



Representación y Codificación de Señales Audiovisuales en Televisión Digital Introducción a los estándares MPEG

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Introduction: MPEG Standardisation Group



Moving Picture Experts Group

(created in 1988)

ISO/IEC JTC 1/SC 29/ WG 11

Int. Standards Organization/Int. Electrotechnical Commission

Development of standards for the coded representation of
moving pictures and associated audio

MPEG-1 MPEG-2 MPEG-4 MPEG-7 MPEG-21 MPEG-X

Introduction: Mission (Terms of Reference)

Informal Title

Moving Picture Experts Group (MPEG)

Formal Title

Coding of Moving Pictures and Audio

Area of work

Development of international standards for compression, decompression, processing, and coded representation of moving pictures, audio, and their combination, in order to satisfy a wide variety of applications.

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The MPEG Family

- MPEG-1 - Error free environments
- MPEG-2 - Broadcast TV (SD and HD)
- MPEG-4 - Object based coding
- MPEG-7 - Multimedia description
- MPEG-21 - Seven element initiative for multimedia deployment

- *MPEG-A – Combining parts for applications design*
- *MPEG-B – Binary Format for XML, Fragment Request Unit*
- *MPEG-C – Fixed point DCT/IDCT, Auxiliary Video Data Representation*
- *MPEG-D – MPEG-Surround*
- *MPEG-E – Multimedia Middleware*

The MPEG Family: MPEG-1

MPEG-1: ISO/IEC 11172 (1992)

- Coding of moving pictures and associated audio for digital storage media at around 1.5 Mbit/s
- For digital storage media (CD-ROM)

The MPEG Family: MPEG-2

MPEG-2: ISO/IEC 13818 (1994)

- Generic coding of moving pictures and associated audio information
- Transmission and storage of coding moving pictures and associated audio with contribution and distribution (broadcast) quality for Digital Television (3 ~ 15 Mbit/s)
- More complex and flexible than MPEG-1
 - Different formats of video input (4:2:0, 4:2:2 – progressive, interlaced).
 - More flexibility for determining movement vectors at MBs level.
 - Scalability
- Some minor extensions underway

The MPEG Family: MPEG-4

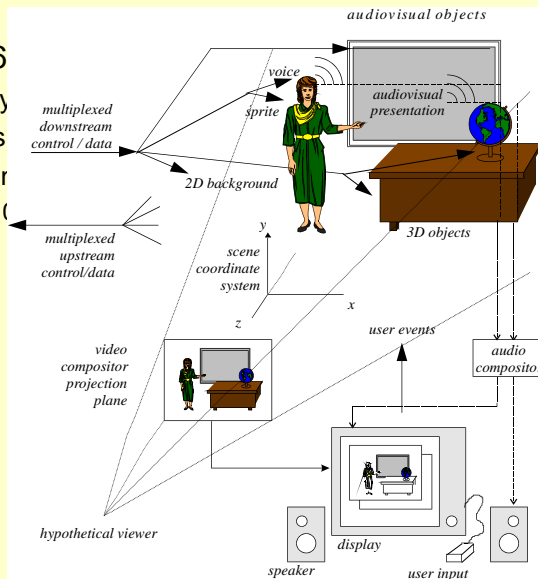
MPEG-4: ISO/IEC 14496 (1998)

- coding of natural and synthetic audiovisual objects
- Multimedia applications
- further extensions (mainly) in video and systems parts underway
 - H.264/MPEG-4 part 10: the “ultimate video standard” (not object based)

The MPEG Family: MPEG-4

MPEG-4: ISO/IEC 14496

- coding of natural and synthetic
- Multimedia applications
- further extensions (mainly H.264/MPEG-4 part 10)



The MPEG Family: MPEG-7

MPEG-7: ISO/IEC 15938 (2001)

- multimedia content description for AV material
- content search, filter and access (navigation, browsing, transcoding, ...)

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The MPEG Family: Scope of MPEG-7

The description generation (feature extraction, indexing process, annotation & authoring tools,...) and consumption (search engine, filtering tool, retrieval process, browsing device, ...) are non normative parts of MPEG-7.

The goal is to define the minimum that enables interoperability.

