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Cable networks for television signals, sound signals and interactive services - Part 9: Interfaces for CATV/SMATV headends and similar professional equipment for DVB/MPEG-2 transport streams

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Kabelnetze für Fernsehsignale, Tonsignale und interaktive Dienste -- Teil 9: Schnittstellen für CATV-/SMATV-Kopfstellen und vergleichbare professionelle Geräte für DVB/MPEG-2-Transportströme

Réseaux de distribution par câbles pour signaux de télévision, signaux de radiodiffusion sonore et services interactifs -- Partie 9: Interfaces pour les têtes de résaux pour antennes communautaires, antennes collectives par satellite et matériels professionnels analogues pour les flux transport DVB/MPEG-2

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English version

Cable networks for television signals, sound signals and interactive services Part 9: Interfaces for CATV/SMATV headends and similar professional equipment for DVB/MPEG-2 transport streams

Réseaux de distribution par câbles destinés aux signaux de radiodiffusion sonore, de télévision et aux services interactifs
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This European Standard was approved by CENELEC on 2002-07-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

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Foreword

This European Standard was prepared by CENELEC Technical Committee TC 209, "Cable networks for television signals, sound signals and interactive services" on the basis of EN 50083-9:1998 and a draft amendment to which was submitted to the Unique Acceptance Procedure.

The amendment was approved by CENELEC on 2002-07-01 to be published as part of a third edition of EN 50083-9.

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)	2003-07-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2005-07-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annexes A and B are normative and annexes C, D, E, F and G are informative.

Contents

Figures

Tables

1 Scope

1.1 General

Standards of EN 50083 series deal with cable networks for television signals, sound signals and interactive services including equipment, systems and installations

- for headend reception, processing and distribution of television and sound signals and their associated data signals and
- for processing, interfacing and transmitting all kinds of signals for interactive services

using all applicable transmission media.

All kinds of networks like

- CATV-networks,
- MATV-networks and SMATV-networks,
- Individual receiving networks

and all kinds of equipment, systems and installations installed in such networks, are within this scope.

The extent of this standardization work is from the antennas, special signal source inputs to the headend or other interface points to the network up to the system outlet or the terminal input, where no system outlet exists.

The standardization of any user terminals (i.e. tuners, receivers, decoders, multimedia terminals etc.) as well as of any coaxial and optical cables and accessories therefor is excluded.

1.2 Specific scope of this part 9

This standard describes physical interfaces for the interconnection of signal processing devices for professional CATV/SMATV headend equipment or for similar systems, such as in uplink stations. Especially this document specifies the transfer of DVB/MPEG-2 data signals in the standardized transport layer format between devices of different signal processing functions.

RF interfaces and interfaces to telecom networks are not covered in this document.

In addition references are made to all other parts of EN 50083 series (Cable networks for television signals, sound signals and interactive services) and in particular for RF, video and audio interfaces to part 5: "Headend equipment“.

For connections to telecom networks a special Data Communication Equipment (DCE) is necessary to adapt the serial or parallel interfaces specified in this document to the bitrates and transmission formats of the public Plesiochronic Digital Hierarchy (PDH) networks. Other emerging technologies such as Connectionless Broadband Data Services (CBDS), Synchronous Digital Hierarchy (SDH), Asynchronous Transfer Mode (ATM) etc. can be used for transmitting MPEG-2 Transport Streams (TS) between remote locations. ATM is particularly suitable for providing bandwidth on demand and it allows for high data rates.

2 Normative references

This European Standard incorporates by dated or 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 European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 50083		Cable networks for television signals, sound signals and interactive services
EN 50083-1 + A1 + A2	1993 1997 1997	Part 1: Safety requirements
EN 50083-2	2001	Part 2: Electromagnetic compatibility for equipment
EN 50083-3	2002	Part 3: Active wideband equipment for coaxial cable networks
EN 50083-4	1998	Part 4: Passive wideband equipment for coaxial cable networks
EN 50083-5	2001	Part 5: Headend equipment
EN 50083-6	1997	Part 6: Optical equipment
EN 50083-7 + A1	1996 2000	Part 7: System performance
EN 50083-8	2002	Part 8: Electromagnetic compatibility for networks
EN 60793-2-10	2002	Optical fibres - Part 2-10: Product specifications - Sectional specification for category A1 multimode fibres (IEC 60793-2-10:2002)
EN 60793-2-50	2002	Optical fibres - Part 2-50: Product specifications - Sectional specification for class B single-mode fibres (IEC 60793-2-50:2002)
EN ISO/IEC 13818-1	1997	Information technology - Generic coding of moving pictures and associated audio information - Part 1: Systems (ISO/IEC 13818-1:1996)
EN ISO/IEC 13818-9	2000	Information technology - Generic coding of moving pictures and associated audio information - Part 9: Extension for real-time interface for systems decoders (ISO/IEC 13818-9:1996)
EN 300 421	1997	Digital Video Broadcasting (DVB) - Framing structure, channel coding and modulation for 11/12 GHz satellite services
EN 300 429	1997	Digital Video Broadcasting (DVB) - Framing structure, channel coding and modulation for cable systems

