Guideline of Transmission and Control for DVD-Video/Audio through IEEE1394 Bus

Version 0.9

Revision 0

September 2001

This page is intentionally left blank.

INDEX

List of Figures

List of Tables

1. General

1.1 Scope

This guideline defines the connection through IEEE1394 Bus between DVD-Video/Audio player and its peripheral equipment (e.g. Digital TV, Audio Amplifier). The output stream from DVD player complies with MPEG Transport Stream (MPEG-TS) or Audio and Music Data Transmission Protocol (A&M Protocol).

1.2 Normative References

The following standards contain provisions, which through reference in this guideline. All the standards listed are normative references. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

[R1] DVD Specifications for Read-Only Disc Part3: VIDEO SPECIFICATIONS Version 1.1

[R2] DVD Specifications for Read-Only Disc Part4: AUDIO SPECIFICATIONS Version 1.2

[R3] IEEE Std 1394-1995, Standard for a High Performance Serial Bus

[R4] IEEE Std 1394a-2000, Standard for a High Performance Serial Bus —Amendment 1

[R5] IEC 61883-4, Consumer audio/video equipment – Digital interface – Part 4: MPEG2-TS data transmission.

[R6] ISO/IEC 13818-1, Information Technology – Generic Coding of moving pictures and associated audio : System

[R7] ISO/IEC 13818-2, Information Technology – Generic Coding of moving pictures and associated audio : Video

[R8] ISO/IEC 13818-3, Information Technology – Generic Coding of moving pictures and associated audio : Audio

[R9] ISO/IEC 11172-2, Information Technology – Generic Coding of moving pictures and associated audio for digital storage media at up to about 1.5Mbit/s: Video

[R10] ISO/IEC 11172-3, Information Technology – Generic Coding of moving pictures and associated audio for digital storage media at up to about 1.5Mbit/s: Audio

[R11] ATSC STANDARD "DIGITAL AUDIO COMPRESSION (AC-3)"Doc.A/52 20 Dec, 1995

[R12] ETS 300 468, Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems

[R13] ETR 211, Digital Video Broadcasting (DVB); implementation guidelines for the use of MPEG-2 systems; Guidelines on implementation and usage of service information

[R14] Audio and Music Data Transmission Protocol, Version 1.0 (TA Document 1997001)

[R15] Enhancement to Audio and Music Data Transmission Protocol 1.0 (TA Document 1999014)

[R16] Audio and Music Data Transmission Protocol, Version 2.0 (TA Document 2001003)

[R17] AV/C Digital Interface Command Set General Specification Version 3.0 (TA Document 1998003)

[R18] Enhancements to the AV/C General Specification 3.0, Version 1.1 (TA Document 2000004)

[R19] AV/C Disc Subunit General Specification, Version 1.0 (TA Document 1998013)

[R20] AV/C Disc Media Type Specification – CD-DA, Version 1.0 (TA Document 1999002)

[R21] AV/C Disc Media Type Specification – DVD, Version 1.0 (TA Document 2000001)

[R22] AV/C Panel Subunit Specification, Version 1.1 (TA Document 2001001)

Copies of the IEEE1394 specifications can be obtained from the IEEE, see http://www.ieee.org
Copies of the 1394 Trade Association specifications can be obtained from the 1394 Trade Association, see http://www.1394ta.org

At the time of issuance, the version numbers indicated were valid.
All specifications are subject to the updated version, and latest version of the specifications listed above shall be applied.

This page is intentionally left blank.

2. Technical Elements

2.1 Definitions

expected: A key word used to describe the behaviour of the hardware or software in the design models *assumed* by this guideline. Other hardware and software design models may also be implemented.
may: A key word that indicates flexibility of choice with *no implied preference*.
shall: A key word indicating a mandatory requirement. Designers are *required* to implement all such mandatory requirements.
should: A key word indicating flexibility of choice with a strongly preferred alternative. Equivalent to the phrase *is recommended*.
reserved codes: A set of codes for a reserved field that are defined in this specification, but not otherwise used. Future specifications may implement the use of these codes. A product implementing this specification shall not generate these codes.
reserved fields: A set of bits for a reserved field that are defined in this guideline, but are not otherwise used. Products that implement this specification shall zero these fields. Products that implement future revisions of this guideline may set these codes as defined by the guideline.
byte: Eight bits of data, used as a synonym for octet.
quadlet: Four bytes of data
data_element[m..n]: The inclusive range of bits between bit m and bit n in the data_element.

2.2 Symbols

2.2.1 Relational operators

= or ==	Equal to
≠ or !=	Not equal to
≥ or >=	Greater than or equal to
>	Greater than
≤ or <=	Less than or equal to
<	Less than

2.2.2 Arithmetic operators

+	Addition
–	Subtraction
++	Increment
– –	Decrement
×	Multiplication
/	Division

2.2.3 Assignment

=	Assignment operator

2.2.4 Mnemonics

bslbf: Bit string, left bit first, where "left" is the order in which bit strings are written in this guideline. Bit strings are written as a string of 1s and 0s within single quote marks, e.g. '1000 0001'. Blanks within a bit string are for ease of reading and have no significance.
uimsbf: Unsigned integer, most significant bit first.
rpchof: Remainder polynomial coefficients, highest order first.
CH: channel

2.2.5 Method of describing bitstream

Refer to ISO/IEC 13818-1: 2.3.

2.3 Notations

2.3.1 Numerical notation

Numbers in decimal notation are represented by decimal digits, namely 0 to 9.

Numbers in hexadecimal notation are represented as a sequence of one or more hexadecimal digits, namely 0 to 9 and A to F, suffixed by "h" or "$_{16}$".

Numbers in binary notation are represented as a sequence of one or more binary digits, namely 0 to 1, suffixed by "b".

Multi-byte numerical values in a description field shall be recorded in the **big endian** representation, e.g. the hexadecimal number '12345678h' shall be recorded as '12h', '34h', '56h', '78h'.

1 Mbytes represents 10^6 bytes.

1 Gbytes represents 10^9 bytes.

1 kB represents 2^{10} bytes.

1 MB represents 2^{20} bytes.

1 GB represents 2^{30} bytes.

2.3.2 Range

Constant_1..Constant_2 or [Constant_1..Constant_2] denotes the range from and including Constant_1 up to and including Constant_2, in increments of 1.

2.3.3 Bit fields

Certain fields or parts of fields are interpreted as an array of bits. This array of bits shall be referred to as a bit field. Bit positions within an **n** bit field are numbered such that the least significant bit is numbered 0 and the most significant bit is numbered **n–1**.

2.4 Terminology

AM824

A 32-bit data field that has an 8-bit LABEL and 24-bit data field defined in A&M Protocol.

Ancillary Data

A 32-bit data field that has an 8-bit LABEL and recommended an 8-bit Sub LABEL and 16-bit data field for ancillary information in A&M Protocol.

Audio and Music Data Transmission Protocol (A&M Protocol)

This describes a protocol for the transmission of audio and music data over IEEE 1394-1995 standard. This includes the transport of IEC 60958 digital audio interface format, raw audio samples, and MIDI data. Refer to [R16].

Audio Object (AOB)

The AOB is the presentation data in DVD-Audio content. Each AOB is a MPEG Program Stream or a part of MPEG Program Stream, which is made up of a group of Elementary streams. There may be two types of Elementary streams; one Audio stream for mandatory and a RTI (Real Time Information) stream for option. Refer to [R2].

Audio stream

Audio stream is the stream transmitted by A&M Protocol. Audio stream can transmit only Audio data. Refer to section 3.1.2 .

Audio Still Video Object (ASVOB)

The ASVOB is a MPEG Program Stream for one ASV (Audio Still Video), and consists of one HLI_PCK (Highlight Information Pack), SP_PCKs (Sub-picture Packs) and SPCT_PCKs (Still Picture Packs). These packs for each ASVOB shall be recorded contiguously in the above-described order. Refer to [R2].

AV/C Digital Interface Command Set (AV/C Command)

AV/C Commands are used to control consumer audio/video (AV/C) devices on IEEE1394 Bus. Refer to [R17] and [R18].

AV/C Disc Subunit

This provides the AV/C commands needed for controlling Disc players and recorders, see [R19] AV/C Disc Subunit General Specification. It also defines the Disc-specific data structures and reading mechanisms so that status information about the player can be read by an external controller. In addition, there are associated documents such as AV/C Disc Media Specification – DVD [R21] which describe media-specific items.

AV/C Panel Subunit

This provides UI services including OSD, GUI services for AV/C devices and a model for describing and accessing the physical or logical controls on a device from a remote location. Also this defines several data structures that describe standardized control types (such as buttons, text entry fields, etc) and a use-manipulation command set for accessing these controls. Refer to [R22].

AV stream

AV stream is the stream transmitted by partial MPEG-TS. AV stream can transmit Video and/or Audio data. Refer to section 3.1.1 .

AV subunit

an instantiation of a virtual entity that can be identified uniquely within an AV unit (the physical instantiation of a consumer electronic device) and offers a set of coherent functions.

controller

A device, such as a TV or Amplifier, which wishes to send control commands to the target DVD player and also wishes to receive status information.

CSR Architecture

A convenient abbreviation of the following reference (see clause 2): ISO/IEC 13213: 1994 [ANSI/IEEE Std 1212, 1994 Edition], Information Technology—Microprocessor systems— Control and Status Register (CSR) Architecture for Microcomputer Buses.

Descriptor

This is a general term for a data structure which describes something, such as the subunit identifier or individual pieces of content on media, etc.

DVD audio block

This consists of CIP header and DVD audio data block. DVD audio data block consists of two Ancillary Data fields and two, four or six Sample Word fields in this order. Refer to section 5.2 .

DVD-MBLA

This is Linear PCM audio data which has same Fs and same Qb in two channel groups. Basically, Linear PCM audio, processed scalable Linear PCM audio and decoded compressed audio are transmitted as DVD-MBLA by A&M Protocol. Refer to section 3.1.2 .

DVD-SMBLA

This is Linear PCM audio data which has different Fs and/or Qb in two channel groups. Basically scalable Linear PCM audio is transmitted as DVD-SMBLA by A&M Protocol. Refer to section 3.1.2 .

IEEE1394 Bus

The physical interconnects and higher level protocols for the peer-to-peer transport of serial data, as defined by IEEE Std 1394-1995 ([R3]) and IEEE Std 1394-2000a ([R4]).

information block

Information blocks (also called info blocks) are enhancements to the descriptor model. Each information block contains a collection of related data fields that should be read together; info blocks can also contain other info blocks.

isochronous

A term that indicates the essential characteristic of a time-scale or signal, such that the time intervals between consecutive instances either have the same duration or durations that are integral multiples of the shortest duration. In the context of Serial Bus, "isochronous" is taken to mean a bounded worst-case latency for the transmission of data; physical and logical constraints that introduce jitter preclude the exact definition of "isochronous".

list descriptor

A list descriptor is a data structure which describes a collection of data about objects, such as audio tracks. It has a general header which describes the collection as a whole, then a series of object descriptors, each of which describes an object in the collection.

object descriptor

An object descriptor is a data structure which describes a piece of information about a specific object such as an audio track.

partial MPEG-TS

A partial MPEG-TS in this guideline book comply with ISO/IEC 13818-1 and ETS 300 468, especially, SIT and DIT shall be required to contain into the partial MPEG-TS stream for playback compatibility.

Profile

DVD players or recorders can be implemented with different levels of functionality. These are described in the Profiles in [R21], AV/C Disc Media Type Specification – DVD, along with the required commands and status needed to support these functions.

sink

A device, such as a TV or Amplifier, which receives the output stream from the DVD player and presents it on a visual display or on loudspeakers. This device is often a controller as well.

source

The DVD player is the source of an MPEG transport stream, which is sent to a sink.

stream

A time-ordered set of digital data originating from one source and terminating at zero or more sinks. A stream is characterized by bounded bandwidth requirements and by synchronization points, or time stamps, within the stream data.

target

This is a controlled device, which is the DVD player in this guideline.

plug

A physical or virtual end-point of a connection implemented by an AV unit or subunit that may receive or transmit isochronous or other data.

Video Object (VOB)

The VOB is a unit of presentation data in DVD-Video/Audio content. Each VOB is the MPEG Program Stream or a part of MPEG Program Stream, which is made up of a group of Elementary streams. There are five types of Elementary; Video, Audio, Sub-picture, PCI (Presentation Control Information) and DSI (Data Search Information). Refer to [R1].

2.5 Abbreviations

AV/C	Audio Video / Control
AMP	Amplifier
DIT	Discontinuity Information Table
DMCT	Down Mix Coefficient Table
DTV	Digital Television
ES	Elementary Stream
GOP	Group of Pictures
GUI	Graphical User Interface
IEEE	The Institute of Electrical and Electronics Engineers, Inc
PAT	Program Association Table
PCR	Program Clock Reference
PES	Packetized Elementary Stream
PID	Packet Identification
PMT	Program Map Table
PSI	Program Specific Information
SIT	Selection Information Table
OSD	On Screen Display
Mux	Multiplexer

3. Introduction

3.1 Basic Concept

The DVD-Video/Audio content can have various kinds of video and audio data. For example, video data including sub-picture in DVD-Video content, audio data with still-picture in DVD-Audio content, audio data with real-time text information such as lyrics in DVD-Audio content or sophisticated menu that includes not only video and audio data but also sub-picture and highlight information.

This guideline specifies two methods to transmit video and/or audio data through IEEE1394 Bus. One is to transmit on partial MPEG-TS. Using this method, both video and audio data can be transmitted. The other is to transmit on A&M Protocol (Audio and Music Data Transmission Protocol). In this way, especially high quality audio data on DVD-Audio content (up to 6 channels and up to 192 kHz/24 bits) can be transmitted.

3.1.1 Concept of AV stream through IEEE1394 Bus (AV stream)

AV stream to transmit video and/or audio data through IEEE1394 Bus shall comply with partial MPEG-TS specifications, but some restrictions of parameter are specified.

To transmit AV stream on partial MPEG-TS, the player shall re-encode video data including sub-picture, highlight information, OSD image and so on. Therefore any DVD specific function, such as color change by display control command of sub-picture, is not required to be implemented in a DTV.

As for audio signal, 2-ch Linear PCM audio (48/44.1 kHz, 16 bits) is transmitted on partial MPEG-TS as mandatory. Multi-channel Linear PCM audio should be down-mixed to 2-ch Linear PCM audio in case of transmission on partial MPEG-TS. Compressed audio is decoded to 2-ch Linear PCM audio to transmit on partial MPEG-TS. Furthermore, if the end user of the system sets up the transmission of the signals between the source and sink devices over IEEE1394 Bus, optional audio defined in this guideline can be transmitted instead of mandatory 2-ch Linear PCM audio.
As for details, refer to chapter 4.

3.1.2 Concept of Audio stream through IEEE1394 Bus (Audio stream)

Audio stream to transmit only audio data through IEEE1394 Bus shall comply with A&M Protocol specifications. It's especially for transmitting high quality audio signal.

A&M Protocol includes AM824 format for audio data transmission. A&M Protocol Enhancement defines details of AM824 for transmission of multi bit linear PCM data and one bit audio data, and also defines an ancillary data for transmission of various accompanied data.
Furthermore, the AM824 format can transmit IEC 60958 format data and also IEC 61937, which is an application of IEC 60958 for non-linear audio data transmission.

Using A&M Protocol, the player can transmit DVD-MBLA (Linear PCM audio which has same Fs and same Qb in two channel groups) and transmit DVD-SMBLA (Linear PCM audio which has different Fs and/or different Qb in two channel groups). In Table 3.1.2-1, the contents that can be transmitted as DVD-MBLA or DVD-SMBLA are described.
In case of transmitting compressed audio as it is, the sink device (e.g. an Audio Amplifier) needs to have the capability to decode that data.
As for details, refer to chapter 5.

◊ Table 3.1.2-1 : Relation between Data and Contents

Data	Contents
DVD-MBLA	Linear PCM audio processed scalable Linear PCM audio decoded compressed audio
DVD-SMBLA	scalable Linear PCM audio

3.2 Relation between Signal Transmission and DVD Content

3.2.1 To transmit Video and/or Audio data through IEEE1394 Bus

When both video and audio data would be transmitted through IEEE1394 Bus, for example,

- Video and Audio data recorded on DVD-Video disc
- Video and Audio data recorded on DVD-Audio disc
- Audio data and Still-picture recorded on DVD-Audio disc

AV stream shall be adopted and transmitted on partial MPEG-TS.

3.2.2 To transmit only Audio data through IEEE1394 Bus

When only audio data would be transmitted through IEEE1394 Bus, for example,

- Only audio data recorded on DVD-Video disc
- Only audio data recorded on DVD-Audio disc

Normally audio stream is adopted and transmitted on A&M Protocol. But AV stream can also be adopted and transmitted on partial MPEG-TS.

Table 3.2.2-1 shows the relation between Objects in DVD-Video/Audio disc and the stream used to transmit through IEEE1394 Bus.

◊ **Table 3.2.2-1 : Relation between Object and Stream**

Disc	Object	Stream
DVD-Video disc	VOB (*1)	AV stream
	Audio data in VOB	Audio stream (or AV stream)
DVD-Audio disc	AOB (*2) and ASVOB (*3)	AV stream
	VOB (for visual menu)	
	ASVOB	
	AOB	Audio stream (or AV stream)
	Audio data in VOB	

Note:

*1…Video Object on DVD-Video or DVD-Audio disc

*2…Audio Object on DVD-Audio disc

*3…Audio Still Video Object on DVD-Audio disc

As for details, refer to DVD-Video and DVD-Audio specifications.