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The MPEG Family: Abstract MPEG-7 Architecture and Working Areas

Manual Automatic Supervised

MM Content

Users and computational systems

Feature extraction

Description Schemes (DS) MPEG-7 Visual, MPEG-7 Audio, MPEG-7 MDS

Description Generation

Instantiation

MPEG7 Description (XML)

Storage

Encoder for Delivery

Binary and Textual MPEG-7 Coded Description (BiM/TeMAU)

Decoder for Delivery

MPEG-7 Terminal

Search & Browse

Filter

Push

Pull

Syntax and semantic of feature representation and structuring (schemas)

Description Definition Language (DDL) MPEG-7 DDL

Syntactic definition

tags

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The MPEG Family: MPEG-21

MPEG-21: ISO/IEC 21000 (2001)

- multimedia framework
 - To enable transparent and augmented use of multimedia resources across a wide range of networks and devices
 - A Digital Item is a structured digital object with a standard representation, identification and metadata within the MPEG-21 framework. This entity is also the fundamental unit of distribution and transaction within this framework
- integration of e-content technologies

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The MPEG Family: MPEG-21

MPEG-21: ISO/IEC 21000 (2001)

- multimedia framework
 - To enable transparent and augmented use of multimedia resources across a wide range of networks and devices
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- integration of e-content technologies

Examples: Container, Item, Resource

Examples: Unique Identifiers, Content Descriptors

Examples: Storage Management, Content Personalisation

Examples: Encryption, Authentication, Watermarking

Examples: Resource Abstraction, Resource Mgt. (QoS)

Examples: Natural and Synthetic, Scalability

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MPEG-1 Parts

ISO/IEC 11172: MPEG-1 (1992)

Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s

Part 1 - MPEG-1 Systems - Program Stream (1993)

Part 2 - MPEG-1 Video for CD-I (1993)

Part 3 - MPEG-1 audio (1993)

including Layers I, II, and III (a.k.a. mp3)

Part 4 – Compliance Testing (1995)

Part 5 – Software Simulation (1998)

Part 6 – Specification for implementation of IDCT (CD)

Directed primarily at error free environments

MPEG-1 Systems (*)

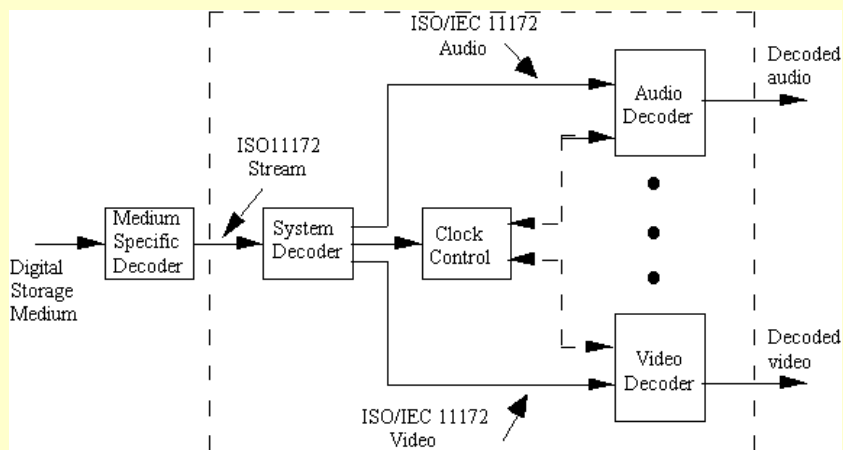
ISO/IEC 11172-1:1993 Information technology -- Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s -- Part 1: Systems

- ISO/IEC 11172-1:1993/Cor 1:1996
- ISO/IEC 11172-1:1993/Cor 2:1999

Addresses the problem of combining one or more data streams from the video and audio parts of the MPEG-1 standard with timing information to form a single stream. This is an important function because, once combined into a single stream, the data are in a form well suited to digital storage or transmission.

MPEG-1 Systems (*)

Prototypical ISO/IEC 11172 decoder



MPEG-1 Visual (*)

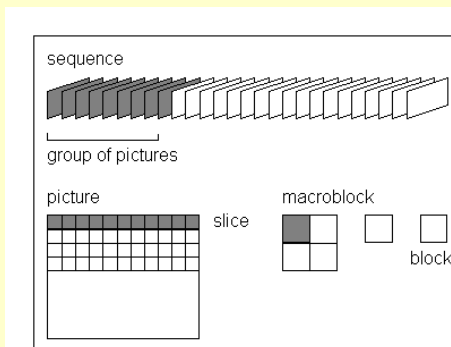
ISO/IEC 11172-2:1993 Information technology -- Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s -- Part 2: Video

- ISO/IEC 11172-2:1993/Cor 1:1996
- ISO/IEC 11172-2:1993/Cor 2:1999
- ISO/IEC 11172-2:1993/Cor 3:2003

Specifies a coded representation that can be used for compressing video sequences - both 625-line and 525-lines - to bitrates around 1,5 Mbit/s. Part 2 was developed to operate principally from storage media offering a continuous transfer rate of about 1,5 Mbit/s. Nevertheless it can be used more widely than this because the approach taken is generic.