EN 300 473	1997	Digital Video Broadcasting (DVB) - Satellite Master Antenna Television (SMATV) distribution systems
ETR 290	1997	Digital Video Broadcasting (DVB) - Measurement guidelines for DVB systems
IEC 60169-8	1978	Radio frequency connectors - Part 8: RF coaxial connectors with inner diameter of outer conductor 6,5 mm (0,25 in) with bayonet lock - Characteristic impedance 50 Ω (type BNC)
IEC 60793-2	series	Optical fibres - Part 2: Product specifications
IEC 60874-14	1993	Connectors for optical fibres and cables - Part 14: Sectional specification for fibre-optic connector - Type SC
ISO 2110	1989	Information technology - Data communication, 25 pole DTE/DCE interface connector and contact number assignments
ISO/IEC 14165-111	[1]	Information technology - Fibre Channel - Part 111: Physical and signalling interface (FC-PH)
ITU-R Rec. BT.656-4	1998	Interfaces for digital component video signals in 525-line and 625-line television systems operating at the 4:2:2 level of recommendation ITU-R BT.601
ITU-T Rec. G.654	2002	Characteristics of cut-off shifted single-mode optical fibre and cable
ITU-T Rec. G.703	2001	Physical/electrical characteristics of hierarchical digital interfaces
ITU-T Rec. G.957	1999	Optical interfaces for equipments and systems relating to the synchronous digital hierarchy

3 Terms, definitions and abbreviations

3.1 Terms and definitions

3.1.1
headend
equipment which is connected between receiving antennas or other signal sources and the remainder of the cable distribution system to process the signals to be distributed

NOTE The headend may, for example, comprise antenna amplifiers, frequency converters, combiners, selectors and generators.

3.1.2
Satellite Master Antenna Television system (SMATV)
a system which is designed to provide sound and television signals to the households of a building or group of buildings

[1] In preparation

NOTE Two system configurations are defined in EN 300 473 as follows:

- SMATV system A, based on transparent transmodulation of QPSK satellite signals into QAM signals to be distributed to the user
- SMATV system B, based on direct distribution of QPSK signals to the user, with two options:
  - SMATV-IF distribution in the satellite IF band (above 950 MHz)
  - SMATV-S distribution in the VHF/UHF band, for example in the extended S-band (230-470 MHz)

3.1.3
Biphase Mark
a line code which ensures DC balance, easy clock recovery and polarity freedom

3.1.4
Transport Stream
includes one or more programs with one or more independent time bases into a single stream. The Transport Stream is designed for use in environments where errors are likely, such as storage or transmission in lossy or noisy media.

3.1.5
Transport Packet
a packetized element of the Transport Stream. The packets are either 188 bytes or in case of using Reed Solomon FEC 204 byte in length

3.1.6
DVALID
a signal which indicates in the 204 byte mode of a Transport Stream that the empty space is filled with dummy bytes

3.1.7
PSYNC
A flag which indicates the beginning of a packet

3.2 Abbreviations

8B/10B	eight to ten bit conversion
ACCP	Accumulated Phase
ACCT	Accumulated Time
ASI	Asynchronous Serial Interface
ASI-C	Asynchronous Serial Interface on coacial cable
ASI-O	Asynchronous Serial Interface on opticaL fiber
ATM	Asynchronous Transfer Mode
BER	Bit Error Rate
CBDS	Connectionless Broadband Data Services
DFB	Distributed Feedback
DJ	Deterministic Jitter
DVALID	data valid
DVB	Digital Video Broadcast
FC	FIBRE Channel
FEC	Forward Error Correction
FIFO	First In First Out
FWHM	Full Width Half Max
IEC	International Electrotechnical Commission
ISO	International Standards Organisation
ITU-R	International Telecommunication Union Radiocommunication
ITU-T	International Telecommunication Union Telecommunication
LF	Low Frequency