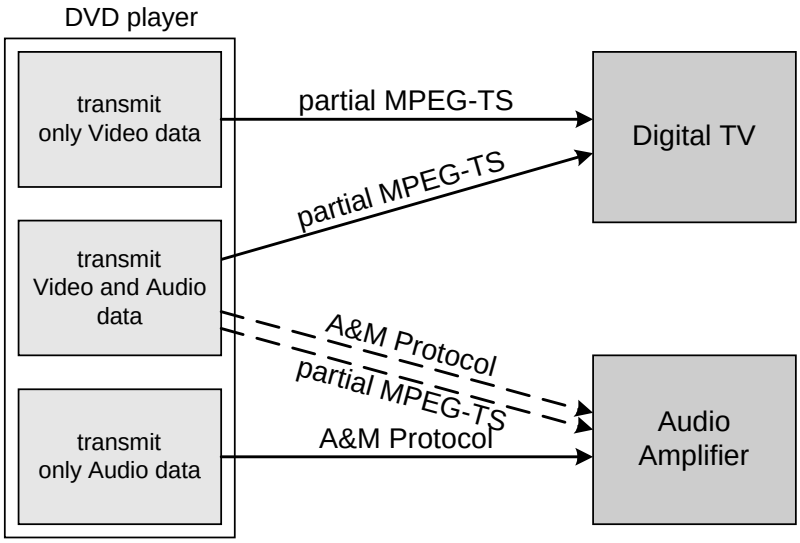
3.2.3 Relation between Video data and Audio data

The relation between DVD player and the contents to be transmitted is described in Figure 3.2.3-1 and also the relation between partial MPEG-TS and A&M Protocol is described in Table 3.2.3-1.

Figure 3.2.3-1 shows which formats (partial MPEG-TS or A&M Protocol) are sent to a Digital TV or an Audio Amplifier. Table 3.2.3-1 shows which contents in the streams are transmitted.

From a DVD player to a Digital TV, video and/or audio data can be transmitted on partial MPEG-TS. From a DVD player to an Audio Amplifier, only audio data can be transmitted on A&M Protocol or may be transmitted on partial MPEG-TS. Of course, in transmitting on partial MPEG-TS, more restrictions should be applied.

Furthermore, a DVD player may output both AV stream and Audio stream, i.e. a DVD player may well output video data on partial MPEG-TS to a Digital TV and audio data on A&M Protocol to an Audio Amplifier simultaneously.



◊ **Figure 3.2.3-1 : Recommended System Model among DVD player, DTV and Audio Amplifier**

◊ **Table 3.2.3-1 : Signal Specification of the Stream**

Transmission	Contents	Mandatory Signal		Optional Signal
AV stream (partial MPEG-TS)	Both Video/Audio data, Only Video data or Only Audio data	V	MPEG1 or MPEG2 (MP@ML,MP@LL, SP@ML,MP@H-14*)	-
		A	Linear PCM (2 ch,44.1/48 kHz, 16 bits)	Dolby AC-3, MPEG1 or MPEG2
Audio stream (A&M Protocol)	Only Audio data	A	DVD-MBLA or DVD-SMBLA	-

Note:

*…Constrained MP@H-14 (As for details, see Table 4.4-1)

V…Video data

A…Audio data

3.3 System Model for Signal Transmission

It is desirable for a DVD product to support to output both AV stream and Audio stream. But it isn't mandatory, because there are many kinds of DVD products. For example,

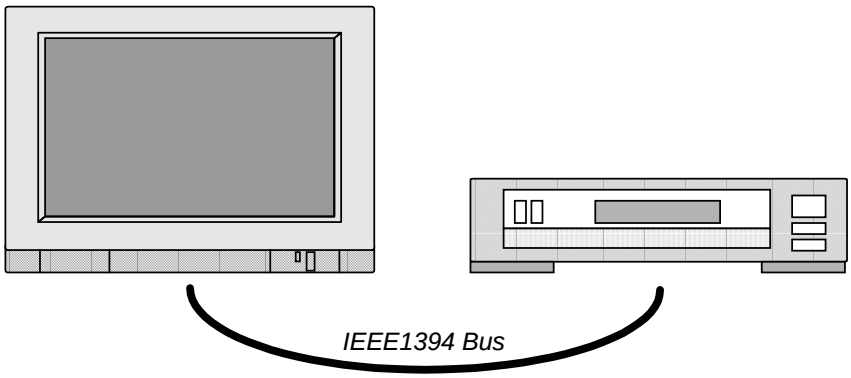
- In case of a 1394-enabled DVD-Video player, the player doesn't normally support Audio stream because the target device of the player is a DTV and it can't playback a DVD-Audio disc.
- In case of a 1394-enabled DVD-Audio player which doesn't have the playback capability of video data (e.g. still-picture), the player doesn't support AV stream. This is because the target device of the player is an Audio Amplifier which can't playback a DVD-Video disc, or the video data on a DVD-Audio disc.
- In case of a 1394-enabled DVD universal player which has the playback capability for both DVD-Video and DVD-Audio discs, the player may support both AV stream and Audio stream.

3.3.1 An example of the Connection between DVD-Video player and DTV

In this model, a DVD-Video player connects with a Digital TV through IEEE1394 Bus, as described in Figure 3.3.1-1.

Process to transmit of Video data

1) The DVD player makes re-encoded video data including sub-picture ,OSD image and others.
2) The DVD player transmits re-encoded video data as AV stream to the DTV.



◊ **Figure 3.3.1-1 : Connection between DVD player and DTV**

3.3.2 An example of the Connection between DVD-Audio player and Audio Amplifier

In this model, a DVD-Audio player connects with an Audio Amplifier through IEEE1394 Bus, as described in Figure 3.3.2-1.

Process to transmit of Audio data

Case A : Transmission of Linear PCM contents, which is not scalable contents

The DVD player transmits DVD-MBLA as Audio stream to the Audio Amplifier.

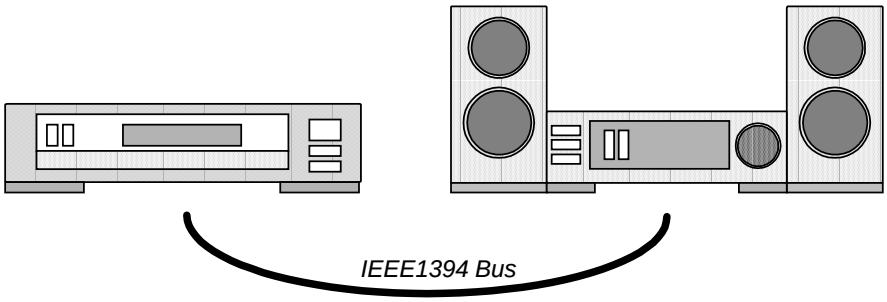
Case B : Transmission of Linear PCM contents, which is scalable contents

The DVD player transmits DVD-SMBLA in Audio stream to the Audio Amplifier.

Case C : Transmission of Packed PCM or compressed audio contents

1) The DVD player decodes the contents.

2) The DVD player transmits DVD-MBLA as Audio stream.

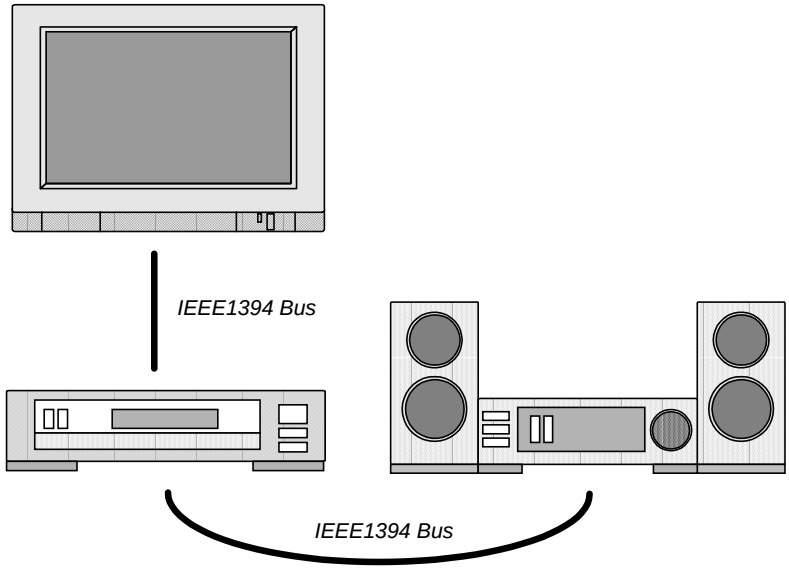


◊ **Figure 3.3.2-1 : Connection between DVD-Audio player and Audio Amplifier**

3.3.3 An example of the Connection between DVD-Video/Audio player, DTV and Audio Amplifier

In this model, a DVD-Video/Audio player connects with a DTV and an Audio Amplifier through IEEE1394 Bus, as described in Figure 3.3.3-1.

In this case, there are two methods to transmit. One is to transmit video and audio data as AV stream to the DTV and the Audio Amplifier. The other is to transmit in two isochronous channels, i.e. to transmit video data as AV stream to the DTV and transmit audio data as Audio stream to the Audio Amplifier.



◊ **Figure 3.3.3-1 : Connection between DVD-Video / Audio player, DTV and Audio Amplifier**

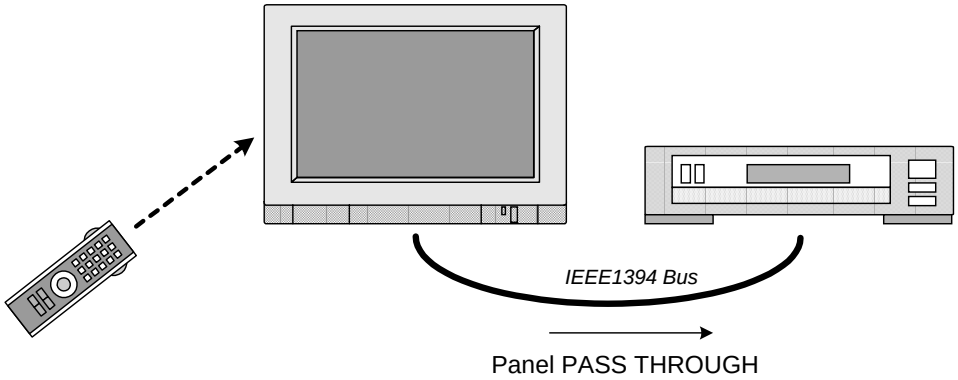
3.4 Concept of DVD Control

3.4.1 Control Command

To control a DVD player, this guideline recommends a Controller (e.g. a DTV) to transfer the user's remote control commands from the Controller to the DVD player using the Panel Subunit PASS THROUGH command, as described in Figure 3.4.1-1. Some Panel PASS THROUGH commands aren't handled in this guideline. (e.g. Channel up/down, Volume up/down, Record) Some Panel PASS THROUGH commands have the interpretation for DVD equipment. (e.g. Root menu, Setup menu, Exit)
As for details, refer to section 6.2.1 .

Process of Control

1) The controller receives the user's operation. (e.g. user points a DTV remote controller at a DTV so that he can control a DVD player)
2) The controller transfers user's remote control commands to the DVD player using the "Panel Subunit PASS THROUGH" command through IEEE1394 Bus.
3) The DVD player receives the commands and then works.



◊ **Figure 3.4.1-1 : Panel PASS THROUGH Model**

A DVD player shall support 16 commands in the PASS THROUGH command as mandatory, as shown in Table 3.4.1-1. A DVD player may support other commands as optional. As for details, refer to section 6.2.2 .

◊ **Table 3.4.1-1 : Operation List**

User operation	
Select	Exit
Up	Play
Down	Stop
Left	Pause
Right	Rewind
Root menu	Fast forward
Setup menu	Forward
Contents menu	Backward

3.4.2 Status Information

Almost all the DVD products have the capability to transmit status information and control menu as a part of AV stream, for example;

- The status information such as playback position, time information is transmitted onto video screen as OSD image
- A menu stream to select contents, language, etc

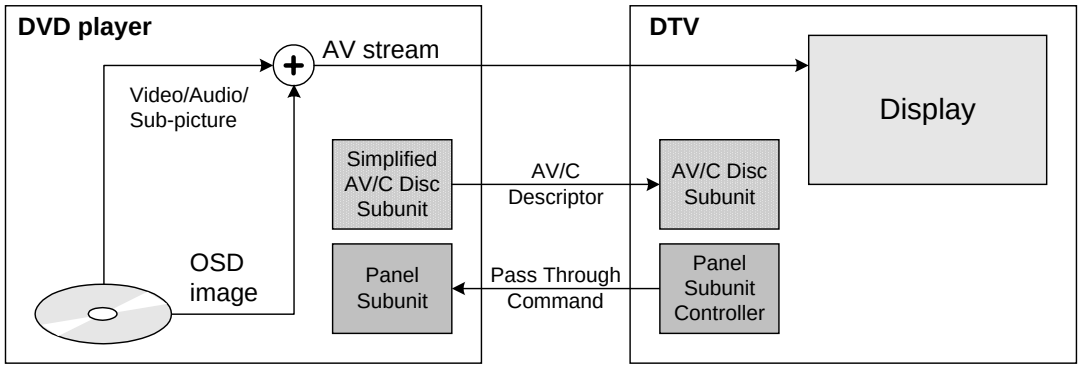
For a DVD player, a simplified status mechanism to provide its basic status information is necessary. Because, in case that some devices don't have the capability to display (e.g. an Audio Amplifier), they cannot display its status information when transmitted as a part of AV stream. So a DVD player shall have the functions to transmit the following information in Table 3.4.2-1 by AV/C Descriptor. Of course, a player may well have any other functions to show its status. As for details, refer to chapter 7.

◊ **Table 3.4.2-1 : Status Information**

Description	AV/C Status Name	Support Level
Media capabilities of the player (e.g. DVD-Video or DVD-Audio)	supported_media_type	Mandatory
Whether there is currently a disc in the drive	disc_in_drive	Mandatory
Type of disc in the drive	media_type	Mandatory
Status of drive (e.g. playing)	operating_mode	Optional
Current playing position	position_info_block	Optional
Total disc playback time	av_object_type_specific_info_block	Optional

3.4.3 Control System Model

To sum up, a DVD player shall have the simplified AV/C Disc Subunit Descriptor to return the status information and the Panel Subunit to interpret the control commands, as described in Figure 3.4.3-1.

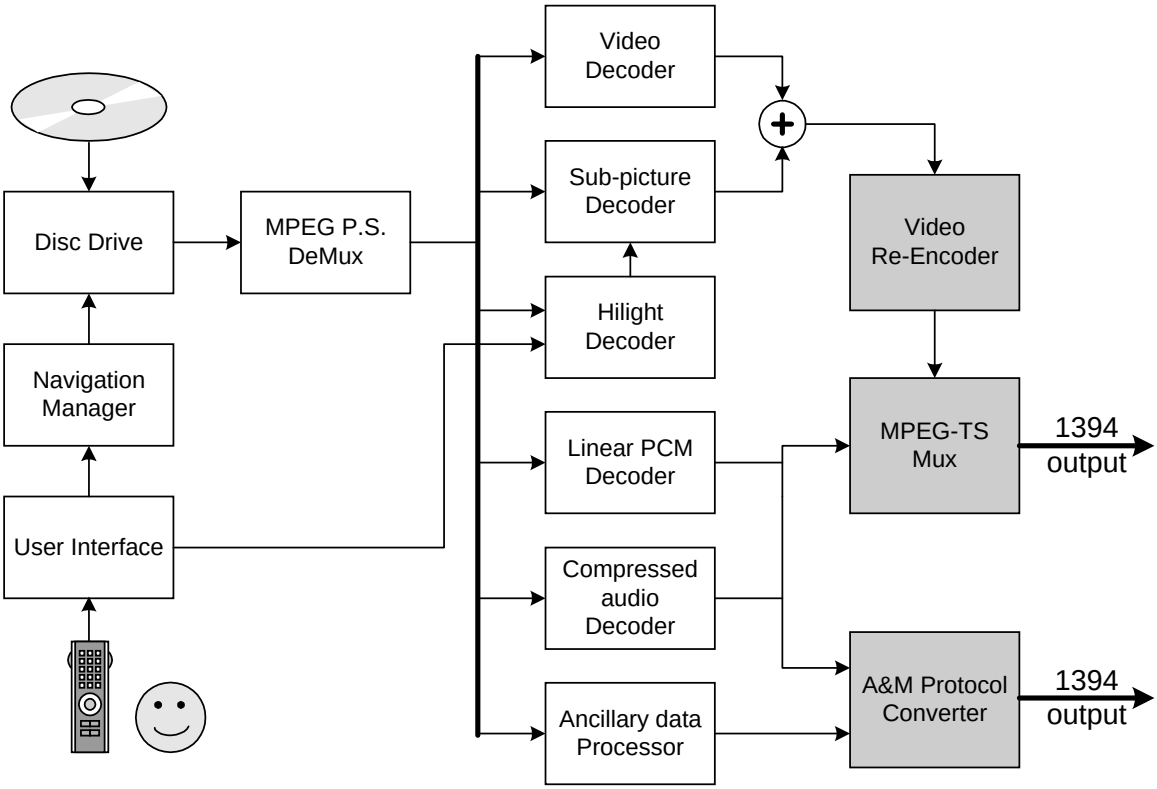


◊ **Figure 3.4.3-1 : Control System Model**

3.5 Implementation of DVD-Video/Audio player

An example model for the implementation of a DVD-Video/Audio player is described in Figure 3.5-1. In comparison with the DVD-Video/Audio player which doesn't have the capability to transmit through IEEE1394 Bus, the player have the following functions;

- Video Re-Encoder (to overlay sub-picture on video data)
- MPEG-TS Mux (to multiplex and transmit video and audio data)
- A&M Protocol Converter (especially to transmit high quality or multi-channel audio data)



◊ **Figure 3.5-1 : Implementation Model of DVD-Video/Audio player**

3.6 Copy Protection (Informative)

When a DVD player transmits the video/audio data through IEEE1394 Bus, there are some rules of the copy protection system. Refer to the scheme and its compliance rules.

