Recommendation G.824: "The control of jitter and wander within digital networks which are based on the 1 544 kbit/s hierarchy".

[17] ITU-T Recommendation G.826: "Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate".

[18] ITU-T Recommendation G.832: "Transport of SDH elements on PDH networks: Frame and multiplexing structure".

[19] ITU-T Recommendation H.222.0: "Information technology - Generic coding of moving pictures and associated audio information: Systems".

[20] ITU-T Recommendation I.361: "B-ISDN ATM layer specification".

[21] ITU-T Recommendation I.363.1: "B-ISDN ATM adaptation layer (AAL) specification".

[22] ITU-T Recommendation I.432: "B-ISDN user-network interface - physical layer specification".

[23] ITU-T Recommendation I.732: "Functional characteristics of ATM equipment".

[24] ITU-T Recommendation J.82: "Transport of MPEG-2 constant bit rate television signals in B-ISDN".

[25] ITU-T Recommendation M.2120: "Digital paths, section and transmission system fault detection and localization procedures".

[26] ITU-T Recommendation Q.822: "Stage 1, stage 2 and stage 3 description for the Q3 interface - performance management".

3 Definitions and abbreviations

3.1 Definitions

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

MPEG-2 Transport Stream (TS) packet: A data packet possessing a length of 188 bytes including 4 bytes of header information. The header contains MPEG related data.

RS coded MPEG-2 Transport Stream (TS) packet: A data packet possessing a length of 204 bytes. Bytes 1 to 188 contain an MPEG-2-TS packet. Bytes 189 to 204 contain the parity-check bytes for the error correction of the preceding bytes of this packet. These parity-check bytes are generated using a shortened Reed-Solomon code RS(204,188).

3.2 Abbreviations

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

AAL	ATM Adaptation Layer
ASI	Asynchronous Serial Interface
ATM	Asynchronous Transfer Mode
BER	Bit Error Rate
CRC	Cyclic Redundancy Check
CS	Convergence Sublayer
DVB	Digital Video Broadcasting

EMF	Equipment Management Function
FAS	Frame Alignment Signal
FEC	Forward Error Correction
LOF	Loss Of Frame
OAM	Operation Administration and Maintenance
MAA	MPEG ATM Adaptation
MMI	Man Machine Interface
MPEG	Motion Picture Expert Group
MPI	MPEG Physical Interface
NE	Network Element
PDH	Plesiochronous Digital Hierarchy
PDU	Protocol Data Unit
PPI	PDH Physical Interface
PPT	PDH Path Termination
RDI	Remote Defect Indication
RS	Reed-Solomon
SAR	Segmentation And Re-assembly Sublayer
SDH	Synchronous Digital Hierarchy
SN	Sequence Number
SPI	Synchronous Parallel Interface
SSI	Synchronous Serial Interface
TS	Transport Stream
VP	Virtual Path
VPE	VP Entity
VPME	VP Multiplexing Entity

4 Baseline specification

The Network Adapter is an equipment which performs the adaptation of data structured as an MPEG-2-TS to the characteristics of a PDH link (see ITU-T Recommendation H.222.0 [19]). The solution selected for the transmission of MPEG-2-TS packets, respectively RS coded MPEG-2-TS packets, over PDH links is based on the use of ATM cells. Therefore, the adaptation of the transport of an MPEG-2-TS basically consists in:

- adaptation of MPEG-2-TS packets or RS coded MPEG-2-TS packets to ATM cells;
- adaptation of ATM cells to PDH framing.

The normative references applicable to the adaptation unless specifically mentioned are given here below:

- the adaptation of MPEG-2-TS packets into ATM cells using an AAL type 1 shall be performed as described in ITU-T Recommendation J.82 [24].
  AAL type 1 is specified in ITU-T Recommendation I.363.1 [21], the ATM layer is specified in ITU-T Recommendation I.361 [20];
- the adaptation of ATM cells into PDH framing shall be performed as described in ITU-T Recommendation G.804 [14].

There is no normative reference for the adaptation of RS coded MPEG-2-TS packets to ATM cells. This adaptation shall be performed as described in ITU-T Recommendation J.82 [24] for MPEG-2-TS packets, with the only exception that the RS coded MPEG-2-TS packets are not aligned with the structure of the AAL1 interleaving matrix.