MPEG-1 Visual (*)

A number of techniques are used to achieve a high compression ratio. The first is to select an appropriate spatial resolution for the signal. The algorithm then uses block-based motion compensation to reduce the temporal redundancy. Motion compensation is used for causal prediction of the current picture from a previous picture, for non-causal prediction of the current picture from a future picture, or for interpolative prediction from past and future pictures. The difference signal, the prediction error, is further compressed using the discrete cosine transform (DCT) to remove spatial correlation and is then quantised. Finally, the motion vectors are combined with the DCT information, and coded using variable length codes.



MPEG-1 Audio (*)

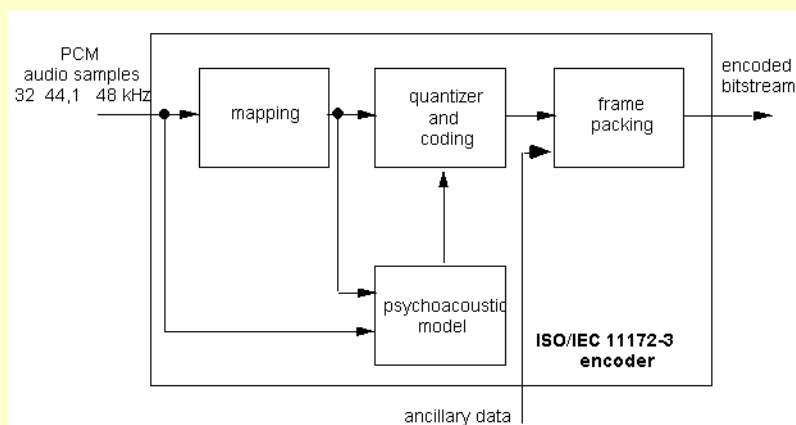
ISO/IEC 11172-3:1993 Information technology -- Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s -- Part 3: Audio

- ISO/IEC 11172-3:1993/Cor 1:1996

Specifies a coded representation that can be used for compressing audio sequences - both mono and stereo.

- Input audio samples are fed into the encoder.
- The mapping creates a filtered and subsampled representation of the input audio stream.
- A psychoacoustic model creates a set of data to control the quantiser and coding.
- The quantiser and coding block creates a set of coding symbols from the mapped input samples.
- The block 'frame packing' assembles the actual bitstream from the output data of the other blocks, and adds other information (e.g. error correction) if necessary.

MPEG-1 Audio (*)



MPEG-1 Compliance (*)

ISO/IEC 11172-4:1995 Information technology -- Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s -- Part 4: Compliance testing

Specifies how tests can be designed to verify whether bitstreams and decoders meet the requirements as specified in parts 1, 2 and 3 of the MPEG-1 standard. These tests can be used by:

- manufacturers of encoders, and their customers, to verify whether the encoder produces valid bitstreams.
- manufacturers of decoders and their customers to verify whether the decoder meets the requirements specified in parts 1,2 and 3 of the standard for the claimed decoder capabilities.
- applications to verify whether the characteristics of a given bitstream meet the application requirements, for example whether the size of the coded picture does not exceed the maximum value allowed for the application.

MPEG-1 Software simulation (*)

ISO/IEC TR 11172-5:1998 Information technology -- Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s -- Part 5: Software simulation

A technical report giving a full software implementation of the first three parts of the MPEG-1 standard

MPEG-1 implementation of IDCT (*)

ISO/IEC TR 11172-6:200X Information technology -- Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s -- *Part 6: Specification for implementation of IDCT (CD)*

Will provide the specification of IDCT accuracy. The current standard refers to the IEEE 1180 standard, which has been withdrawn. This part will provide equivalent text or extension thereof.