This page is intentionally left blank.

4. Signal Definition of AV stream through IEEE1394 Bus

4.1 Purpose

In particular, this chapter describes how the Video and Audio outputs are put in the partial MPEG-2 Transport Stream which is then sent over the IEEE 1394 Bus according to IEC 61883-4.

4.2 Scope

This chapter describes the specification of the parameters of the Audio/Video data output from DVD equipment via IEEE 1394 Bus. This guideline provides the transport syntax, T-STD model parameters, and restrictions on detailed parameters.

This chapter defines a mandatory baseline stream format. At several places in this guideline optional stream formats are also defined.
The mandatory baseline stream format is defined in order to guarantee interoperability. Compliant source and sink devices shall be capable of processing the mandatory baseline stream format.
Optional stream formats may be used instead of the mandatory baseline stream format, if the end user of the system sets up the transmission of the signals between the source and sink devices over the IEEE 1394 Bus to use these optional signals. This may be done by means of player set-up or an equivalent method.

Chapter 7 in this document and "AV/C Disc Media Type Specification – DVD"([R21]) describes the control of a DVD-Video player

Note: Each parameter defined in this guideline is provisional value. Some parameters may be changed if necessary.

4.3 Protocol Stack

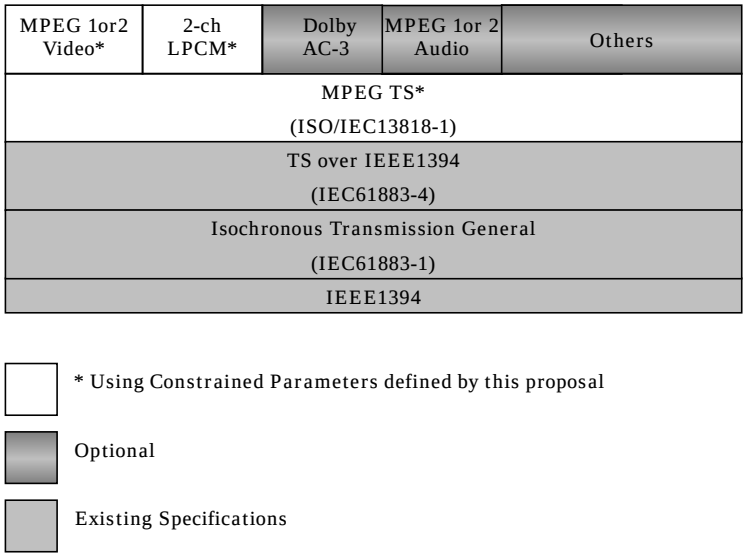
Figure 4.3-1 shows protocol stack to transmit Audio/Video data defined in this guideline using IEEE1394 isochronous channel. This guideline provides restrictions on parameters of asterisked layer shown in Figure 4.3-1. However, this guideline doesn't impose restrictions on the hatched existing standard shown in Figure 4.3-1.

This version of the DVD guideline defines several audio formats that may be multiplexed with a video signal into an MPEG2 Transport Stream. Multiplexing audio and video into a Transport Stream allows audio and video to be closely synchronized on playback and presentation.

This DVD guideline document defines a baseline audio format, and a number of optional formats that extend the capability of the system. The baseline audio format uses 16-bit LPCM stereo coding without compression at a sampling rate of either 44.1 kHz or 48kHz. This allows consumers to watch synchronized audio and video with full "CD-quality" sound system.

In addition to this baseline format, compressed audio formats that can be used within the transport stream have been defined. These formats allow a more efficient use to be made of the network bandwidth.

For the first stage of standardization, the DVD Forum considers this simple, two-channel system meets the current requirements for synchronized DVD playback over a digital interface. However, it is anticipated that it will be necessary to define formats for higher quality audio to be carried within the Transport Stream in the future, so that consumers may have the benefit of the highest quality A/V presentation with accurate synchronization. Thus LPCM formats for higher sampling rates, more bits/samples, and for multi-channel audio, which have been excluded from this current version of the guideline document in order to keep the system as simple as is consistent with the requirements, may be introduced in the future.



◊ **Figure 4.3-1 : Protocol Stack**

4.4 Video Elementary Stream

The video elementary stream to be transmitted shall conform to constrained video ES parameters shown in Table 4.4-1.

◊ Table 4.4-1 : Constrained Video ES Parameters

Items	Restrictions		
Compression format	MPEG1 (Constrained Parameters)	MPEG2 (MP@ML, MP@LL, SP@ML)	MPEG2 (MP@H-14 as constrained in this guideline)
Resolution	352x240 (for 525/60) 352x288 (for 625/50)	352x240, 352x480, 704x480, 720x480 (for 525/60) 352x288, 352x576, 704x576, 720x576 (for 625/50)	
Max. bit rate	1.856 Mb/s as in ISO/IEC 11172-2	15 Mb/s (4 for MP@LL) as in ISO/IEC 13818-2	30 Mb/s
Frame Rate	29.97 Hz (for 525/60) 25 Hz (for 625/50)		
Display Aspect Ratio	4:3 or 16:9		
Frequency of *Sequence Header*	*Sequence Header* shall appear at least every 0.7 seconds.		
Frequency of *GOP Header*	If low_delay is set to 0, *GOP Header* shall appear at least every 0.7 seconds, and *Sequence Header* shall precede every *GOP Header*. If low_delay is set to 1, *GOP Header* is optional.		
Low delay	Not Applicable	Permitted	
Buffer size	as in ISO/IEC 11172-2	as in ISO/IEC 13818-2	1 835 008 bits (as in ISO/IEC 13818-2 MP@ML)
Picture coding type	as in ISO/IEC 11172-2	as in ISO/IEC 13818-2	intra-coded only picture_coding_type = 001

4.5 Audio Elementary Stream

4.5.1 Audio elementary stream formats

The audio elementary stream to be transmitted shall conform to one of the formats shown in Table 4.5.1-1.

◊ Table 4.5.1-1 : Constrained Audio ES Parameters

		Mandatory	Optional
Audio ES format	LPCM	Raw Audio Data as defined in this guideline	-
	Dolby AC-3	-	48 kHz
	MPEG1 Audio	-	48 kHz
	MPEG2 Audio	-	48 kHz
Sampling Frequency		44.1 / 48 kHz	48 kHz
Bits per sample		16 bits	-
Number of channels		stereo (L/R)	Max. 2-ch/MPEG1 audio Max. 8-ch/MPEG2 audio Max. 2-ch/Dolby AC-3

4.5.2 Linear PCM audio

Linear PCM audio supports the basic modes of operation in

Table 4.5.2-2. All source devices that comply with this guideline are able to support 48 kHz or 44.1 kHz, 16-bit, stereo sampling. All source devices have the freedom to select 48 kHz or 44.1 kHz whichever is easiest to generate, depending on the audio source. All sink devices that comply with this guideline are able to support 48 kHz and 44.1 kHz, 16-bit, stereo sampling.

The audio format to be transmitted shall conform to constrained audio format shown in Table 4.5.2-1.

◊ Table 4.5.2-1 : Constrained LPCM Parameters

Audio Format	2 ch LPCM (Format defined in this guideline)
Sampling Frequency	44.1 / 48 kHz
Bits per sample	16 bits
Number of channels	2 ch
Mode	Stereo / Mono

◊ **Table 4.5.2-2 : Basic parameters of LPCM**

Sampling frequency	48 kHz	44.1 kHz
Sampling phase	Simultaneous in all channels	
Quantization	16 bits of 2's complement	
Emphasis	Permitted zero point 50 μs Pole 15 μs	Permitted zero point 50 μs Pole 15 μs

4.5.2.1 LPCM PES packet structure

Linear PCM audio shall use the follow PES packet structure.

◊ **Table 4.5.2.1-1 : Structure of audio PES packet for LPCM**

packet Header	sub stream id	LPCM audio header	Audio data (Linear PCM audio)
16 bytes	1 byte	3 bytes	2 channels/16 bits: 1536 bytes

The contents of the packet header are shown in Table 4.5.2.1-2.

◊ Table 4.5.2.1-2 : Audio PES packet header

Field	Number of bits	Value
packet_start_code_prefix	24	$00\ 00\ 01_{16}$
stream_id	8	1011 1101b
PES_packet_length	16	shall be set to correct value
'10'	2	10b
PES_scrambling_control	2	00b
PES_Priority	1	0
data_alignment_indicator	1	0
Copyright	1	0
original_or_copy	1	1 or 0
PTS_DTS_flag	2	10b
ESCR_flag	1	0
ES_rate_flag	1	0
DSM_trick_mode_flag	1	0
additional_copy_info_flag	1	0
PES_CRC_flag	1	0
PES_extension_flag	1	0
PES_header_data_length	8	07_{16}
'0010'	4	0010b
PTS[32..30]	3	shall be set to correct value
marker_bit	1	1b
PTS[29..15]	15	shall be set to correct value
marker_bit	1	1b
PTS[14..0]	15	shall be set to correct value
marker_bit	1	1b
stuffing_bytes	16	$FF\ FF_{16}$
sub_stream_id	8	1010 0000b
number_of_frame_headers	8	0000 0100b
reserved	7	000 0000b
audio_emphasis_flag	1	provider defined
quantization_word_length	2	provider defined
audio_sampling_frequency	3	provider defined
number_of_audio_channels	3	provider defined

Semantics for the Audio PES packet header:

stream_id: The stream_id of the audio packet shall be set to 1011 1101b (private_stream_1).

PES_packet_length: The PES_packet_length shall be set to the correct length.

PES_header_data_length: The PES_header_data_length shall be set to 07_{16} to indicate that there it is followed by 7 bytes of optional data.

sub_stream_id: The sub_stream_id shall be set to 1010 0000b.

stuffing bytes: There shall be 2 stuffing bytes.

number_of_frame_headers: The number_of_frame_headers shall be set to 0000 0100b. In this guideline there shall be four audio frames in each PES packet. The first byte of the PES packet payload shall be the first byte of an audio frame. The LPCM audio Access unit, a term used in defining MPEG TS multiplexing and buffer models, is an audio frame.

audio_emphasis_flag: The audio_emphasis_flag gives the state of audio emphasis and takes the values shown in Table 4.5.2.1-3.

◊ Table 4.5.2.1-3 : Audio Emphasis Flag

Value	Emphasis
0b	Emphasis Off
1b	Emphasis On

quantization_word_length: The quantization_word_length gives the length of audio samples and has the values in Table 4.5.2.1-4.

◊ Table 4.5.2.1-4 : Quantization_word_length

Value	Quantization_word_length
00b	16 bits
01b	reserved
10b	reserved
11b	reserved

audio_sampling_frequency: The audio_sampling_frequency takes the values shown in Table 4.5.2.1-5.

◊ Table 4.5.2.1-5 : Audio_sampling_frequency

Value	Audio_sampling_frequency
000b	reserved
001b	44.1 kHz
010b	48 kHz
011b	reserved
100b	reserved
101b	reserved
110b	reserved
111b	reserved

number_of_audio_channels: The number_of_audio_channels takes the values shown in Table 4.5.2.1-6.

◊ **Table 4.5.2.1-6 : Number_of_audio_channels**

Value	number_of_audio_channels
000b	2 ch (dual-mono: L=R)
001b	2 ch (stereo)
010b	reserved
011b	reserved
100b	reserved
101b	reserved
110b	reserved
111b	reserved

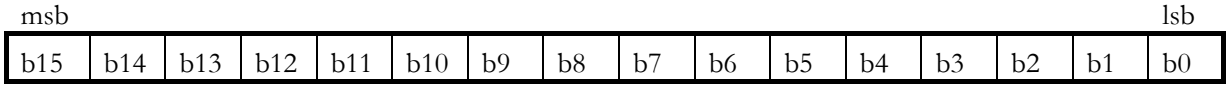
Note: In case of output of monaural audio, dual-mono audio shall be applied; i.e. number_of_audio_channels = 000b.

4.5.2.2 Linear PCM audio

Audio samples are 16-bit two's complement integers. Bit ordering for LPCM audio samples is such that the most significant bit (msb) is the first (left-most) bit and the least significant bit (lsb) is last.

4.5.2.2.1 16-bit LPCM audio samples

A 16-bit LPCM sample is split into two 8-bit bytes, a shown in Figure 4.5.2.2.1-1.



◊ **Figure 4.5.2.2.1-1 : 16-bit LPCM sample**

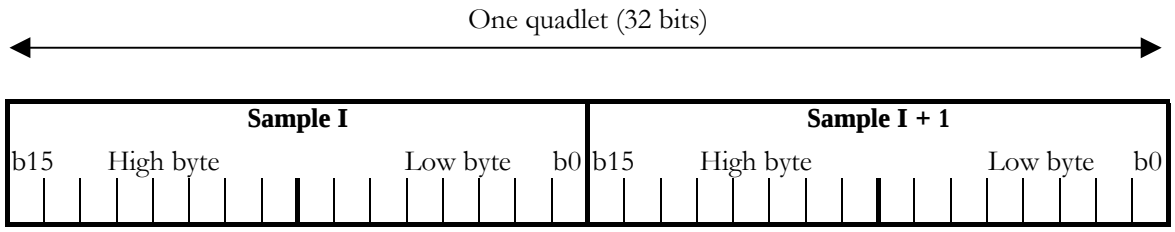
The high byte represents the eight most significant (b15...b8), and the low byte represents the eight least significant bits (b7...b0).

4.5.2.3 Packing LPCM samples

A method of packing samples into 32-bit words is provided. This is called 16 by 2 and shall be used for 16-bit samples.

4.5.2.3.1 16-bit by 2 linear PCM audio sample packing

Pairs of 16-bit LPCM samples are packed into one 32-bit word as shown in Figure 4.5.2.3.1-1.



◊ **Figure 4.5.2.3.1-1 : 16-bit by 2 sample packing**

4.5.2.4 Audio Framing

In all cases an audio frame consists of 80 samples per stereo. The frame size of 80 samples is chosen so that data for one frame fits exactly into an integer number of 32-bit words without the need for padding.
It is required that all audio frames contain exactly 80 samples so that they start and end on a 32-bit word boundary. To ensure this, it may be necessary to pad audio with silence to the end of a frame.
Audio frames contain no header. There is a header carried at the start of each PES packet.

◊ **Table 4.5.2.4-1 : Audio Frame Sizes**

Number of channels	Bits	Frame size	
		Bytes	Quadlets
2 (stereo)	16	320	80

4.5.2.5 Channel Mapping

Synchronous audio samples for each of the 2 channels are packed sequentially according to the appropriate packing scheme (16 by 2) depending on the quantization of the samples. The 2 samples that correspond to the same sampling time are written sequentially in a 2-sample group. The 2-sample groups are written sequentially corresponding to increasing sampling time. The synchronous samples in each 2-sample group are given alphabetical labels that correspond to the order in which they are packed.
e.g. we have labeling A, B, A, B, ...

4.5.2.5.1 Mono Audio

Samples are sequentially ordered as shown in Table 4.5.2.5.1-1.

◊ **Table 4.5.2.5.1-1 : Mono channel mapping**

Sample	Channel
A	Mono
B	Mono

4.5.2.5.2 Stereo Audio

Samples A and B correspond to signals as shown in Table 4.5.2.5.2-1.

◊ Table 4.5.2.5.2-1 : Stereo channel mapping

Sample	Channel
A	Left
B	Right

4.5.3 Dolby AC-3

For Dolby AC-3 audio stream shall comply with Dolby AC-3 Standard (ATSC STANDARD "DIGITAL AUDIO COMPRESSION (AC-3)"Doc.A/52 20 Dec, 1995, [R11]) and DVD Specifications for Read-Only Disc/Part 3: Video Specifications ([R1]).

Note: Reference of the AC-3 specification may be modified when the specification is updated.

Restricted Items of AC-3 are as follows.

◊ Table 4.5.3-1 : Ristricted Items for Dolby AC-3 streams

Bit rate	Between 64 k and 448 kbps
Sampling frequency	48 kHz only
Audio coding mode	1/0, 2/0
Language Code	Not used (may be modified)

4.5.3.1 PES packet

Constraints on the semantics of PES packet fields are as follows:

stream_id: set to "1011 1101" (private_stream_1).

PTS_DTS_flag: Each PES packet shall contain a PTS, i.e., PTS_DTS_flag shall be equal to '10'.

4.5.4 MPEG1 audio

MPEG1 audio streams shall comply with the syntax and semantics as specified in ISO/IEC 11172-3 (MPEG1 audio standard, [R10]) and [R1].

Additional constraints on MPEG1 audio streams are specified as follows.

◊ Table 4.5.4-1 : Ristricted Items for MPEG1 coding streams

Layer	LayerII only
Protection	CRC Check always on
Bit rate	Mono(1-channel): between 64 k and 192 kbps Stereo(2-channel): between 64 k and 384 kbps
Sampling frequency	48 kHz only
Private bit	set to 0
Mode	1/0, 2/0
Emphasis	Always no emphasis
Surround	-
Dematrix-procedure	Unmatrix mode('11b') excluded (always MPEG1 compatible)
Number of multilingual ch.	0
mc-prediction-on	0
Number of bit reserved for "dynamic-range-contrl" in ancillary data	Not used

4.5.4.1 PES packet of the MPEG1 audio stream

Constraints of PES packet fields are as follows:

stream_id: set to "1100 000x" (ISO/IEC 11172-3 audio stream number x). For the primary audio stream, the value "x" equals 0. For the secondary audio stream, the value "x" equals 1.