LVDS	Low Voltage Differential Signalling
MPEG	Motion Picture Experts Group
MSB	Most Significant Bit
NA	not applicable
NRZ	Non-Return-to-Zero
NTSC	National Television System Committee
PAL	Phase Alternation Line
PCR	Program Clock Reference
PDH	Plesiosynchronic Digital Hierarchy
PLL	Phase Lock Loop
PMD	Physical Medium Dependent
PSYNC	Packet Synchron
QAM	Quadrature Amplitude Modulation
QPSK	Quarternary Phase Shift Keying
RB	Receiver Buffer
RD	Running Disparity
RIN	Relative Intrinsic Noise
RJ	Random Jitter
RS	Reed Solomon
rx-clk	receiver clock
SDH	Synchronous Digital Hierarchy
SMPT	Society of Motion Picture and Television Engineers
SPI	Synchronous Parallel Interface
SSI	Synchronous Serial Interface
SSI-C	Synchronous Serial Interface on coacial cable
SSI-O	Synchronous Serial Interface on optical fiber
TB	Transmission Buffer
Tr	rise-time
TS	Transport Stream
tx-clk	transmission clock
UNC	Unified National Coarse Thread

NOTE Only the abbreviations used in the English version of this part of EN 50083 are mentioned in this subclause. The German and the French versions of this part may use other abbreviations. Refer to 3.2 of each language version for details.

4 Interfaces for MPEG-2 data signals

4.1 Introduction

This subclause describes possible interfaces for devices transmitting or receiving MPEG-2 data as transport packets, such as QPSK demodulators, QAM modulators, multiplexers, demultiplexers, or telecom network adapters.

This specification is similar to EN 300 429 and EN 300 421.

NOTE Both standards describe a first functional block representing the MPEG2 source coding and multiplexing as standardised in EN ISO/IEC 13818-1, a second functional block representing the channel adaptation, whereas an interface in between shall be based on MPEG2 transport stream specification as per EN ISO/IEC 13818-1.

The function of the channel modulator/demodulator is to adapt the signal to the characteristics of the transmission channel: satellite, terrestrial or cable as specified in the DVB base line documents.

Also the case where data signals are transmitted to or from a headend via a telecom network or if a headend serves to insert data signals into such networks is considered to be covered by the generic channel modulator / demodulator functional block. The interface parameters valid for this network have to be met. For the latter reference is made to ITU-T G.703 for Plesiochronic Digital Hierarchy (PDH) networks.

4.1.1 Application requirements

In order to avoid any unnecessary processing at transmitting or receiving station of an interface in certain applications, it is considered an application requirement that the interface supports 204 byte packet length in such cases, in addition to or instead of the 188 packet lengthas specified in EN ISO/IEC 13818-1. These two cases are identified in the protocol diagrams of Figures 1 and 2 where also the scope of this specification is delineated. The relevant associated packet structures are illustrated in Figures 3 and 4.