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MPEG-2 Parts

ISO/IEC 13818: MPEG-2 (1994)

Generic coding of moving pictures and associated audio information



1996 Emmy for technical excellence

- Part 1 Systems (joint with ITU) - 2nd edition 2000
- Part 2 Video (joint with ITU) - 2nd edition 2000
- Part 3 Audio-fwd/bwd compatible to MPEG-1 (1998)
- Part 4 Conformance testing – 2nd edition 2004
- Part 5 Software simulation/Reference software (1998)
- Part 6 DSM-CC: Digital Storage Media Cmd and Cntl (1998)
- Part 7 AAC - Advanced Audio Coding – 3rd ed. 2004
- Part 9 RTI - Real Time Interface (1996)
- Part 10 Conformance Extensions for DSM-CC (1999)
- Part 11 IPMP on MPEG-2 Systems (2004)

MPEG-2 Systems

ISO/IEC 13818-1:2000 Information technology -- Generic coding of moving pictures and associated audio information: Systems

Addresses the combining of one or more elementary streams of video and audio, as well as, other data into single or multiple streams which are suitable for storage or transmission. This is specified in two forms: the Program Stream and the Transport Stream. Each is optimised for a different set of applications.

MPEG-2 Systems

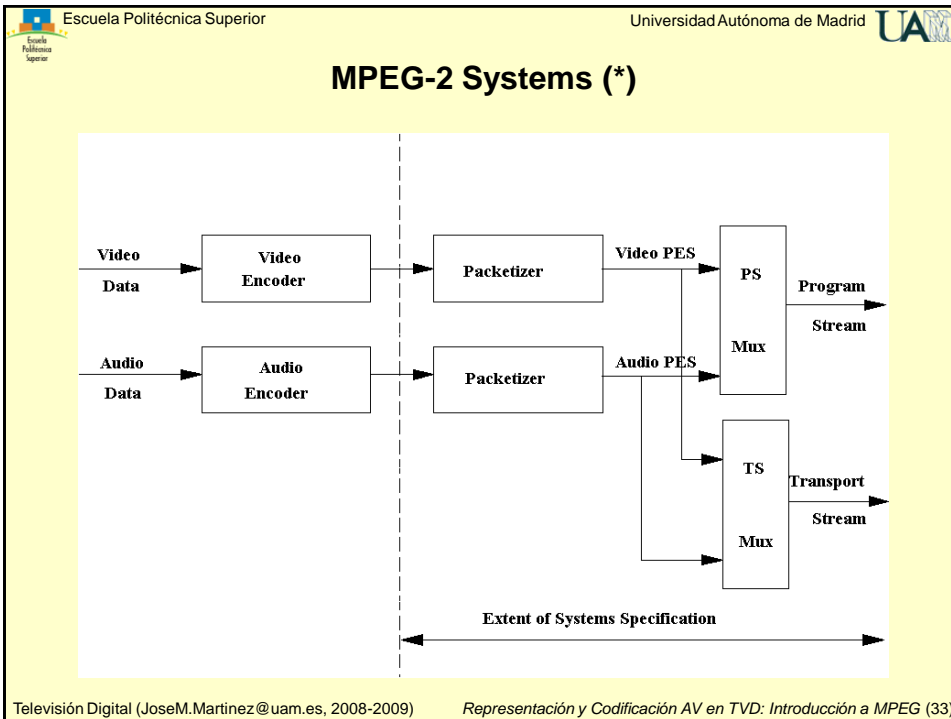
The Program Stream is similar to MPEG-1 Systems Multiplex. It results from combining one or more Packetised Elementary Streams (PES), which have a common time base, into a single stream. The Program Stream is designed for use in relatively error-free environments and is suitable for applications which may involve software processing. Program stream packets may be of variable and relatively great length.

The Transport Stream combines one or more Packetized Elementary Streams (PES) with one or more independent time bases into a single stream. Elementary streams sharing a common timebase form a program. The Transport Stream is designed for use in environments where errors are likely, such as storage or transmission in lossy or noisy media. Transport stream packets are 188 bytes long.