PTS_DTS_flag: Each PES packet shall contain a PTS, i.e., PTS_DTS_flag shall be equal to '10'.

The first byte of PES packet payload shall be the first byte of audio frame.

One PES packet may contain more than one audio frame.

4.5.5 MPEG2 audio

For MPEG2 audio the audio stream shall comply with ISO/IEC 13818-3 ([R8]) and the further constraints defined by the DVD-Video specifications ([R1]).

4.5.5.1 PES packets for MPEG2 audio streams

For MPEG2 audio without an extension stream, the audio stream shall be consecutively inserted into the payload of audio PES packets. The audio PES packets packetisation rules are identical to the rules defined in [R1]. For MPEG2 audio with an extension stream, the PES packetisation rules are identical to the rules defined in [R1].

4.5.5.2 Transport packets for MPEG2 audio streams

The PES packets for audio shall be inserted into transport packets according to ISO/IEC 13818-1([R6]). In the case of MPEG2 audio with an extension stream, the sequence order of main and extension PES packets defined in the DVD-Video specification shall be preserved. The base and extension streams shall be transported in different PIDs that shall be assigned according to Table 4.6.2-1 of this guideline.

4.6 Partial Transport Stream

4.6.1 Restrictions on Partial TS parameters

The parameters of partial transport stream to be transmitted shall conform to constrained partial TS parameters shown in Table 4.6.1-1.

◊ Table 4.6.1-1 : Constrained Partial TS Parameters

Items	Restrictions
Max. Transport Rate	36.096 Mb/s
Number of Video streams*	0 - 1
Number of Audio streams*	0 - 2
PSI	Both PAT and PMT shall appear at least every 100 msec.
SIT	SIT shall appear at least every 3 second.
DIT	DIT shall appear when needed
Others	shall conform to ISO/IEC 13818-1 (MPEG-TS)

Note 1:

It is recommended to transmit the DIT, PAT, PMT, and SIT before any other data in the transport stream, so that presentation may begin at the beginning of the sequence.
Also, it is recommended that the PAT/PMT/SIT should be sent significantly before the first AV data to allow demultiplexing PID filters to be initialized.

Note 2:

At the beginning of the transmission sequence, it is recommended to transmit the PAT and P MT more than once to ensure receiving at the target device. Also refer to 2.4.2.6 in ISO/IEC 13838-1 for avoiding any misunderstandings.

* At least one Video or Audio stream shall be multiplexed.

4.6.2 PID assignments

PID assigned in PMT, SIT, and DIT shall conform to Table 4.6.2-1.

◊ Table 4.6.2-1 : PID assignments

PID	Value
PAT_PID	00 00_{16} (fixed value)
PMT_PID	00 40_{16} – $1FFE_{16}$ (assigned in PAT)
SIT_PID	00 $1F_{16}$ (fixed value)
DIT_PID	00 $1E_{16}$ (fixed value)
PCR_PID	00 40_{16} – 1F FE_{16} (assigned in PMT)
VIDEO_PID	00 40_{16} – 1F FE_{16} (assigned in PMT)
AUDIO_1_PID	00 40_{16} – 1F FE_{16} (assigned in PMT if audio stream is multiplexed in partial TS)
AUDIO_2_PID	00 40_{16} – 1F FE_{16} (assigned in PMT if 2 audio streams are multiplexed in partial TS)
Null packet	1F FF_{16} (fixed value)

Note:

It is recommended that a fixed PID mapping be used for all streams during a stream connection.

4.6.3 stream_type definition

This guideline defines stream_type for N-ch LPCM using user area of stream_type as shown in Table 4.6.3-1.

◊ Table 4.6.3-1 : stream_type definition

Value	Description
Defined by MPEG2 System (ISO/IEC 13818-1):	
02_{16}	MPEG2 video (ISO/IEC 13818-2) or MPEG1 constrained parameter video (ISO/IEC 11172-2)
03_{16}	MPEG1 audio (ISO/IEC 11172-3)
04_{16}	MPEG2 audio(ISO/IEC 13818-3)
Defined by this guideline:	
81_{16}	Dolby AC-3
83_{16}	2-ch LPCM audio

4.6.4 stream_id assignments

private_stream_1 defined in MPEG2 System (ISO/IEC 13818-1, [R6]) shall be used for stream_id for 2-ch LPCM, as shown in Table 4.6.4-1.

◊ **Table 4.6.4-1 : stream_id assignments**

Elementary Stream	Value
Defined by MPEG2 System (ISO/IEC 13818-1):	
MPEG1 video	$E0_{16}$ – EF_{16} (arbitrary)
MPEG2 video	$E0_{16}$ – EF_{16} (arbitrary)
MPEG1 audio	$C0_{16}$ – DF_{16} (arbitrary)
Defined by this guideline:	
2-ch LPCM audio	BD_{16} (private_stream_1)
Dolby AC-3	BD_{16} (private_stream_1)

4.6.5 PSI format

Some of Information, such as PAT, PMT, SIT and DIT shall be introduced.

4.6.5.1 PAT

PAT shall conform to constrained program association section format shown in Table 4.6.5.1-1.

◊ **Table 4.6.5.1-1 : Constrained Program Association Section format**

PID : 00_{16}

Field	No. of bits	Value
table_id	8	00_{16}
section_syntax_indicator	1	1b
'0'	1	0b
reserved	2	11b
section_length	12	011_{16}
transport_stream_id	16	arbitrary
reserved	2	11b
version_number	5	shall be set to correct value
current_next_indicator	1	1b
section_number	8	00_{16}
last_section_number	8	00_{16}
program_number	16	0000_{16}
reserved	3	111b
network_PID	13	$001F_{16}$
program_number	16	Non zero value
reserved	3	111b
program_map_PID	13	0040_{16} – $1FFE_{16}$
CRC_32	32	shall be set to correct value

Semantics for the Constrained Program Association Section format:

transport stream id: This field should have appropriate value for transport stream id.

version_number: This 5-bit field is the version number of the table. The version_number shall be incremented by 1 when a change in the information carried within the table occurs. When it reaches value 31, it wraps around to 0.

network PID: This 13-bit field always has value $001F_{16}$, and it shows PID of SIT.

program map PID: This field shows PMT PID which describes the program number(=service id).

4.6.5.2 PMT

PMT shall conform to constrained transport stream program map section format shown in Table 4.6.5.2-1.

◊ Table 4.6.5.2-1: Constrained Transport Stream Program Map Section format

PID : assigned in PAT

Field	No. of bits	Value
table_id	8	02_{16}
section_syntax_indicator	1	1
'0'	1	0
reserved	2	11b
section_length	12	shall be set to correct value
program_number	16	shall be identical with PAT
reserved	2	11b
version_number	5	shall be set to correct value
current_next_indicator	1	1
section_number	8	00_{16}
last_section_number	8	00_{16}
reserved	3	111b
PCR_PID	13	0040_{16} – $1FFE_{16}$
reserved	4	1111b
program_info_length	12	shall be set to correct value
registration_descriptor()	48	(see Table 4.6.6.2-1)
reserved for copy control descriptor		
DVD_stream_descriptor()	32	(see Table 4.6.6.4-1)
Video_Elementary_Stream_Info()	40 or 0	(see Table 4.6.5.2-2)
Audio_Elementary_Stream_1_Info()	72 or 0	(see Table 4.6.5.2-3)
Audio_Elementary_Stream_2_Info()	72 or 0	
CRC32	32	shall be set to correct value

Semantics for the Constrained Transport Stream Program Map Section format:

version_number: This 5-bit field is the version number of the table. The version_number shall be incremented by 1 when a change in the information carried within the table occurs. When it reaches value 31, it wraps around to 0.

copy control descriptor: This descriptor may be required in transmitting the copyrighted contents. The size of the descriptor is TBD.

◊ Table 4.6.5.2-2 : Video_Elementary_Stream_Info format

Field	No. of bits	Value
stream_type	8	02_{16} (see Table 4.6.3-1)
reserved	3	111b
VIDEO_PID	13	0040_{16} – $1FFE_{16}$ (see Table 4.6.2-1)
reserved	4	1111b
ES_info_length	12	shall be set to correct value
for (i=0, i<N, i++)		
descriptor(s)		optional

◊ Table 4.6.5.2-3 : Audio_Elementary_Stream_x_Info format

Field	No. of bits	Value
stream_type	8	shall be set to correct value (see Table 4.6.3-1)
reserved	3	111b
AUDIO_x_PID	13	0040_{16} – $1FFE_{16}$ (see Table 4.6.2-1)
reserved	4	1111b
ES_info_length	12	shall be set to correct value
for (i=0, i<N, i++){		
LPCM_audio_stream_descriptor	32	(see Table 4.6.6.5-1)
descriptor(s)		optional
}		

x: audio stream number (1-2)

4.6.5.3 SIT

DVD-Video TS shall contain the SIT defined in ETS 300 468 ([R12]).
Constraints on the semantics of Selection_information_section fields are defined as follows.
service_id: The SIT shall contain exactly one service_id, and this value is the same as the program_number in the PMT.
running_status: This field shall be set to 0 ("undefined").

The Partial transport stream descriptor with 63_{16} of descriptor_tag shall be located in SIT 1st loop as Mandatory.
Maximum time interval for the SIT is less than 3 second.

Partial Transport Stream Descriptor:

- The Selection_information_section shall contain the partial transport stream descriptor in the transmission_info loop (1st loop).
- The partial transport stream descriptor is also defined in ETS 300 468([R12]), Section 4.5.6.

4.6.5.3.1 Selection Information Table (SIT)

The SIT describes the service(s) and event(s) carried by the "partial" TS.

◊ **Table 4.6.5.3.1-1 : Selection Information section**

Syntax	No. of bits	Identifier
selection_information_section(){		
table_id	8	uimsbf
selection_syntax_indicator	1	bslbf
reserved_future_use	1	bslbf
ISO_reserved	2	bslbf
section_length	12	uimsbf
reserved_future_use	16	bslbf
ISO_reserved	2	bslbf
version_number	5	uimsbf
current_next_indicator	1	bslbf
section_number	8	uimsbf
last_section_number	8	uimsbf
reserved_future_use	4	uimsbf
transmission_info_loop_length	12	uimsbf
for (i=0; i<N; i++){		
descriptor()		(see Table 4.6.6.3-1)
}		
for (i=0; i<N; i++){		
service_id	16	uimsbf
reserved_future_use	1	bslbf
running_status	3	bslbf
service_loop_length	12	bslbf
for (j=0; j<M; j++){		
descriptor()		not used
}		
}		
CRC32	32	rpchof
}		

Semantics for the Selection Information section:

table_id: $7F_{16}$

section_syntax_indicator: The section_syntax_indicator is a 1-bit field which shall be set to "1".

section_length: This is a 12-bit field. It specifies the number of bytes of the section, starting immediately following the section_length field and including the CRC. The section_length shall not exceed 4093 so that the entire section has a maximum length of 4096 bytes.

version_number: This 5-bit field is the version number of the table. The version_number shall be incremented

by 1 when a change in the information carried within the table occurs. When it reaches value 31, it wraps around to 0.

current_next_indicator: This 1-bit indicator, when set to "1"

section_number: This 8-bit field gives the number of the section. The section_number shall be 00_{16}.

last_section_number: This 8-bit field specifies the number of the last section. The last_section_number shall be 00_{16}.

transmission_info_loop_length: This 12-bit field gives the total length in bytes of the following descriptor loop describing the transmission parameters of the partial TS.

descriptor in transmission_info_loop: The transmission_info_loop in SIT shall contain the Partial_transport_stream_descriptor. As for the partial_transport_stream descriptor for DVD TS stream, refer to section 4.6.6.3 .

service_id: This is a 16-bit field which serves as a label to identify this service from any other service within a TS. The service_id is the same as the program_number in the corresponding program_map_section.

running_status: This 3-bit field indicates the running status of the event in the original stream. This is the running status of the original present event. If no present event exists in the original stream the status is considered as "not running". The meaning of the running_status value is as defined in ETR 211([R13]).

service_loop_length: This 12-bit field gives the total length in bytes of the following descriptor loop containing SI related inforkation on the service and event contained in the partial TS.

descriptor in servece_loop: The service_loop in SIT does not contain any descriptors, however, optionally some descriptors might be introduced in the future.

CRC_32: This is a 32-bit field that contains the CRC value that gives a zero output of the registers in the decoder defined in annex B of ISO/IEC 13818-1 after processing the entire section.

4.6.5.4 DIT

4.6.5.4.1 Discontinuity Information Table (DIT)

Bitstreams may have transitions where they are discontinuous with respect to any of the SI information and the time-base, as defined by the PCRs. ETS 300 468 defines the DIT table that is designed to be inserted into the stream at these points to indicate the exact transition point. A receiver may use this information to recapture the SI/PSI information and re-synchronize the system time base.

Note that it is not necessary to insert a DIT table to signal normal changes to the SI/PSI information that are described by the normal table version signaling mechanism.

This specification requires that bitstreams shall contain a DIT table, as defined in Table 4.6.5.4.1-1, at transition points at which the timebase or PSI/SI information are discontinuous. The rules for insertion of the DIT are given in section 4.6.5.4.2.

Whenever a partial bitstream discontinuity occurs, two transport packets belonging to PID $001E_{16}$ shall be inserted directly at the transition point, with no other packets in between. The first one shall have 184 bytes of

adaptation field stuffing with discontinuity_flag set to "1" (in order to ensure compliance to MPEG2 continuity counting constraints for successions of transitions introduced at independent transmission/storage stages). The second of these transport packets shall contain the "DIT" and shall not have such a flag set to "1".

◊ Table 4.6.5.4.1-1 : Discontinuity Information section

Syntax	No. of bits	Identifier
discontinuity_information_section() {		
table_id	8	uimsbf
section_syntax_indicatior	1	bslbf
reserved_future_use	1	bslbf
reserved	2	bslbf
section_length	12	uimsbf
transition_flag	1	uimsbf
reserved_future_use	7	bslbf
}		

Semantics for the Discontinuity Information section:

table_id: $7E_{16}$

section_syntax_indicator: The section_syntax_indicator is a 1-bit field which shall be set to "0".

section_length: This is a 12-bit field, which is set to 001_{16}.

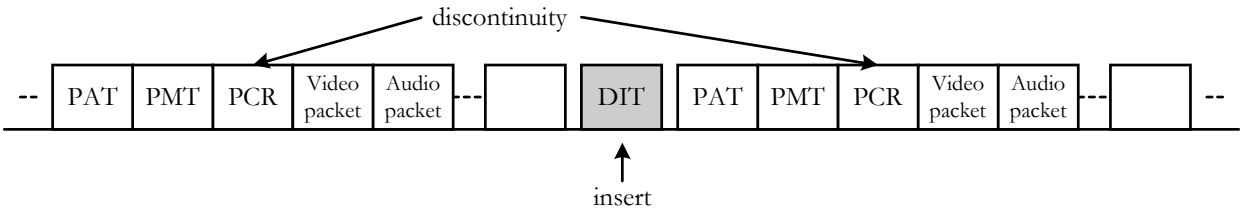
transition_flag: This 1-bit flag indicates the kind of transition in the TS. When the bit is set to "1", it indicates that the transition is due to a change of the originating source. The change of the originating source can be a change of originating TS and/or a change of the position in the TS (e.g. in case of time-shift). When the bit is set to "0", it indicates that the transition is due to a change of the selection only, i.e. while staying within the same originating TS at the same position.

4.6.5.4.2 Insert condition of DIT

Following conditions are applied for DIT inserting condition**;**

- DIT shall be inserted when the time base discontinuity (that is a PCR discontinuity) occurs in outputting partial TS stream. (See Figure 4.6.5-1)
  Note: DIT may be inserted other than this condition.

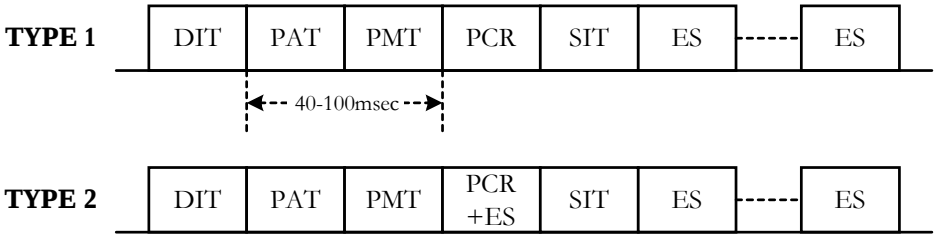
- DIT is inserted at the start position in a sequence of partial TS stream, followed by PAT, PMT, PCR, SIT and Elementary Streams.



◊ **Figure 4.6.5-1 : Insertion of DIT**

Note:

There are 2 types of transmission of PCR in a sequence of partial TS stream. One is by using PCR-PID which consists only adaptation field, and the other is to be included in the AV packets. Both of them are permitted for output from the source device. See Figure 4.6.5-2.



◊ **Figure 4.6.5-2 : A sequence of partial TS stream**

4.6.6 Descriptors

4.6.6.1 Descriptor Tag

This guideline defines descriptors and descriptor tag value using user area of descriptor tag as shown in Table 4.6.6.1-1.

◊ **Table 4.6.6.1-1 : Descriptor Tag**

Value	Description
05_{16}	registration_descriptor
63_{16}	partial_transport_stream_descriptor
82_{16}	DVD_stream_descriptor
83_{16}	LPCM_audio_stream_descriptor

Note:

copy_control_descriptor will be defined in future and other descriptors may be added.

4.6.6.2 registration descriptor

The registration_descriptor for DVD is shown in Table 4.6.6.2-1. The registration descriptor shall appear in program_info_loop of PMT.