The Network Adapter is described as a group of functional blocks. The partitioning into functional blocks is based on existing recommendations on Synchronous Digital Hierarchy (SDH) equipment (ITU-T Recommendation G.783 [13]) and ATM equipment (ITU-T Recommendation I.732 [23]). The equipment consists of the following blocks (see also figure 1):

- MPEG Physical Interface;
- MPEG/ATM Adaptation;
- ATM/VP Termination;
- VP Multiplexing Entity;

- PDH Path Termination;
- PDH Physical Interface; and
- Equipment Management Function.

The present description is a functional description and does not imply any specific equipment implementation but it allows for the implementation of a separate transmitter and receiver as well as a combined transmitter/receiver.

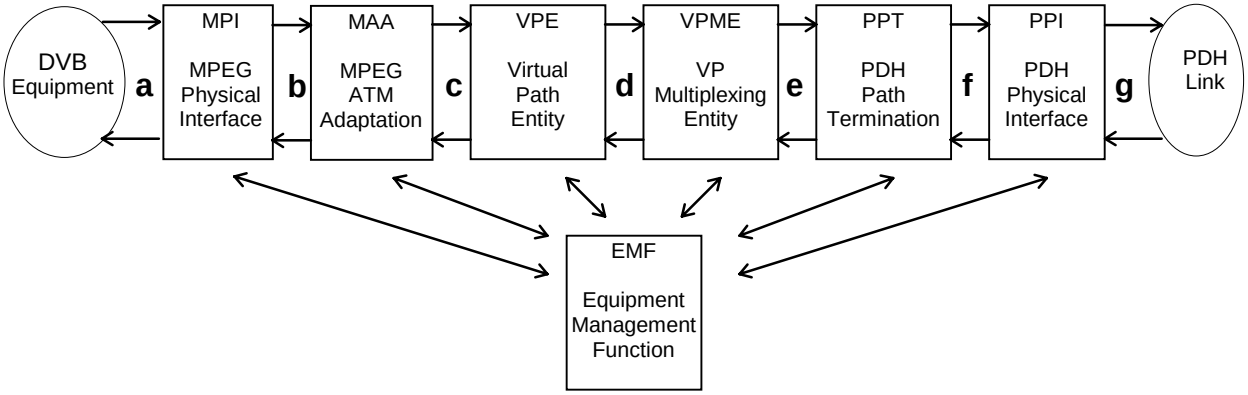

Figure 1: Functional blocks of the Network Adapter

It should be noticed that most of ATM functional blocks contained in ITU-T Recommendation I.732 [23] do not appear in figure 1 as they are not relevant for the adaptation.

This adaptation corresponds to the protocol stack shown in figure 2:

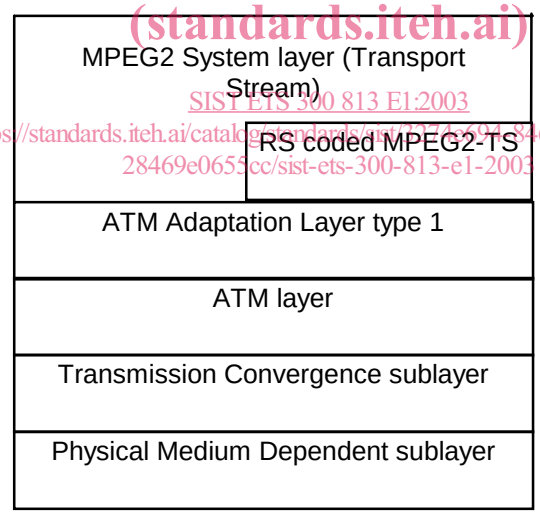

Figure 2: Protocol stack for the adaptation process

The following functional blocks are identified:

- the MPEG-2-TS Physical Interface:

  the Network Adapter accepts, at its input port, either an MPEG-2-TS consisting of consecutive MPEG-2-TS packets, or an extended version of an MPEG-2-TS that already contains error protection (RS coded MPEG-2-TS packets). Packets length of 188 bytes and 204 bytes can be handled;