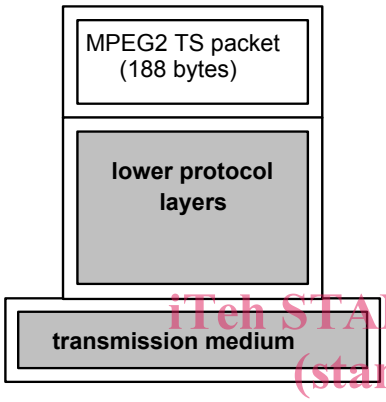

Figure 1 - Protocol stack for 188 byte packets

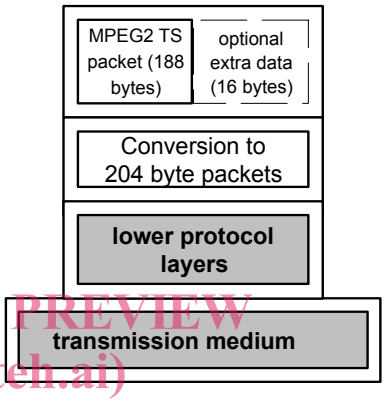

Figure 2 - Protocol stack for 204 byte packets

NOTE Shaded areas identify the scope of this standard

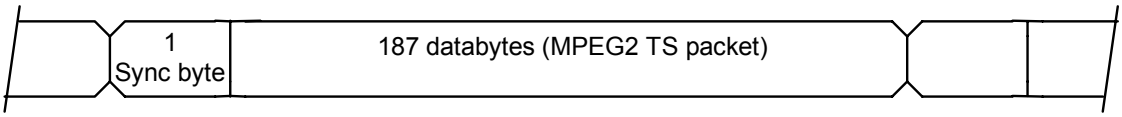

Figure 3 - Packet structure of 188 byte packet

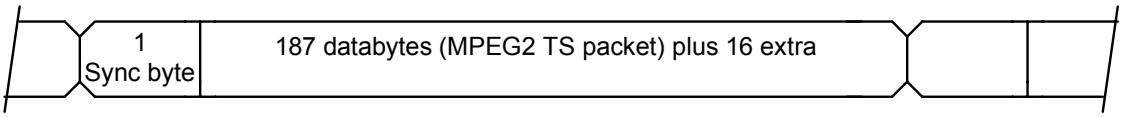

Figure 4 - Packet structure of 204 byte packet

4.1.2 Interfaces

Three interfaces and two serial transmission media are specified as follows:

- SPI (Synchronous Parallel Interface);
- SSI-C (Synchronous Serial Interface on coaxial cable);
- SSI-O (Synchronous Serial Interface on optical fibre);
- ASI-C (Asynchronous Serial Interface on coaxial cable);
- ASI-O (Asynchronous Serial Interface on optical fibre).

Each of these interfaces feature a BER such that FEC is not required for reliable data transport.

The synchronous parallel interface is specified to cover short or medium distances, i.e. for devices arranged near to each other. Subclause 4.2 describes the definitions for such a parallel interface derived from ITU-R Recommendation BT.656-4. Flags are provided to distinguish 188 byte packets from 204 byte packets, and to signal the existence of valid RS bytes. Note that the interface as such is transparent to the RS bytes.

The synchronous serial interface (SSI) which can be seen as an extension of the parallel interface, is briefly introduced in subclause 4.3 and described in detail in annexes A and D. The packet length and the existence of valid RS bytes are conveyed through suitable coding mechanisms.

Subclause 4.4 introduces the Asynchronous Serial Interface (ASI). Details of the ASI are provided in annexes B and E. The ASI is configurable to either convey 188 byte packets (which is mandatory) or optionally 204 byte packets.

4.1.3 Packet length and contents

Each of the interface specifications can be used to convey either 188 byte packets or 204 byte packets in order to enable selection of the appropriate interface characteristics dependent on the kind of equipment to be interconnected. Which packet sizes are mandatory and which are optional is specified in Table 1.

Table 1 - Mandatory and optional packet lengths

Interface		Data packet carrying capability		
		188 bytes	204 bytes (with 16 dummy bytes)	204 bytes (with 16 RS bytes)
SPI	transmitter	O	M	O
	receiver	M	M	M
SSI	transmitter	O	M	O
	receiver	M	M	M
ASI	transmitter	M	O	O
	receiver	M	O	O
M mandatory O optional				

In case the data stream is packetised in 188 byte packets and the interface is configured to convey 204 byte packets, the extra packet length can be used for additional data. The contents of the 16 bytes in this extra packet length are not specified in this standard. One application could be the transmission of 16 RS bytes associated with the preceding transport package.

4.1.4 Compliance

For an equipment to be compliant to this standard it is sufficient for the equipment to show at least one instance of at least one of the interface specifications as introduced in 4.1.2 and specified in detail in subsequent subclauses of this standard, while at least the mandatory packet sizes as indicated in 4.1.3 shall be supported.

4.1.5 System integration

The interfaces specified in this standard define physical connections between various pieces of equipment. It is important to notice that various parameters which are important for interoperation are not specified in this standard. This is intentional as it leaves maximum implementation flexibility for different applications. In order to facilitate system integration equipment suppliers shall provide the following information about the characteristics of the interfaces in their equipment:

- Interface type (SPI, SSI-C, SSI-O, ASI-C, ASI-O);
- Supported packet length (188 bytes, 204 bytes, both);
- Maximum input jitter (jitter measured as specified in EN ISO/IEC 13818-9);
- Output jitter (jitter measured as specified in EN ISO/IEC 13818-9);
- Minimum input data rate (rate measured as specified in EN ISO/IEC 13818-1);
- Maximum input data rate (rate measured as specified in EN ISO/IEC 13818-1).

Some of these parameters may not be applicable to certain types of equipment. If all relevant parameters are provided by equipment suppliers, the proper functioning of the complete system can be ensured.