◊ **Table 4.6.6.2-1 : registration_descriptor**

Syntax	No. of bits	Value
registration_descriptor() {		
descriptor_tag	8	05_{16}
descriptor_length	8	04_{16}
format_identifier	32	DVDF
for (i = 0; i < N; i++){		
additional_identification_info	8	not used
}		
}		

When the registration_descriptor which has 44 56 44 46_{16} value insert into the 1st loop in PMT, the program which is pointed by the PMT shows partial TS as of DVD in this guideline.

4.6.6.3 partial transport stream descriptor

A partial_transport_stream_descriptor for DVD is shown in Table 4.6.6.3-1. The descriptor shall appear in transmission_info_loop of SIT.

◊ **Table 4.6.6.3-1 : partial_transport_stream_descriptor**

Syntax	No. of bits	Value
partial_transport_stream_descriptor(){		
descriptor_tag	8	63_{16}
descriptor_length	8	08_{16}
reserved_future_use	2	11b
peak_rate	22	shall be set to correct value
reserved_future_use	2	11b
minimum_overall_smoothing_rate	22	shall be set to correct value
reserved_future_use	2	11b
minimum_overall_smoothing_buffer	14	shall be set correct value
}		

Semantics for the partial TS descriptor:

peak_rate: The maximum momentary transport packet rate (i.e. 188 bytes divided by the time interval between start times of two succeeding TS packets). At least an upper bound for this peak_rate should be given. This 22-bit field is coded as a positive integer in units of 400 bits/second.

minimum_overall_smoothing_rate: Minimum smoothing buffer leak rate for the overall TS (all packets are covered). This 22-bit field is coded as a positive integer in units of 400 bits/second. The value 3F FF FF_{16} is used to indicate that the minimum smoothing rate is undefined.

maximum_overall_smoothing_buffer: Maximum smoothing buffer size for the overall TS (all packets are covered). This 14-bit field is coded as a positive integer in units of 1 byte. The value 3F FF FF_{16} is used to indicate that the maximum smoothing buffer size is undefined.

4.6.6.4 DVD stream descriptor

DVD stream descriptor is shown in Table 4.6.6.4-1. The descriptor shall appear in PMT.

◊ Table 4.6.6.4-1 : DVD_stream_descriptor

Field	No. of bits	Value
DVD_stream_descriptor(){		
descriptor_tag	8	82_{16} (see Table 4.6.6.1-1)
descriptor_length	8	02_{16}
type	8	01_{16} (as defined in this guideline)
reserved	8	FF_{16}
}		

4.6.6.5 LPCM audio stream descriptor

LPCM audio stream descriptor, which shows sampling rate, bits per sample, emphasis flag and number of channels of LPCM audio data multiplexed in DVD TS stream, is shown in Table 4.6.6.5-1. If DVD TS streamcontains LPCM audio, LPCM audio stream descriptor associated with each LPCM audio stream shall appear in PMT.

◊ Table 4.6.6.5-1 : LPCM_audio_stream_descriptor

Field	No. of bits	Value
LPCM_audio_stream_descriptor(){		
descriptor_tag	8	83_{16} (see Table 4.6.6.1-1)
descriptor_length	8	02_{16}
sampling_frequency	3	001b or 010b (see Table 4.5.2.1-5)
bits_per_sample	2	00b (see Table 4.5.2.1-4)
reserved	2	11b
emphasis_flag*	1	0b or 1b (see Table 4.5.2.1-3)
number_of_channels	3	000b or 001b (see Table 4.5.2.1-6)
reserved	5	1111b
}		

* Emphasis (zero point: 50 μs, Pole: 15 μs) can be applied only for 48 kHz or 44.1 kHz, see

Table 4.5.2-2.

4.6.6.6 MPEG2 audio descriptors

There are 2 types of MPEG2 audio descriptors.

4.6.6.6.1 MPEG2 audio without extension

The stream_type in the PMT associated with the PID that carries the MPEG2 audio streams shall be 04_{16}.

4.6.6.6.2 MPEG2 audio with extension

The PMT will define two PIDs - one for the base and one for the extension stream.
The stream_type in the PMT associated with the PIDs that carry the MPEG2 audio streams shall be 04_{16}.
Associated with each PID described in the inner loop of the PMT shall be an appropriate "hierarchy_descriptor" (see ISO/IEC 13818-1).
For the PID carrying the base stream the hierarchy descriptor shall have the following content:

◊ Table 4.6.6.6.2-1 : PID for MPEG2 audio base stream

Hierarchy Descriptor	Value
descriptor_tag	04_{16}
descriptor_length	04_{16}
hierarchy_type	$0F_{16}$
hierarchy_layer_index	00_{16}
hierarchy_embedded_layer_index	00_{16}
hierarchy_channel	00_{16}

For the PID carrying the extension stream the hierarchy descriptor shall have the following content:

◊ Table 4.6.6.6.2-2 : PID for MPEG2 audio extension stream

Hierarchy Descriptor	Value
descriptor_tag	04_{16}
descriptor_length	04_{16}
hierarchy_type	05_{16}
hierarchy_layer_index	01_{16}
hierarchy_embedded_layer_index	00_{16}
hierarchy_channel	00_{16}

4.7 Elementary Stream Multiplexing

4.7.1 MPEG1 video / MPEG2 video Multiplexing format

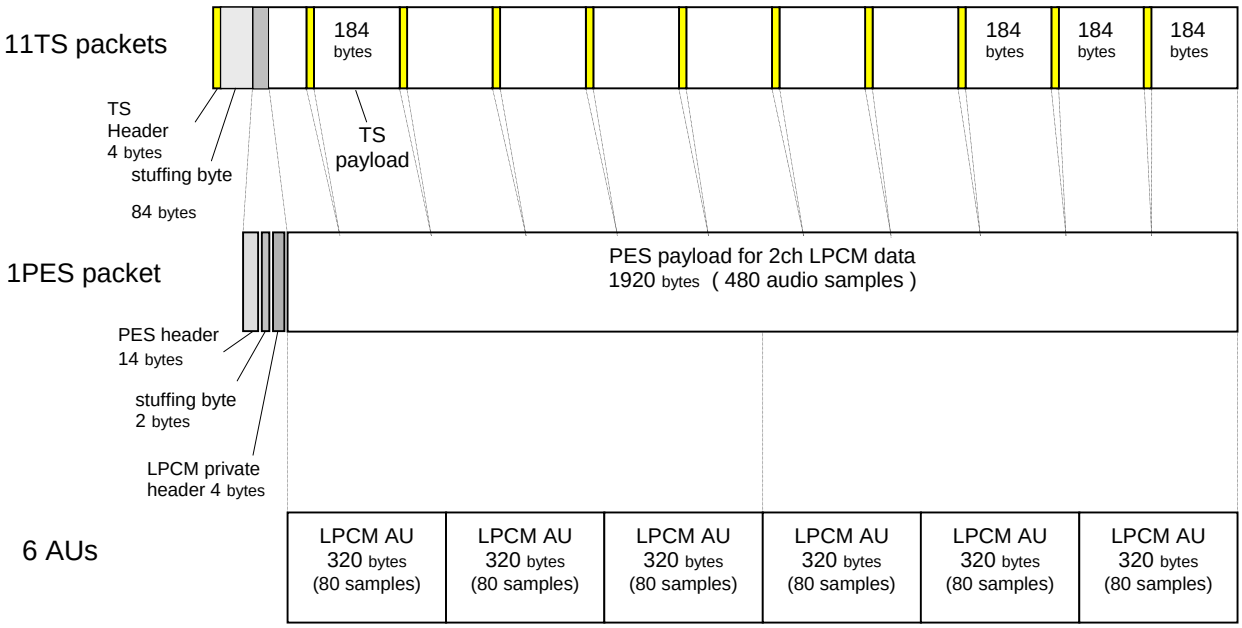
For MPEG2 video and MPEG1 video, packetizing and multiplexing format shall conform to MPEG-TS specified in ISO/IEC 13818-1 (MPEG2 System) and restrictions defined in this guideline.

4.7.2 stereo LPCM audio Multiplexing format (mandatory)

The PES format for stereo LPCM shall conform to restrictions defined in section 4.5.2.1 . The multiplexing format into TS packets is as defined in MPEG-TS standard (ISO/IEC 13813-1).
Table 4.7.2-1 shows a typical set of parameters for a stereo LPCM stream, while Figure 4.7.2-1 shows a typical transport format for carrying this stream.

◊ Table 4.7.2-1 : Typical Multiplexing parameters for stereo LPCM audio

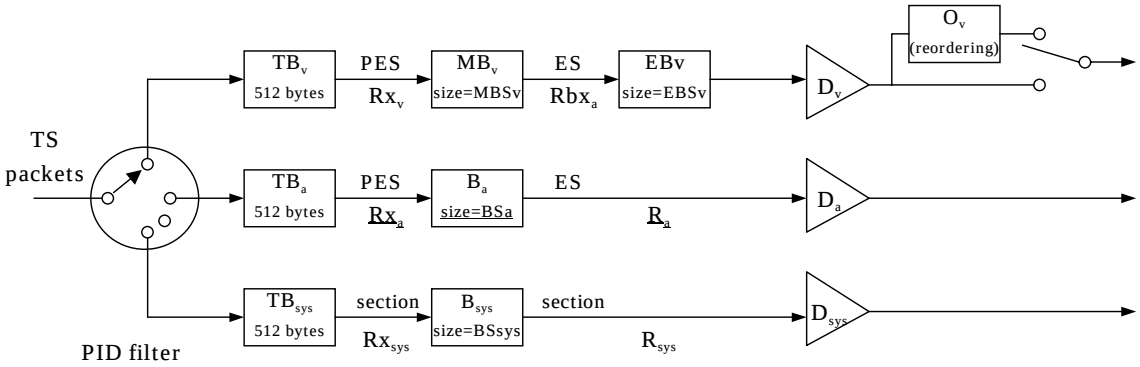
Parameters	Value	
	Fs = 48 kHz	Fs = 44.1 kHz
Size of Access Unit (AU)	80 samples	
Number of AUs in PES	6 AUs	
Size of PES packet	1920 bytes	
Number of samples in PES	480 samples	
Size of PES header	16 bytes (including 2 bytes stuffing)	
PES private header	4 bytes	
PES alignment	First byte of PES payload shall be first byte of audio AU	



◊ **Figure 4.7.2-1 : Typical Multiplexing parameters for stereo LPCM audio**

4.8 T-STD Model

Figure 4.8-1 shows T-STD model which is specified in ISO/IEC 13818-1 (MPEG2 System).



◊ Figure 4.8-1 : MPEG2 Transport stream STD buffer model

4.8.1 T-STD for MPEG1 video / MPEG2 video

T-STD for MPEG1 video / MPEG2 video shall conform to MPEG-TS specified in ISO/IEC 13818-1 (MPEG2 System) and restrictions defined in this guideline.

4.8.2 T-STD for 2-ch LPCM audio (mandatory)

T-STD model for LPCM audio shall conform to T-STD model for MPEG audio except T-STD model parameters. T-STD model parameters for LPCM audio shall conform to Table 4.8.2-1.

◊ Table 4.8.2-1 : T-STD parameters for 2-ch LPCM audio

Parameters	Value			
	for 48 kHz		for 44.1 kHz	
	16-bit	20/24-bit	16-bit	20/24-bit
Rx_a	2 250 000 bps	3 000 000 bps	2 250 000 bps	3 000 000 bps
R_a	1 536 000 bps	2 304 000 bps	1 411 200 bps	2 116 800 bps
BS_a	4096 bytes			
AU size	80 samples			

4.8.3 T-STD for MPEG 1 Audio (optional)

T-STD for MPEG1 audio shall conform to MPEG-TS specified in ISO/IEC 13818-1 (MPEG2 System) and restrictions defined in this guideline.

4.8.4 T-STD for Dolby AC-3 (optional)

T-STD for Dolby AC-3 shall conform to Dolby AC-3 Standard (ATSC STANDARD "DIGITAL AUDIO COMPRESSION (AC-3)"Doc.A/52 20 Dec, 1995, [R11])

Note: Reference of the AC-3 specification may be modified when the specification is updated.

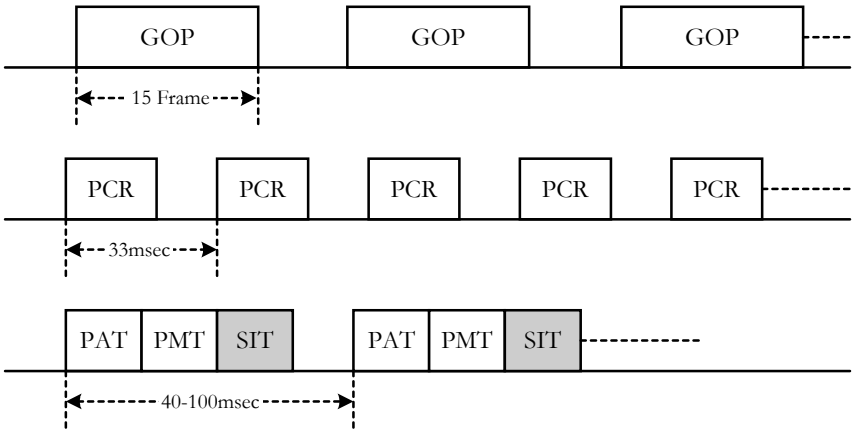
4.8.5 T-STD for PSI data

T-STD model for PSI data shall conform to MPEG-TS specified in ISO/IEC 13818-1.

4.9 Recommendations

4.9.1 Pause

As to output of the AV stream during in PAUSE period on source device, it is recommended to output the AV stream from the source device continuously. In this case, video signal, which might be a still-picture, should be transmitted and audio signal doesn't need to be transmitted. Also source device should continuously output PCR, PAT, PMT and SIT. Figure 4.9.1-1 shows the relation between the packets as an example of the MP@ML video stream.



◊ **Figure 4.9.1-1 : Tramsmission of the stream in PAUSE period**

5. Signal Definition of Audio stream through IEEE1394 Bus

5.1 Overview

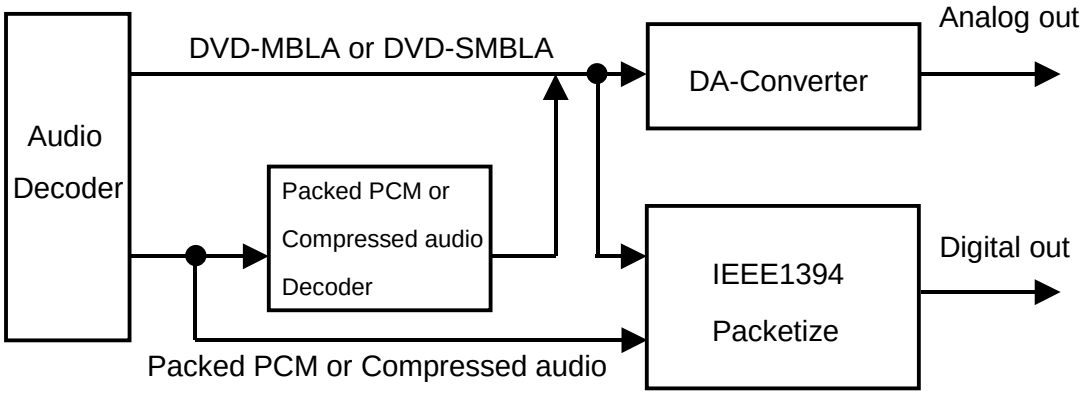
5.1.1 Purpose

This clause defines Audio stream output of DVD player through IEEE1394 Bus. Audio object recorded on DVD-Audio disc can be completely transmitted by using Audio and Music Data Transmission Protocol (Here in after, shortened as A&M Protocol) and Enhancement to Audio and Music Data Transmission Protocol 1.0 (also, shortened as A&M Protocol Enhancement). These protocols are applied to transmission of decoded compressed audio as well as DVD-MBLA and DVD-SMBLA of Linear PCM.
DVD-MBLA means Linear PCM without scalable and DVD-SMBLA means Linear PCM with scalable.
Transmission of compressed audio itself can be utilized with IEC 60958 conformant defined in A&M Protocol. Therefore this guideline does not specify it.
Also audio stream in Video object can be transmitted with up to six channels according to channel assignment specified in this guideline.

As for the relationship between contents recorded on DVD-Audio/Video and the transmission method of A&M Protocol, refer to section 3.1.2 .

5.1.2 Transmission Model

This guideline specifies the transmission model of DVD-MBLA or DVD-SMBLA as shown below. Therefore it is possible to transmit as DVD-MBLA when Packed PCM or compressed audio are decoded and also it is possible to transmit as DVD-MBLA when the scalable data of DVD-SMBLA is processed.
Note that transmission model of Packed PCM and compressed audio themselves aren't specified in this guideline.



◊ **Figure 5.1.2-1 : Transmission model**

5.2 Audio transmission method

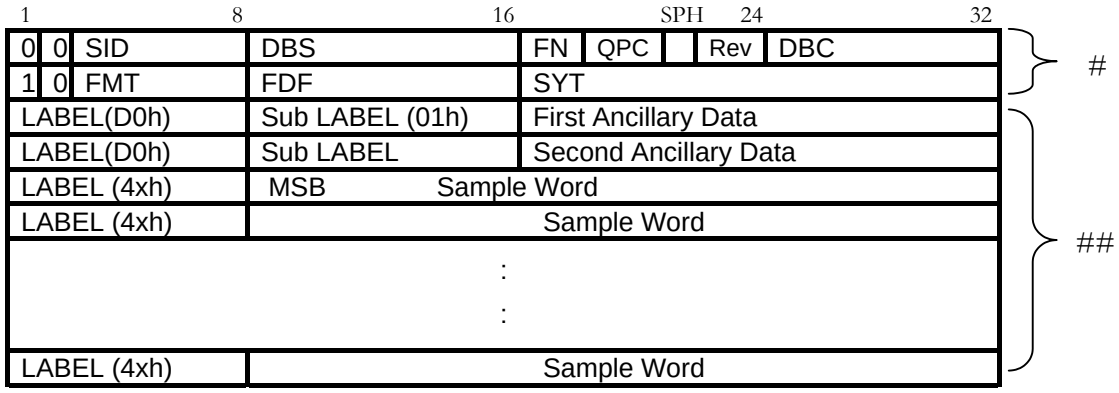
This section specifies how to use A&M Protocol, A&M Protocol Enhancement and A&M Protocol 2.0.