- the MPEG/ATM Adaptation:

  this corresponds to the adaptation between the MPEG-2-TS respectively the RS coded MPEG-2-TS and the ATM cells via an AAL type 1. This adaptation, besides format adaptation, provides functions for the MPEG-2-TS clock transmission transparency (adaptive

clock method) and information transparency using the clock and data recovery mechanism of AAL1. It is expected that under normal transmission conditions the received MPEG-2-TS will be quasi error free, corresponding to a Bit Error Rate (BER) of about 10^{-10} to 10^{-11} at the input of an MPEG-2 equipment at the receiver site. This requirement is in accordance with DVB systems using satellite services EN 300 421 [4] and cable systems EN 300 429 [5];

- the ATM Virtual Path (VP) Termination:

  the only function performed is the VP setting. It allows the simultaneous transmission of several independent MPEG-2-TS on one PDH link;

- the VP Multiplexing Entity:

  if different MPEG-2-TS have to be simultaneously transported, the ATM cells belonging to different VPs are multiplexed in the transmitter respectively demultiplexed in the receiver. If only one MPEG-2-TS has to be transported, only one VP is used. The adaptation to the useful bit-rate offered by the PDH link is performed by adding respectively removing idle cells. At the receiver, this block also performs cell delineation and ATM cell header checking;

- the PDH Path Termination:

  this block generates and terminates all the overhead of the PDH frames carrying ATM cells. The overhead contains information providing Operation Administration and Maintenance (OAM) functions;

- the PDH Physical Interface:

  this block prepares the signal for the transmission on the physical medium. Channel encoding is used as described in ITU-T Recommendation G.703 [9] that allows a network clock recovery directly from the received signal;

- the Equipment Management Function:

  this block manages all the other functional blocks. It ensures the Man Machine Interface (MMI).

4.1 MPEG Physical Interface (MPI)

This function provides the interface between the Network Adapter and the MPEG-2-TS sources or receivers. The physical characteristics of this interface shall follow the specification given in EN 50083-9 [7]. Three different types of interfaces are specified. They are called:

- Synchronous Parallel Interface (SPI);
- Synchronous Serial Interface (SSI);
- Asynchronous Serial Interface (ASI).

The interfaces use the MPEG-2-TS Packet structure (188 bytes) or the RS-coded packet structure (204 bytes). For the SPI and the SSI, the 204-byte format may be used either for the transmission of 188-byte MPEG-2-TS packets with 16 dummy bytes, or for the transmission of 204-byte RS-coded packets.

In order to prevent alarms being raised and failures being reported during set-up procedures or if the input port is not in use (in the case of a multi-port equipment), the MPI function shall have the ability to enable or disable fault case declaration. The MPI shall be either monitored (MON) or not monitored (NMON). The state MON or NMON is provisioned by the equipment manager to the MPI via the EMF function.

4.1.1 Signal processing in the transmitter

Signal flow from a-to-b (see figure 1).

a) Recovery of MPEG-2 packets

This function recovers the data bytes and their clock from the received signals:

- for the SPI, this recovery is based on the use of the Data (0-7), the DVALID, PSYNC and clock signals, as specified in subclause 4.1 of EN 50083-9 [7];

- for the SSI interface, the processing includes optical receiver (for fibre-optic-based link) or coupling/impedance matching (for coaxial cable), amplifier/buffer, clock recovery and bi-phase decoding, serial to parallel conversion, as specified in annex A of EN 50083-9 [7];

- for the ASI interface, the processing includes optical receiver (for fibre-optic-based link) or coupling/impedance matching (for coaxial cable), amplifier/buffer, clock/data recovery and serial-to-parallel conversion, FC comma deletion, 8B/10B decoding, as specified in annex B of EN 50083-9 [7]. In the next step, the recovery of the TS clock is performed (see annex E of EN 50083-9 [7] on Implementation guidelines and deriving clocks from the MPEG-2 packets for the ASI).

The function also realizes the sync acquisition of the MPEG-2-TS packets respectively of the RS-coded MPEG-2-TS packets, on the basis of the method proposed in subclause 3.2 of ETR 290 [6] (five consecutive correct sync bytes for sync acquisition; two or more consecutive corrupted sync bytes should indicate sync loss).