4.2 Synchronous parallel interface (SPI)

This subclause describes an interface for a system for parallel transmission of variable data rates. The data transfer is synchronized to the byte clock of the data stream, which is the MPEG Transport Stream. Transmission links use LVDS technology, (for details concerning LVDS, see [2]) and 25 pin connections.

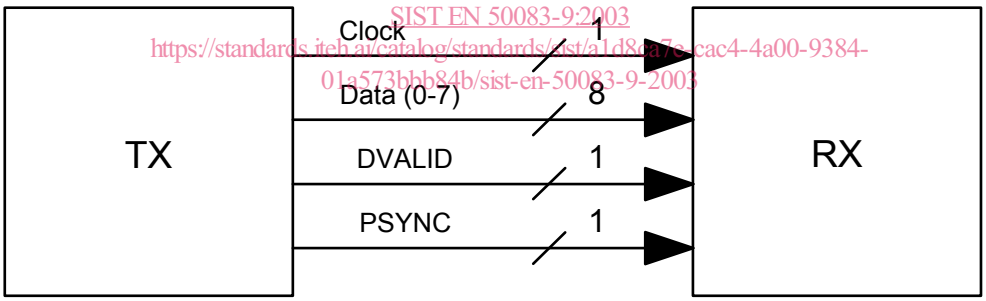

Figure 5 - System for parallel transmission

The data to be transmitted are MPEG-2 Transport Packets with 188 or 204 bytes. In the case of the 204 byte packet format packets may contain a 16 bytes "empty space", a DVALID Signal serves to identify these dummy bytes. A PSYNC flag labels the beginning of a packet. The data are synchronized to the clock depending on the transmission rate.

Equipment which implements the parallel interface shall support the three transmission formats as shown in Figures 6, 7 and 8.

4.2.1 Signal format

The clock, data, and synchronization signals shall be transmitted in parallel: 8 data bits together with one (MPEG-2) PSYUNC singal and a DVALID signal which indicates in the 204 byte mode that the empty space is filled with dummy bytes. All signals are synchronous to the clock signal. The signals are coded in NRZ form.

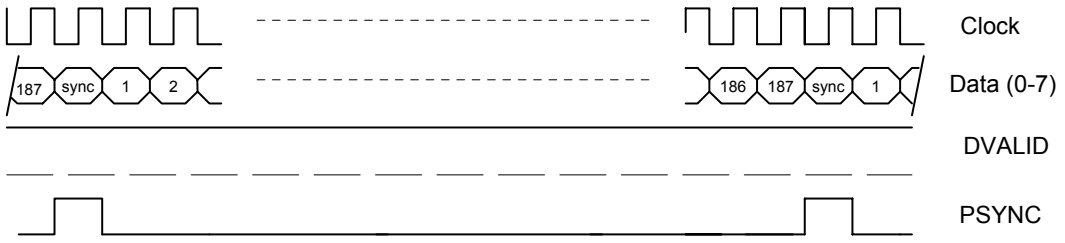

Figure 6 - Transmission format with 188 byte packets

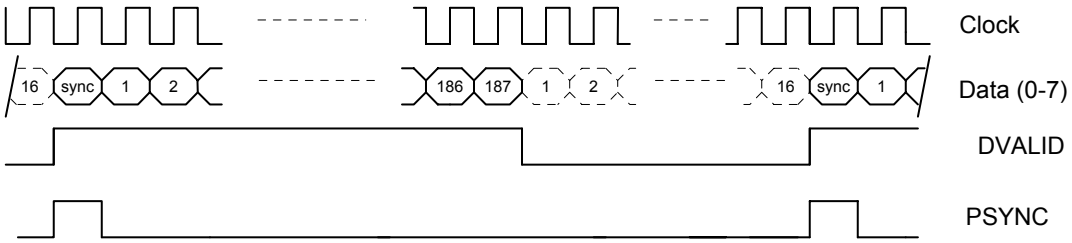

Figure 7 - Transmission format with 204 byte packets (188 data bytes and 16 dummy bytes)

Figure 8 - Transmission format with RS-coded packets (204 bytes; 188 data bytes and 16 valid extra bytes) as specified in EN 300 421

Data (0-7): Transport packet data word (8 bit: Data 0 to Data 7). Data 7 is the Most Significant Bit (MSB).

DVALID: active logic "1". Indicates valid data at the interface. It is constantly high in the 188 byte mode. In the 204 byte mode a low logical state indicates not to check the extra (dummy) bytes.

PSYNC: active logic "1". Indicates the beginning of a Transport Packet by signalling the sync byte.