Note:
A&M Protocol 2.0 is now discussed in 1394TA/AVWG and a member of 1394TA can refer that from 1394TA web site, and also a non-member can refer after that is authorized.

5.2.1 Basic structure for Audio transmission

DVD audio block transmitted in Audio stream is shown in Figure 5.2.1-1.

DVD audio block shall consist of CIP header marked as "#", and DVD audio data block marked as "##" in this order as shown in Figure 5.2.1-1.
DVD audio data block shall consist of two Ancillary data fields and two, four or six Sample Word fields in this order as shown in Figure 5.2.1-1.
Ancillary data field consists of LABEL with the value D0h, Sub LABEL and First or Second Ancillary data.
Sample Word field consists of LABEL with the value 48h to 4Fh and Sample Word.



◊ Figure 5.2.1-1 : Basic Structure of DVD audio block

Although Compound data block structure is defined in A&M Protocol Enhancement, for DVD, compound data block structure is prohibited. Therefore in the case of simultaneous transmission of 6 channels and down mixed 2 channels, 2 isochronous channels are required for DVD.

It is strongly recommended to set the maximum bandwidth that DVD audio data block has 6 channels at 96 kHz, because if Audio contents are changed during streaming, the transmission will malfunction for lack of bandwidth.

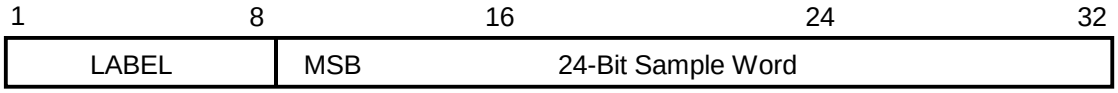
5.2.2 CIP header

The definition of each field in CIP header is as same as that of IEC 61883-1 and IEC 61883-6.
But the following restrictions are applied to DVD audio block.

1) The value of SFC in FDF shall not be set to 000b.
2) The value of SFC in FDF identifies the fs of Channel_Group1. The fs of Channel_Group2 is identified in ancillary data when DVD-SMBLA is transmitted.

5.2.3 LABEL definition

A&M Protocol has a 32-bit slot structure, and it consists of 24-bit data and 8-bit LABEL. Therefore, this structure is called AM824, AM is for Audio and Music.



◊ **Figure 5.2.3-1 : Data structure of AM824**

Audio stream uses one of the applications of DVD-MBLA with the range from 48h to 4Fh. The value of D0h for ancillary data is also defined for Audio stream. As for details, refer to section 5.2.4 .

◊ **Table 5.2.3-1 : LABEL Definition in A&M Protocol Enhancement**

Value	Description
00-3Fh	IEC 60958 Conformant
40-4Fh	Multi-Bit Linear Audio (MBLA)
50-57h	One-Bit Audio (Plain)
58-5Fh	One-Bit Audio (Encoded)
60-7Fh	reserved
80-83h	MIDI Conformant
84-87h	Extended Music Data
88-8Bh	SMPTE Time Code Conformant
8C-8Fh	Sample Count
90-BFh	reserved
C0-EFh	Ancillary Data
F0-FFh	reserved

5.2.4 Structure of Ancillary data field

5.2.4.1 LABEL in Ancillary data field

The value of LABEL in Ancillary data field shall be set to D0h.

5.2.4.2 Sub LABEL in Ancillary data field

Sub LABEL identifies the ancillary data in Ancillary data field as shown in Table 5.2.4.2-1.

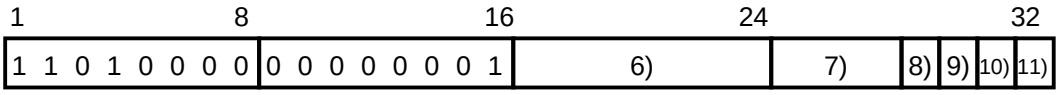
◊ **Table 5.2.4.2-1 : Sub LABEL for DVD**

Value	Description
0 0 0 0 0 0 0 0 b	Not used
0 0 0 0 0 0 0 1 b	Data transmitted at every data block
0 0 0 0 0 0 1 0 b	Data transmitted at data starting point
0 0 0 0 0 0 1 1 b	Table parity (DT) & DMCT-Sum
0 0 0 0 0 1 0 0 b	Start data of DMCT(Down mix coefficient table)
0 0 0 0 0 1 0 1 b	Continuation data of DMCT
1 1 0 0 0 0 0 0 b	CCI
1 1 0 0 0 0 0 1 b	ISRC

5.2.4.3 Ancillary data in Ancillary data field

5.2.4.3.1 Ancillary data transmitted at every data block

This data defined in A&M Protocol Enhancement (LABEL is D0h and Sub LABEL is 01h) shall be transmitted as First Ancillary Data of each DVD audio data block in Audio stream. Contents of this ancillary data have a possibility of change without audio mute in every DVD audio packet, and the sink device cannot recognize the changing point of these data. Therefore these data shall be transmitted at every data block.
Contents of this data are shown in Figure 5.2.4.3.1-1 and Table 5.2.4.3.1-1.



◊ **Figure 5.2.4.3.1-1 : The structure of ancillary data transmission at every data block**

◊ **Table 5.2.4.3.1-1 : Ancillary data transmission at every data block**

Data	Bits	Description
6) Dynamic Range Control	8	Adoptive compression coefficient
7) Down Mix Code	4	Down Mix Table No. or Stream No.
8) Emphasis Flag	1	Emphasis on or off
9) Stereo Playback Mode	1	Down Mix permission
10) Down Mix Code Validity	1	Down Mix Code validity
11) Data Identifier	1	Audio data in AOB or VOB

6) Dynamic Range Control:

describes the same value of dynamic_range_control defined in audio data recorded on DVD-Audio/Video disc. If the DVD player carry on Dynamic Range Control before transmitting the data, this should be set to 10000000b.

For details, refer to [R1] and [R2].

7) Down Mix Code:

When Data Identifier is 0b, this describes the same value of down_mix_code defined for audio data recorded on DVD-Audio disc. For details, refer to [R2].

When Data Identifier is 1b, this describes Decoding Audio stream number. For details, refer to [R1].

8) Emphasis Flag:

describes whether de-emphasis is required for the sink device or not;

0b: de-emphasis is not required

1b: de-emphasis is required

Note that this definition is different from that of DVD-Audio/Video specifications. For example, if the DVD player carry on de-emphasis before transmitting the data, this should be set to 0b.

9) Stereo Playback Mode:

When Data Identifier is 0b, this describes the same value of Stereo Playback Mode defined in audio data recorded on DVD-Audio. For details, refer to DVD-Audio specifications.

When Data Identifier is 1b, this should be set to 0b.

10) Down Mix Code Validity:

When Data Identifier is 0b, this describes the same value of Down Mix Code Validity defined for audio data recorded on DVD-Audio. If DVD player carry Down Mix Code before transmitting the data, this should be set to 1b. For details, refer to DVD-Audio specifications.

When Data Identifier is 1b, same method is applied for VTS_MU_ATS_ATR in DVD-Video specification. If there is a data in VTS_MU_ATS_ATR, this should be set to 1b.

Note that this method is applied up to six channels.

11) Data Identifier:

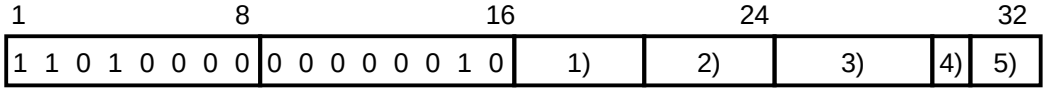
describes whether the data is audio data in AOB or audio data in VOB.

0b: audio data in AOB

1b: audio data in VOB

5.2.4.3.2 Ancillary data transmitted at data starting point

This data defined in A&M Protocol Enhancement (LABEL is D0h and Sub LABEL is 02h) shall be transmitted as Second Ancillary Data of each DVD audio data block when this data is transmitted.
This data shall be transmitted at the starting point of a track because its changing point can be confirmed for mute etc.
Also this data shall be transmitted at least once per less than 300 ms. And the same data shall be continued for more than 0.5 ms.
Contents of this data are shown in Figure 5.2.4.3.2-1 and Table 5.2.4.3.2-1.



◊ **Figure 5.2.4.3.2-1 : The structure of ancillary data transmission at data starting point**

◊ **Table 5.2.4.3.2-1 : Ancillary data transmission at data starting point**

Data	Bits	Description
1) Fs2	4	Sampling Frequency of Ch_Gr2
2) Multi Ch Type	4	Fs, Bit combination table type 1, 2
3) Ch Assignment	5	Ch combination of Gr1 & Gr2
4) Table Parity (AD)	1	Table parity of audio data
5) reserved	2	reserved for future use (set to 00b)

1) Fs2:
When Data Identifier in ancillary data transmitted at every data block is 0b, this describes the same value of audio_sampling_frequency_2 defined for audio data recorded on DVD-Audio disc. If the DVD player carry on up sampling to Fs1 before transmitting the data, this shall be set to 1111b. For details, refer to [R2].
When Data Identifier in Ancillary data transmitted at every data block is 1b, this shall be set to 1111b.

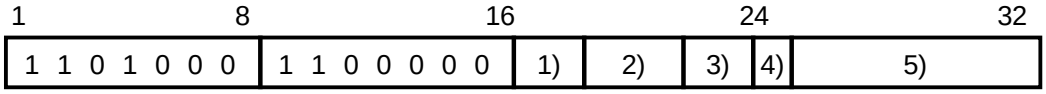
2) Multi Ch Type:
When Data Identifier in Ancillary data transmitted at every data block is 0b, this describes the same value of multi_channel_type defined for audio data recorded on DVD-Audio. For details, refer to [R2].
When Data Identifier in Ancillary data transmitted at every data block is 1b, this should be set to 0000b.

3) Ch Assignment:
describes the value for channel assignment in Table 5.3.1-1 and Table 5.3.1-2.

4) Table Parity (AD):
describes parity data to confirm the status of the handshake of DMCT transmission.
For details, refer to section 5.3.2 and section 5.3.3 .

5.2.4.3.3 Ancillary data for CCI

This data defined in A&M Protocol 2.0 (LABEL is D0h and Sub LABEL is C0h) shall be transmitted as Second Ancillary Data of each DVD audio data block when this data is transmitted. This data shall be transmitted at least once per less than 50 ms. And the same data shall be continued for more than 0.5 ms.



◊ **Figure 5.2.4.3.3-1 : The structure of ancillary data for CCI**

◊ **Table 5.2.4.3.3-1 : Ancillary data for CCI**

Data	Bits	Description
1) Audio_copy_permission	2	See below.
2) Audio_copy_number	3	
3) Audio_quality	2	
4) Audio_transaction	1	
5) reserved	8	reserved for future use (set to 0000 0000b)

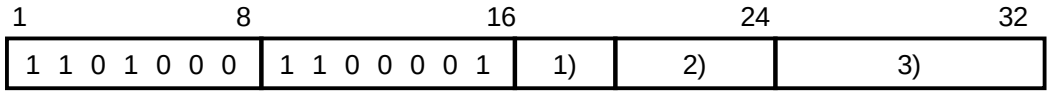
When Data Identifier in Ancillary data transmitted at every data block is 0b, contents of CCI, Audio_copy_permission, Audio_copy_number, Audio quality and Audio transaction are exactly the same as those of defined in [R2].
When Data Identifier in Ancillary data transmitted at every data block is 1b, contents of CCI are set according to the following rules.

- Audio_copy_permission is set to the value of CGMS.
- Audio_copy_number, Audio_quality and Audio_transaction are set to zero.

5.2.4.3.4 Ancillary data for ISRC

This data defined in A&M Protocol 2.0 (LABEL is D0h and Sub LABEL is C1h) shall be transmitted as Second Ancillary Data of each DVD audio data block when this data is transmitted.
An entire ISRC data consists of 32 parts of this data. The entire ISRC data shall be transmitted at least once per less than 50 ms.
An each part of ISRC data shall be continued for more than 0.5 ms. The transmitting order of those parts shall be rising order.

Contents of this data are shown in Figure 5.2.4.3.4-1 and Table 5.2.4.3.4-1.



◊ **Figure 5.2.4.3.4-1 : The structure of ancillary data for ISRC**

◊ **Table 5.2.4.3.4-1 : Ancillary data for ISRC**

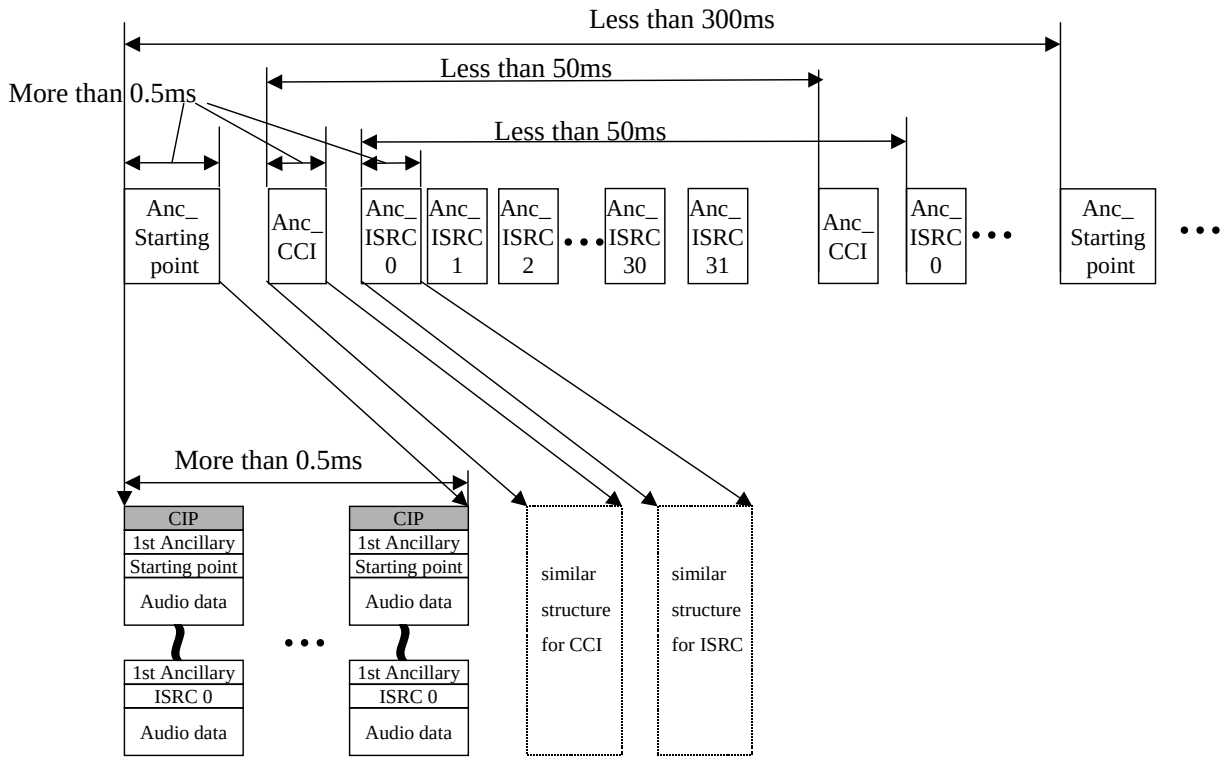
Data	Bits	Description
1) ISRC status	3	See below.
2) UPC_EAN_ISRC Number	5	
3) UPC_EAN_ISRC Data	8	

When Data Identifier in Ancillary data transmitted at every data block is 0b, contents of ISRC, ISRC status, UPC_EAN_ISRC Number and UPC_EAN_ISRC Data are exactly the same as those of defined in [R2].
When Data Identifier in Ancillary data transmitted at every data block is 1b, contents of ISRC are set according to the following rules.

- ISRC status is set to zero.
- UPC_EAN_ISRC Number and UPC_EAN_ISRC Data are the same as defined in [R1].

5.2.4.3.5 Ancillary data transmission timing

Figure 5.2.4.3.5-1 describes the model of ancillary data transmission timing and its structure.



◊ **Figure 5.2.4.3.5-1 : Transmission timing model of the ancillary data**

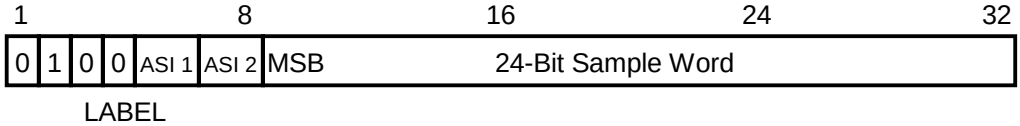
5.2.5 Structure of Sample Word field

5.2.5.1 LABEL in Sample Word field

The value of LABEL in Sample Word field is 48h to 4F h and the value depends on the value of ASI1 and ASI2.

5.2.5.1.1 ASI 1, 2 definition in Label in Sample Word field

A&M Protocol Enhancement defines ASI (Application Specific Information) 1 and 2.
ASI1 and ASI2 are defined in a label as follows.