MPEG-2 Systems (*)

ISO/IEC 13818-1:2000 Information technology --
Generic coding of moving pictures and associated
audio information: Systems

- ISO/IEC 13818-1:2000/Cor 1:2002
- ISO/IEC 13818-1:2000/Cor 2:2002
- ISO/IEC 13818-1:2000/Cor 3:2004
- ISO/IEC 13818-1:2000/Amd 1:2003: Carriage of metadata over 13818-1 streams
- ISO/IEC 13818-1:2000/Amd 2:2004: Support of IPMP on MPEG-2 Systems
- ISO/IEC 13818-1:2000/Amd 3:2004: Transport of AVC over MPEG-streams
- ISO/IEC 13818-1:2000/Amd 4:200x: Metadata application format codepoints (FDAM)
- ISO/IEC 13818-1:2000/Amd 5:200x: New audio profile and level signaling (FDAM)



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MPEG-2 Video

ISO/IEC 13818-2:2000 Information technology -- Generic coding of moving pictures and associated audio information: Video

Buils on the powerful video compression capabilities of the MPEG-1 standard to offer a wide range of coding tools. These have been grouped in profiles (with levels) to offer different functionalities.

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MPEG-2 Video (*)

ISO/IEC 13818-2:2000 Information technology -- Generic coding of moving pictures and associated audio information: Video

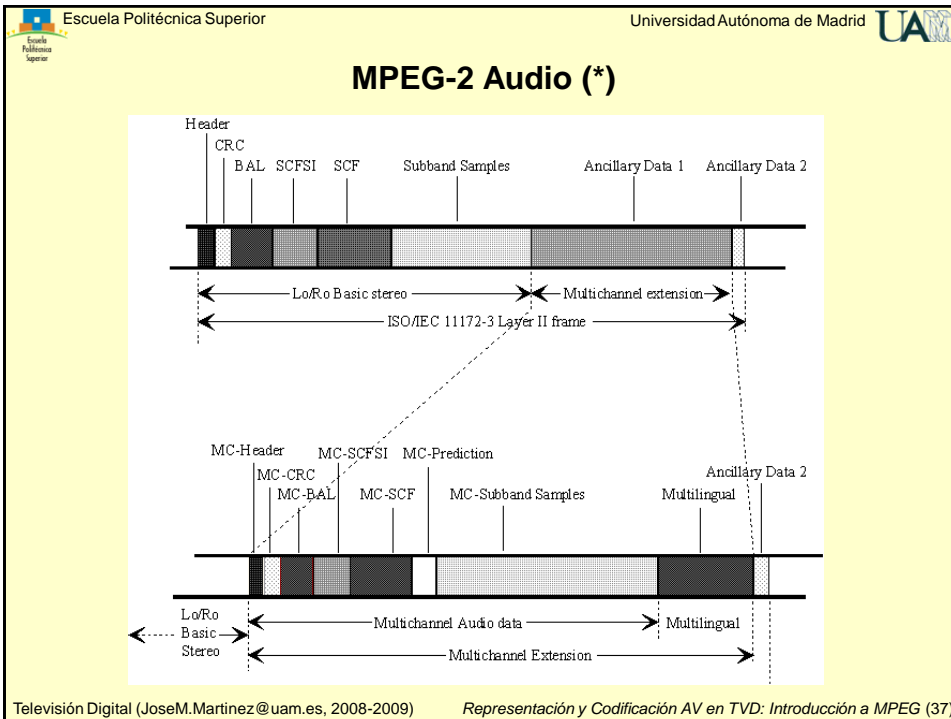
- ISO/IEC 13818-2:2000/Cor 1:2002
- ISO/IEC 13818-2:2000/Amd 1:2001: Content description data

MPEG-2 Audio

ISO/IEC 13818-3:1998 Information technology -- Generic coding of moving pictures and associated audio information -- Part 3: Audio

Backwards-compatible multichannel extension of the MPEG-1 Audio standard.

- This is the MPEG-1 specification really used in DVB



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MPEG-2 Conformance and Software simulation (*)

ISO/IEC 13818-4:2004 Information technology -- Generic coding of moving pictures and associated audio information -- Part 4: Conformance testing

- ISO/IEC 13818-4:2004/Amd 1:200x IPMP conformance testing (FDAM)
- ISO/IEC 13818-4:2004/Amd 2:200x Audio conformance extensions (FDAM)

ISO/IEC TR 13818-5:1997 Information technology -- Generic coding of moving pictures and associated audio information -- Part 5: Software simulation

- ISO/IEC TR 13818-5:1997/Amd 1:1999 Advanced Audio Coding (AAC)
- ISO/IEC TR 13818-5:1997/Amd 2:200x IPMP Reference software