The packet size (188 bytes or 204 bytes) may be recovered from the received signals, on the basis of the PSYNC signal for the parallel interface, or on the basis of periodicity of the synchronization bytes for the serial interfaces. For the case of the SPI and of the SSI interface, the decision between 204-byte format for MPEG-2-TS packets with 16 dummy bytes and 204-byte format for RS-coded MPEG-2-TS packets can be made:

- on the basis of the DVALID signal for the SPI: a high level during the last 16 bytes indicate RS redundancy bytes (see subclause 4.1.1 of EN 50083-9 [7]); or

- on the basis of the value of received synchronization bytes for the SSI interface: 47H indicates 204-byte format with 16 dummy bytes and B8H indicates 204-byte RS coded (see subclause A.3.2 of EN 50083-9 [7]).

For the case of the ASI Interface, the following decision is taken: if the packet size is 204 bytes, it is an RS-coded MPEG-2-TS packet.

Dummy bytes are discarded by the MPI function in the case of the 204-byte format with 16 dummy bytes.

The function passes the recovered MPEG-2-TS packets or the RS coded MPEG-2-TS packets and the timing information to point b of figure 1.

The function shall meet the electrical/optical characteristics, return loss and jitter requirements specified in EN 50083-9 [7].

This function shall also detect:

- the absence of valid input signals;
- the absence of clock;
- a DVALID signal constantly low in the case of the SPI.

If any of these defects is detected, a Loss Of Signal (LOS) is reported at the EMF if the function is in MON state.

If a loss of synchronization of MPEG-2-TS packets or RS coded MPEG-2-TS packets is detected according to the procedure proposed in ETR 290 [6] subclause 3.2 (i.e. two or more consecutive corrupted sync bytes are found), a TS-sync_loss error on the input signal (TSLE_I) is reported at the EMF if the function is in MON state.

b) Performance monitoring

Errored blocks are detected on the basis of the transport_error_indicator present in the headers of the incoming MPEG-2-TS packets, in accordance to ETR 290 [6]. One second filters perform a simple integration of errored blocks by counting during one second interval. The function generates the following performance parameters concerning the input MPEG-2-TS signal received on the interface:

- N_EBC_I: every second, the number of errored blocks within that second is counted as the Near-End Error Block Count (N_EBC_I);

- N_DS_I: every second with at least one occurrence of TSLE_I or LOS (corresponding to the notion of Severely Disturbed Period introduced in ETR 290 [6]) shall be indicated as Near-End Defect Second (N_DS_I).

If the function is in the MON state, at the end of each one second interval, the contents of the N_EBC_I counter and of the N_DS_I indicator are reported to the EMF. Furthermore, on request of the EMF block, the MPI block evaluates and reports to the EMF the number of received MPEG-2-TS packets within one second (BC_I).

4.1.2 Signal processing in the receiver

Signal flow from b-to-a (see figure 1).

a) Generation of the signals at the MPEG physical interface

This function receives the data bytes provided at the reference point b of figure 1 by the MAA block and recovers the synchronization of the MPEG-2-TS packets or of the RS coded MPEG-2-TS packets on the basis of the method proposed in subclause 3.2 of ETR 290 [6] (five consecutive correct sync bytes for sync acquisition; two or more consecutive corrupted sync bytes should indicate sync loss). The type of packet (MPEG-2-TS packet or RS-coded MPEG-2-TS packet) is determined on the basis of the periodicity of the synchronization bytes. After the recovery of the packet structure and only in the case of a MPEG-2-TS packet structure, the function shall use the status indicator of the AAL-SAP (available at reference point b) to set the transport_error_indicator of the MPEG-2-TS packets.

The function determines the transmission format to be used at the output interface according to the following table 1:

Table 1: Transmission format of the output interface

Type of packets received by the MPI block	Transmission format on the physical interface	
MPEG-2-TS packets (188 bytes)	SPI; SSI:	188-byte packets or 204-byte packets with 16 dummy bytes, according to the parameter FORMAT provided by the EMF block
	ASI:	188-byte packets
RS-coded MPEG-2-TS packets (204 bytes)	SPI; SSI; ASI:	204-byte packets

The function generates the appropriate signals at the output interface, according to the type of physical interface and to the transmission format selected:

- For the SPI, the function generates the data (0-7), the DVALID, PSYNC and clock signals, as specified in subclause 4.1 of EN 50083-9 [7];

- For the SSI interface, the processing includes parallel to serial conversion, bi-phase coding, amplifier/buffer and optical emitter (for fibre-optic-based link) or coupling/impedance matching (for coaxial cable), as specified in annex A of EN 50083-9 [7];