◊ **Figure 5.2.5.1.1-1 : MBLA data structure**

For Audio stream, ASI1 shall be used for a unique definition to identify DVD-MBLA or DVD-SMBLA.

ASI1 for DVD-Audio describes whether Audio stream is DVD-MBLA or DVD-SMBLA.

◊ **Table 5.2.5.1.1-1 : ASI 1 for DVD-Audio**

Value	A&M Protocol Enhancement definition
10b	Ordinary (Fs shown by SFC)
11b	Fs2 = (1/2)Fs1 (Scalable Contents)
00b	-
01b	reserved

The definition of ASI2 is as same as that of A&M Protocol Enhancement.

5.2.5.1.2 Summary of LABEL for Sample Word field

The value of LABELs including ASI1 and ASI2 for Sample Word field shall have the value described in Table 5.2.5.1.2-1.

◊ **Table 5.2.5.1.2-1 : LABEL for Sample Word field**

LABEL (hex)	ASI (bin)				Channel Group	
	ASI 1		ASI 2		CH_GR1	CH_GR2
48h	1	0	0	0	Qb = 24 bits	Fs2 = Fs1, Qb = 24 bits
49h	1	0	0	1	Qb = 20 bits	Fs2 = Fs1, Qb = 20 bits
4Ah	1	0	1	0	Qb = 16 bits	Fs2 = Fs1, Qb = 16 bits
4Bh	1	0	1	1	Not used	Not used
4Ch	1	1	0	0	Not used	Fs2 = (1/2) Fs1, Qb = 24 bits
4Dh	1	1	0	1	Not used	Fs2 = (1/2) Fs1, Qb = 20 bits
4Eh	1	1	1	0	Not used	Fs2 = (1/2) Fs1, Qb = 16 bits
4Fh	1	1	1	1	Not used	Previous Sample Word Data Hold

5.3 Required operation for DVD player and Sink device

5.3.1 Channel assignment

The number of channels of audio data in AOB and VOB is restricted to up to 6. Also the channel assignment is restricted as shown in Table 5.3.1-1 and Table 5.3.1-2.

Note that value for channel assignment in Table 5.3.1-1 and Table 5.3.1-2 is transmitted as Ch Assignment in Ancillary data transmitted at data starting point.

◊ Table 5.3.1-1 : Assignment of Channel for AOB

Value for Ch Assignment	Structure of CH_GR1 and CH_GR2 Relation between Audio channel and Audio data					
	ACH0	ACH1	ACH2	ACH3	ACH4	ACH5
0 0 0 0 0 b	C	none	none	none	none	none
0 0 0 0 1 b	L	R	none	none	none	none
0 0 0 1 0 b	Lf	Rf	S	none	none	none
0 0 0 1 1 b	Lf	Rf	Ls	Rs	none	none
0 0 1 0 0 b	Lf	Rf	LEF	none	none	none
0 0 1 0 1 b	Lf	Rf	LEF	S	none	none
0 0 1 1 0 b	Lf	Rf	LEF	Ls	Rs	none
0 0 1 1 1 b	Lf	Rf	C	none	none	none
0 1 0 0 0 b	Lf	Rf	C	S	none	none
0 1 0 0 1 b	Lf	Rf	C	Ls	Rs	none
0 1 0 1 0 b	Lf	Rf	C	LEF	none	none
0 1 0 1 1 b	Lf	Rf	C	LEF	S	none
0 1 1 0 0 b	Lf	Rf	C	LEF	Ls	Rs
0 1 1 0 1 b	Lf	Rf	C	S	none	none
0 1 1 1 0 b	Lf	Rf	C	Ls	Rs	none
0 1 1 1 1 b	Lf	Rf	C	LEF	none	none
1 0 0 0 0 b	Lf	Rf	C	LEF	S	none
1 0 0 0 1 b	Lf	Rf	C	LEF	Ls	Rs
1 0 0 1 0 b	Lf	Rf	Ls	Rs	LEF	none
1 0 0 1 1 b	Lf	Rf	Ls	Rs	C	none
1 0 1 0 0 b	Lf	Rf	Ls	Rs	C	LEF
				CH_GR1	CH_GR_2	

Assignment of channel for VOB is defined as same as assignment of channel for AOB from 00000b to 01100b.

◊ Table 5.3.1-2 : Assignment of Channel for Audio data in VOB

Value for Ch Assignment	Structure of CH_GR1 and CH_GR2 Relation between Audio channel and Audio data					
	ACH0	ACH1	ACH2	ACH3	ACH4	ACH5
0 0 0 0 0 b	C	none	none	none	none	none
0 0 0 0 1 b	L	R	none	none	none	none
0 0 0 1 0 b	Lf	Rf	S	none	none	none
0 0 0 1 1 b	Lf	Rf	Ls	Rs	none	none
0 0 1 0 0 b	Lf	Rf	LEF	none	none	none
0 0 1 0 1 b	Lf	Rf	LEF	S	none	none
0 0 1 1 0 b	Lf	Rf	LEF	Ls	Rs	none
0 0 1 1 1 b	Lf	Rf	C	none	none	none
0 1 0 0 0 b	Lf	Rf	C	S	none	none
0 1 0 0 1 b	Lf	Rf	C	Ls	Rs	none
0 1 0 1 0 b	Lf	Rf	C	LEF	none	none
0 1 0 1 1 b	Lf	Rf	C	LEF	S	none
0 1 1 0 0 b	Lf	Rf	C	LEF	Ls	Rs

5.3.2 Transmission of Down Mix Coefficient Table (DMCT)

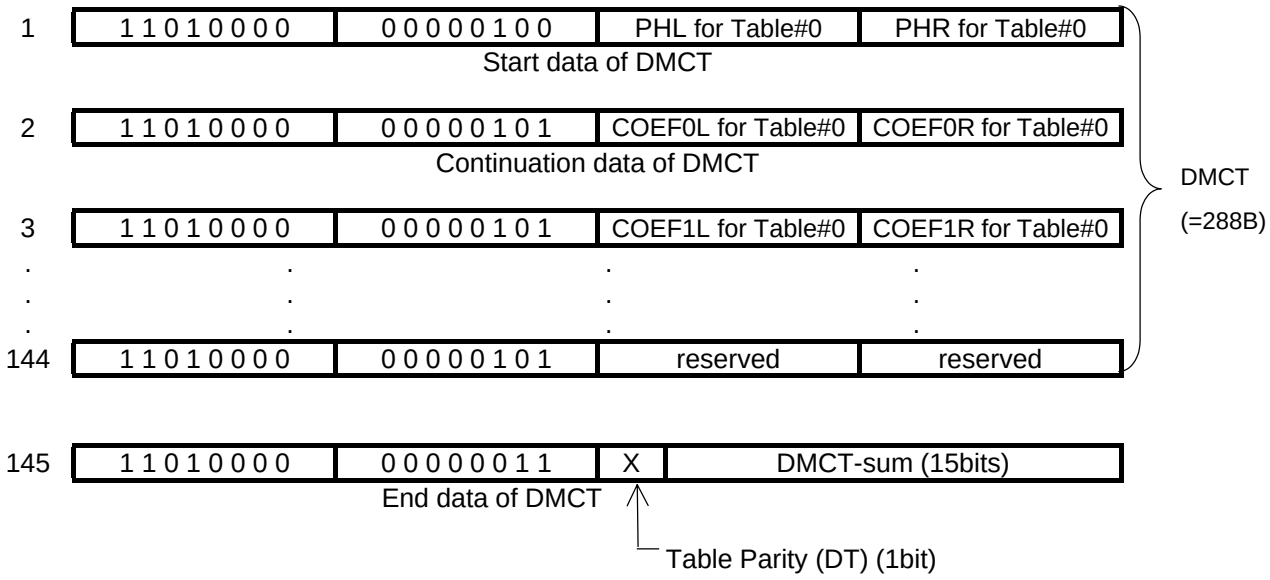
For down mix, it is necessary to transmit DMCT to the sink device in addition to down mix code, stereo playback mode and down mix code validity.
This data shall be transmitted as Second Ancillary Data of each DVD audio data block when this data is transmitted and shall be transmitted at least once per less than 300 ms. And also this data shall be transmitted at least twice before audio data transmission at the beginning of track.

Transmission of DMCT consists of three parts. One is "Start data of DMCT", this is DMCT data itself and its Sub LABEL means start of DMCT transmission. If the sink device loses DMCT sequence by bus reset or some other reason, the sink device can restart to receive DMCT with this start data of DMCT.
Second is "Continuation data of DMCT", this is a data followed "Start data of DMCT" and if the sink device starts to receive this data, it must restart with "Start data of DMCT".
Third is "End data of DMCT", this is Table Parity (DT) & DMCT-sum. This data is not DMCT itself but important for termination of DMCT data receive.
DMCT-sum is transmitted in 15 bits following Table Parity (DT) and used for check sum. Summing rule is to add byte by byte of 288 DMCT and to use truncated lower 15 bits.

When Table Parity (AD) is transmitted, the same value as Table Parity (AD) is newly set in the value of Table Parity (DT). DMCT and Table Parity (DT) are transmitted from DVD player at constant interval. Setting of this interval, refer to section 5.2.4.3.5.

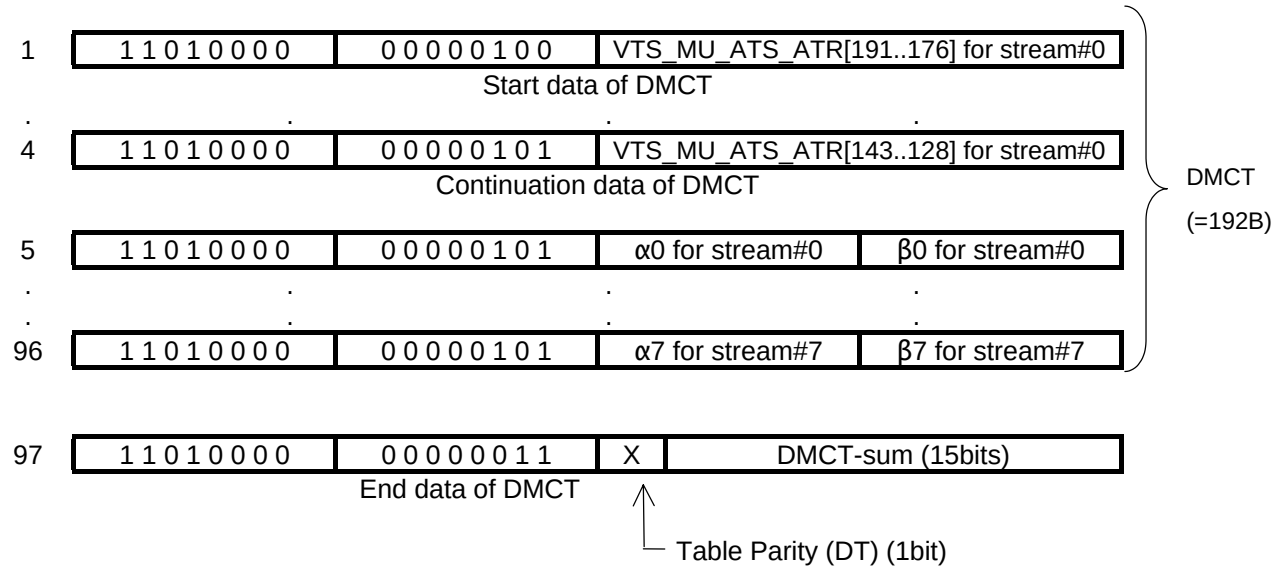
As DMCT for DVD-Audio has 288 bytes fixed length, it is necessary to transmit 145 data blocks of DMCT including Table Parity (DT) & DMCT-sum. DMCT for DVD-Audio is sequentially transmitted from one for

ATS_DM_COEFT#0 to one for ATS_DM_COEFT#15.



◊ **Figure 5.3.2-1 : The structure of DMCT for DVD-Audio and Table Parity (DT) & DMCT-sum**

DMCT for DVD-Video has 192 bytes fixed length, it is necessary to transmit 97 data blocks of DMCT including Table parity (DT) & DMCT-sum. DMCT for DVD-Video consists of VTS_MU_ATS_ATR (1) and VTS_MU_ATS_ATR (2). DMCT for DVD-Video is sequentially transmitted from one for VTS_MU_ATS_ATR of Audio stream #0 to one for VTS_MU_ATS_ATR of Audio stream#7.



◊ **Figure 5.3.2-2 : The structure of DMCT for DVD-Video and Table Parity (DT) & DMCT-sum**

Table Parity (AD) and Table Parity (DT) confirm the correspondence of DMCT and audio data. The sink device can execute down mix when Table Parity (AD) = Table Parity (DT).

5.3.3 Update of DMCT

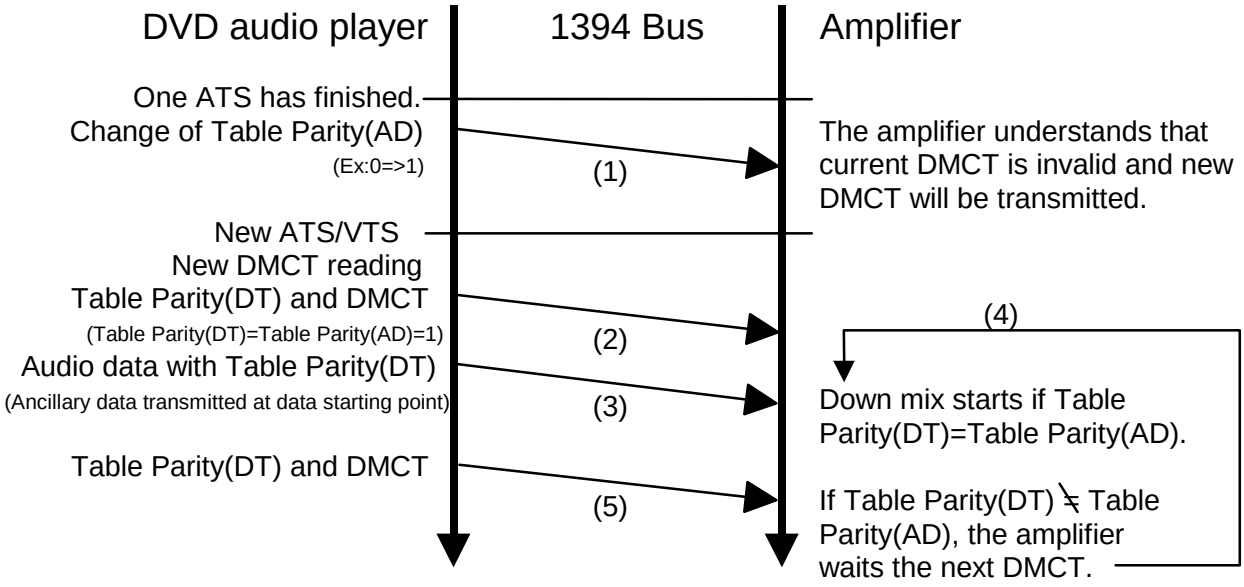
DVD player transmits DMCT with Table Parity (DT) and DMCT-sum at each some period.
The sink device receives and memorizes DMCT that is transmitted at constant interval from the DVD player. The sink device does not need to update the data at every transmission, but the data shall be updated at the following conditions.

1) Status change of DVD player
2) Status change of sink device
3) Update of DMCT by shifting to a new DMCT

"1) Status change of DVD player" means "Power ON -> OFF -> ON", "Stop -> Play" and Disc change etc. The sink device can recognize this status from bus reset or disappearance of data on the bus, etc.
"2) Status change of sink device" means "Input switch of the amplifier", "Power ON -> OFF -> ON" or "Connection of another amplifier to bus" etc. The sink device is able to find these statuses from setting change of oneself or bus reset, etc.

The case of 1) and 2) are status changes, it is easy for the sink device to catch the timing of DMCT update. However, in the case of 3), the sink device can not catch the timing of the DMCT without the player informing the sink of timing of DMCT update.
DMCT is described in ATSI/VTSI and updated at every DMCT unit. Therefore the sink device shall update the memorized DMCT when shifting to the following DMCT. Figure 5.3.3-1 shows the state of transition diagram when the DVD player shifts from the reproduction of one DMCT to the following DMCT. This diagram is applied not only for successive reproduction of DMCT but also for discontinuous reproduction by search operation or etc.

When the DVD player shifts to a new DMCT reproduction, the sink device shall know the current DMCT became invalid and shall take a new DMCT. Table Parity (AD) is used so that the DVD player informs the sink device of the timing of DMCT. Table Parity (AD) means the parity of the audio data, and it is transmitted by the ancillary data transmitted at data starting point. Table Parity (AD) is a reference of Table parity, and it is set by the DVD player. The DVD player reverses Table Parity (AD) and the sink device can know the current DMCT became invalid and need to receive a new DMCT.



◊ **Figure 5.3.3-1 : Flow of shift to new DMCT**

Figure 5.3.3-1 shows follows.
The DVD player search to read the next ATSI/VTSI with mute on after one DMCT reproduction is finished. DMCT is in ATSI/VTSI. Then the player informs the sink device of DMCT having become invalid by sending reversed Table Parity (AD) (See Arrow (1)). For instance, if the Table Parity (AD) is "0" currently, then it becomes "1" as next. When the sink device receives reversed Table Parity (AD), it shall take a new DMCT and annulling the current DMCT.

As soon as the DVD player finishes reading new DMCT, the player keeps transmitting new DMCT and Table Parity (DT) at a constant interval. Table Parity (DT) means the parity of DMCT, and the same value as Table Parity (AD) is always set by the player. In this case, the value of reversed Table Parity (AD) is set in Table Parity (DT) (See Arrow (2)).