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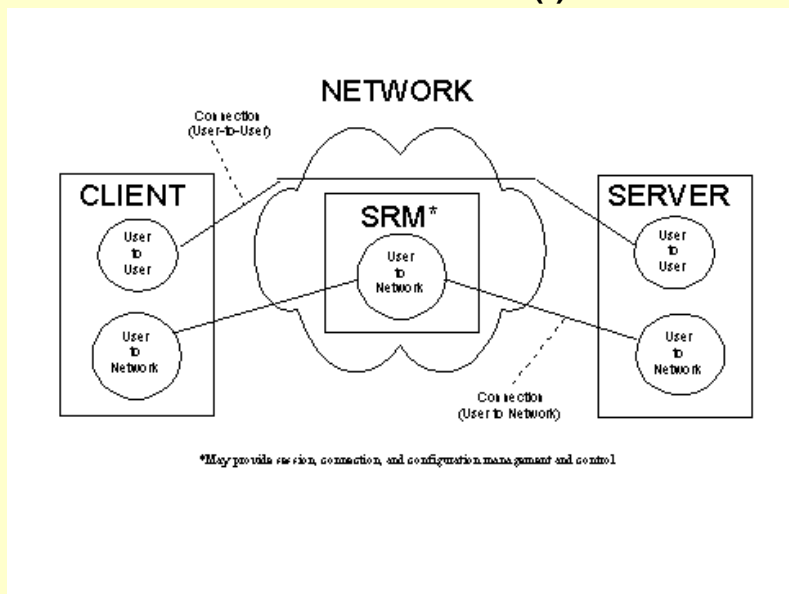
MPEG-2 DSM-CC (*)

ISO/IEC 13818-6:1998 Information technology -- Generic coding of moving pictures and associated audio information -- Part 6: Extensions for DSM-CC

- ISO/IEC 13818-6:1998/Cor 1:1999
- ISO/IEC 13818-6:1998/Amd 1:2000 Additions to support data broadcasting
- ISO/IEC 13818-6:1998/Amd 2:2000 Additions to support synchronized download services, opportunistic data services and resource announcement in broadcast and interactive services
- ISO/IEC 13818-6:1998/Amd 3:2001 Transport buffer model in support of synchronized user-to-network download protocol

Digital Storage Media Command and Control (DSM-CC) is the specification of a set of protocols which provides the control functions and operations specific to managing MPEG-1 and MPEG-2 bitstreams. These protocols may be used to support applications in both stand-alone and heterogeneous network environments. In the DSM-CC model, a stream is sourced by a Server and delivered to a Client. Both the Server and the Client are considered to be Users of the DSM-CC network. DSM-CC defines a logical entity called the Session and Resource Manager (SRM) which provides a (logically) centralized management of the DSM-CC Sessions and Resources

MPEG-2 DSM-CC (*)



MPEG-2 AAC

ISO/IEC 13818-7:2004 Information technology -- Generic coding of moving pictures and associated audio information -- Part 7: Advanced Audio Coding (AAC)

Specification of a multichannel audio coding algorithm not constrained to be backwards-compatible with MPEG-1 Audio.

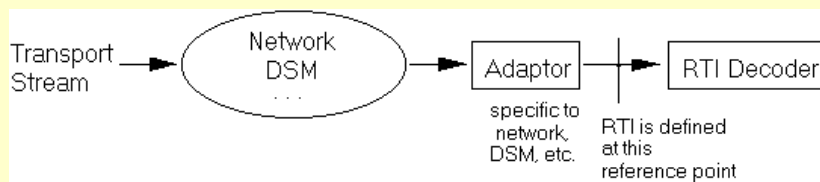
MPEG-2 part 8 (the missing link) (*)

MPEG-2 part 8 was originally planned to be coding of video when input samples are 10 bits. Work on this part was discontinued when it became apparent that there was insufficient interest from industry for such a standard.

MPEG-2 RTI (*)

ISO/IEC 13818-9:1996 Information technology -- Generic coding of moving pictures and associated audio information -- Part 9: Extension for real time interface for systems decoders

Specification of the Real-time Interface (RTI) to Transport Stream decoders which may be utilised for adaptation to all appropriate networks carrying Transport Streams



MPEG-2 Conformance extensions (*)

ISO/IEC 13818-10:1999 Information technology -- Generic coding of moving pictures and associated audio information -- Part 10: Conformance Extensions for DSM-CC

Conformance testing part of DSM-CC

MPEG-2 IPMP (*)

ISO/IEC 13818-11:2004 Information technology -- Generic coding of moving pictures and associated audio information -- Part 11: IPMP on MPEG-2 Systems

IPMP specifications for MPEG-2

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