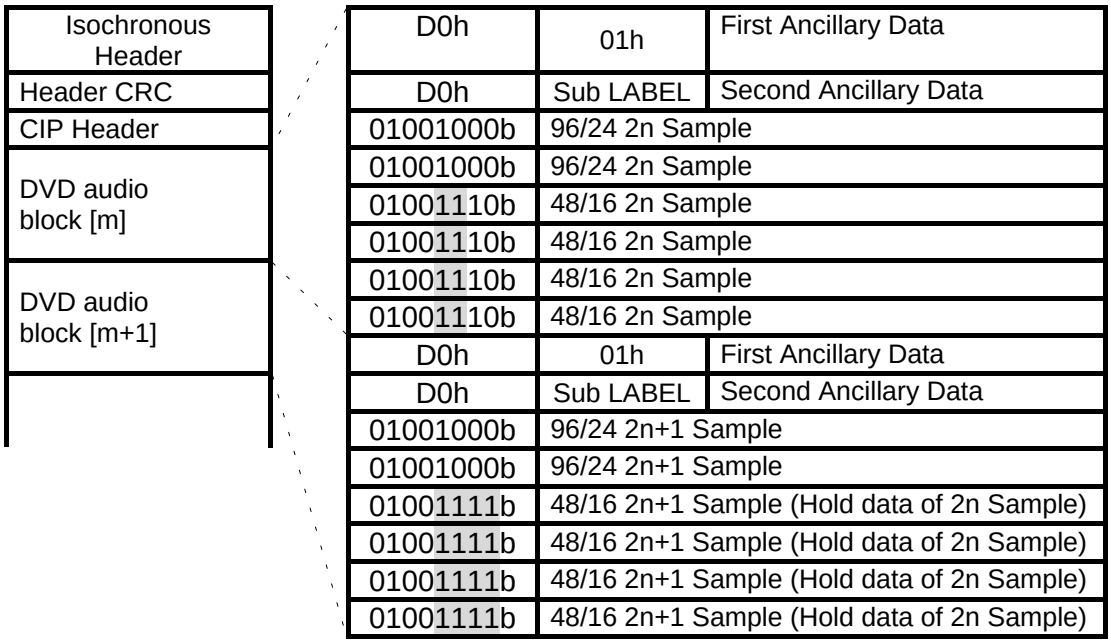
After the transmission of new DMCT and Table Parity (DT) has finished, the DVD player begins the transmission of the audio data. However, it is preferable to transmit audio data after transmitting DMCT several times because it is uncertain whether the sink device took DMCT. However this method is not defined in this guideline, it is depend on each design (See Arrow (3)).
At this time, it isn't necessary to transmit Table Parity (AD) again. However Table Parity (AD) is inevitably transmitted with an ancillary data because the ancillary data transmitted at data starting point shall be transmitted before a new track is reproduced.

When down mix is done by the sink device, down mix begins after the sink device receives DMCT and audio data. When the sink device executes the down mix, compare Table Parity (AD) added to audio data and Table Parity (DT) added to DMCT. The DVD-Audio player sets and manages Table Parity (AD) and sets the same value in Table Parity (DT), therefore the both value must be corresponding. If the both values are corresponding, DMCT is received from current audio data and then the sink device can execute the down mix.

If the both values are different, DMCT of the sink device is not updated, and then the sink device shall take DMCT until Table Parity (AD) and (DT) are corresponding (See Arrow (4)).
Arrow (5) shows that new DMCT is transmitted at a constant interval and this will be sent in the middle of Audio data sending.
Figure 5.3.3-1 is applied to a continuous reproduction of two or more ATSs/VTSs. The operation of the search etc. is included in this continuous reproduction, but Figure 5.3.3-1 is not applied to the change of state of 1) and 2) described above. This is the reason why the sink device can learn the change of state for 1) and 2). The sink device shall update DMCT detecting the change of state when there is a change of state.

5.3.4 Previous Sample Word Data Hold

IEEE1394 Bus cannot have two different Fs in one isochronous channel. So when two kinds of Fs are used in multi channel mode and scalable contents, the data slot for the odd sample of low Fs is filled up with the even sample of low Fs. This operation is called "Previous Sample Word Data Hold".
Figure 5.3.4-1 shows the example of previous sample word data hold. This example is for "Fs1=96 kHz /Qb=24 bits/2 ch and Fs2=48 kHz/Qb=16 bits/4 ch". Previous Sample Word Data Hold is identified by VBL(Valid Bit Length) value of "11b".
This method shall be used for transmission of DVD-SMBLA.



"xxxx11xxb" means Fs2 = (Fs1) / 2.
"xxxxxx11b" means Previous Sample Word Data Hold.

◊ **Figure 5.3.4-1 : Previous Sample Word Data Hold**

5.3.5 No data for Audio stream

No data is defined in A&M Protocol Enhancement for each application.

5.3.5.1 No data definition for DVD

The LABEL of no data is "CF" for all applications.

For Audio stream, there are three types of no data, described in Figure 5.3.5.1-1 including "No data for ancillary data". But the value "0000 0000b" for Sub LABEL is not used for the value of sub label on ancillary data for Audio stream.

LABEL / Sub LABEL	Description
CF D0	No data for ancillary data in Audio stream
CF 40	No data for audio data of DVD-MBLA and DVD-SMBLA
CF CF	No data for pudding to adjust the number of channel in even number

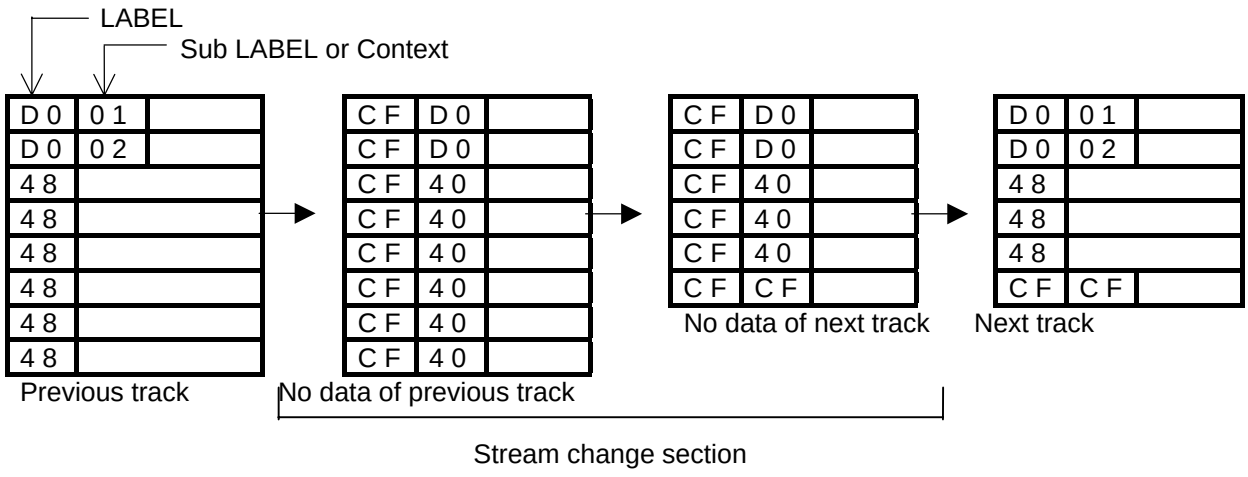
Context
LABEL

◊ **Figure 5.3.5.1-1 : Three kinds of no data for DVD**

5.3.5.2 Stream change

The way of stream change is recommended in A&M Protocol Enhancement to take a time for PLL lock when a stream and Fs are changed.

An example of Audio stream change in case that 6 channels change to 3 channels is shown in Figure 5.3.5.2-1. These kind of no data give a time for PLL lock and for change of system configuration.



◊ **Figure 5.3.5.2-1 : Stream change**

Note: In case of another stream change between another kinds of streams, suitable no data for that stream will be

used.

5.3.6 For Sink device

DVD player output various types of data to sink device, therefore sink device must be designed to support these formats.
Functions as down mix, emphasis and dynamic range control can be done in DVD-Audio player, however for a high quality reproduction, DVD-Audio player transmit a non processed audio data with processing information, then a sink device can reproduce audio signal with high quality.
For this reason there is a freedom for DVD-Audio player whether transmit processed data or non-processed data.
For instance, when DVD-Audio player executes all functions, the sink device only reproduces the signal received from the player because DVD-Audio player executes down mix, de-emphasis and dynamic range control.
If the sink device requires a high quality reproduction, all of function should be executed in the sink device. Basically, in this case, the sink device executes all of down mix, de-emphasis and dynamic range control. Necessary information for execution is transmitted by ancillary data.
And also, some of these functions can be done in DVD-Audio player, for instance DVD-Audio player executes de-emphasis and the sink device executes other functions.

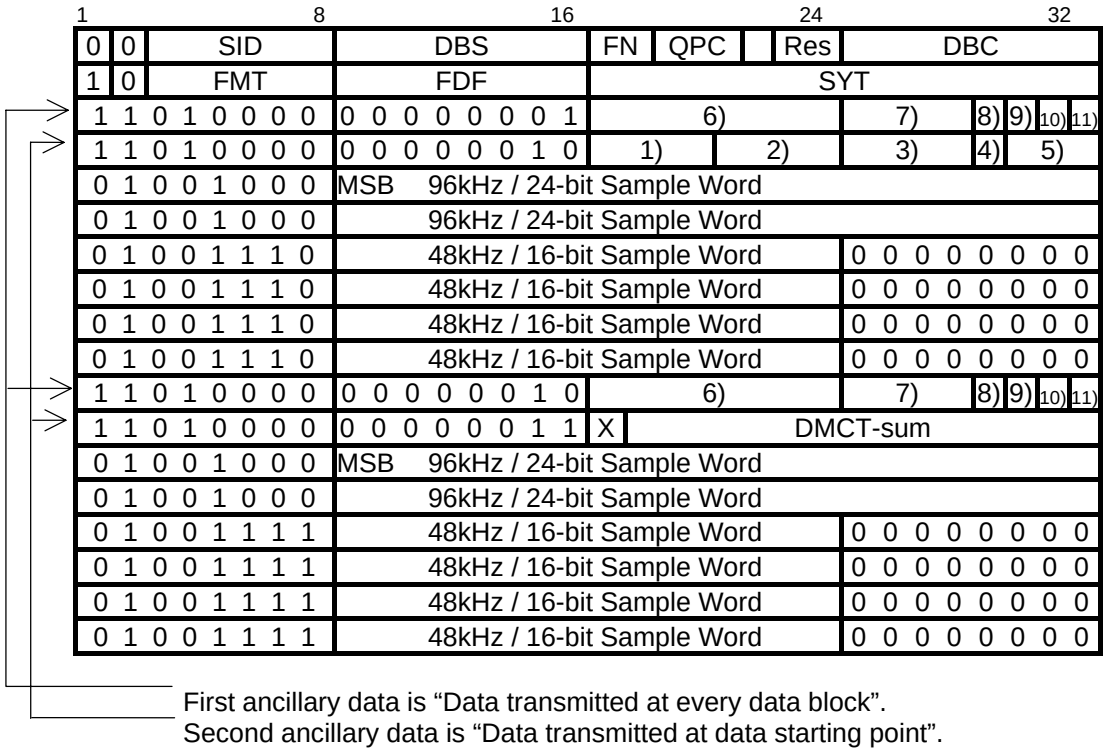
However bit shift is an exception. In this guideline bit shift shall be executed in DVD-Audio player because decoding of bit shift data is all digital and does not degrade the signal.
Note:
Also DVD player and sink device can apply other technique of IEEE1394 Bus. For instance, there are two methods for rate control and one of them uses control command. For rate control details, refer to A&M Protocol Enhancement.

5.3.7 Basic structure of DVD audio blocks (Informative)

Figure 5.3.7-1 shows the "Basic structure of DVD audio blocks". This figure is the example of "Channel Group 1 = 96 kHz/24-bit/2 ch and Channel Group 2 = 48 kHz/16-bit/4 ch".

Two quadlets ancillary data are inserted at the head of each data block. First quadlet ancillary data is "Ancillary data transmitted at every data block", The data blocks cannot be transmitted excluding "Ancillary data transmitted at every data block" in this area. All other data is transmitted with the second quadlet ancillary data. They are "Data transmitted at data starting point", "Table Parity (DT)", DMCT, CCI and ISRC etc. Though they are transmitted with some interval.

The audio data is transmitted following Ancillary data. The order of the channel follows ACH0-ACH5 in the channel assignment table. The sink device assigns each channel according to the channel assignment table.



◊ **Figure 5.3.7-1 : Basic structure of DVD audio blocks**

This page is intentionally left blank.

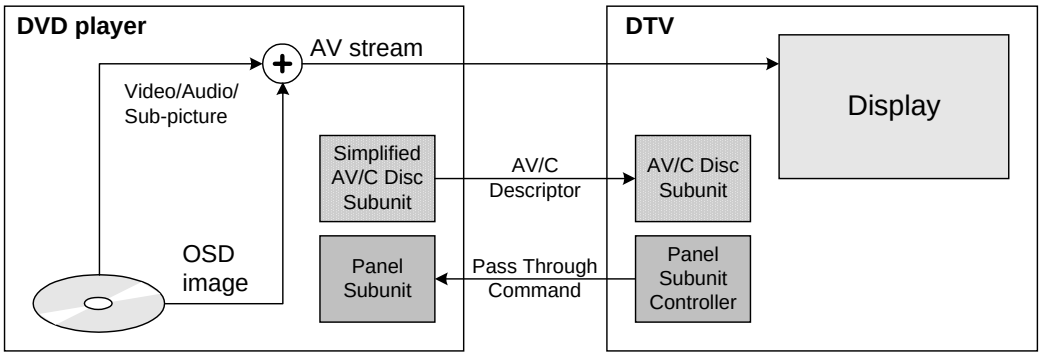
6. AV/C Panel Subunit Commands for DVD

6.1 System Model for DVD Control

To control the DVD player, this guideline recommends the DTV to transfer the user's remote control commands from the DTV to DVD player using the Panel Subunit PASS THROUGH command, which have the same meaning of the button on DVD remote controller. The DVD player shall support 16 commands in the PASS THROUGH command as mandatory with 32 commands as optional.

6.1.1 System Model for DVD player and sophisticated display

The DVD-Video controlling system model provides user interface (UI) services for DVD-Video player and other AV/C controller devices. It provides a model for describing and accessing the physical or logical controls on a device from a remote location. The DVD-Video control command specification defines several data structures that describe standardized control types, and a set of user-manipulation commands for accessing these controls.



◊ **Figure 6.1.1-1 : System Model for DVD player and sophisticated display**

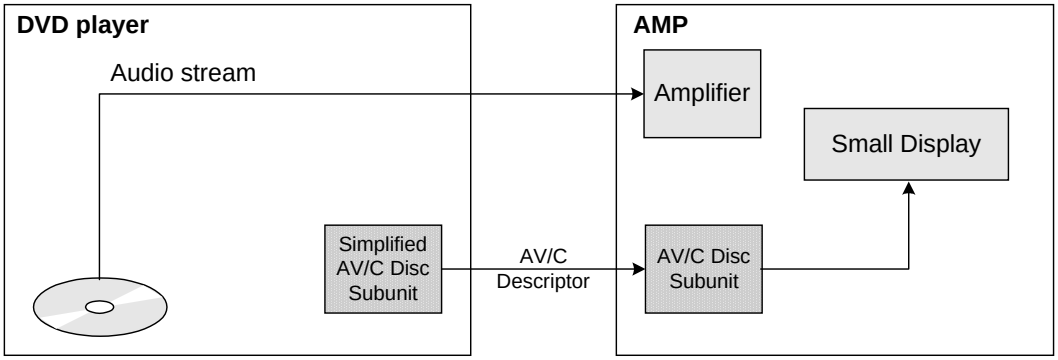
The panel subunit controller (PS-CTR) is used to control the panel subunit according to the user operation depending on the implementation of the controller, such as by the DTV IR remote commander. The user operates a button on a physical or logical remote commander of the controller, and then the controller sends commands back to the panel subunit.

6.1.2 System Model for DVD player and small display

This system is dedicated for audio playback and mostly audio data is transmitted using A&M protocol.

In this case the destination is a digital amplifier that doesn't have a TV display but sometimes has a small text-based display such as LCD or FLD. The controlling system is similar to the video model but the difference is concerned with this display capability. There is no TV display for menu or status of sub picture, so user can not get a confirmation of their control action like with a video model.

This situation is very similar to the current CD player and remote controller. Actually this audio model can display disc information and playback position data on the display of a digital amplifier using information descriptor, and can control DVD-Audio player using PASS THROUGH command such as PLAY, STOP, FORWARD and etc.



◊ **Figure 6.1.2-1 : System Model for DVD player and small display**

6.2 Control Command Type

The DVD controlling system Model uses basically PASS THROUGH control command which is specified in 1394TA AV/C Panel Subunit Specification 1.1 for accessing controls on a device from a remote location. As for the details about this, it is described in [R22].

6.2.1 Interpretation

When receiving a "user operation" from the controller, expected operation to be performed by a DVD player is shown in Table 6.2.1-2 to Table 6.2.1-4.
However "Expected operation to be performed by a DVD player" described below is the recommended basic behavior, and does not limit the possibilities to apply these commands for other purposes. And also the indications on a remote commander or other input device can be different from those shown below as "user operation".

◊ **Table 6.2.1-1 : Cursor navigation and Menu operations**

User operation	Expected operation to be performed by a DVD player
Select	Selects the item focused by cursor.
Up	Moves cursor upper direction.
Down	Moves cursor lower direction.
Left	Moves cursor left direction.
Right	Moves cursor right direction.
Right-up	Moves cursor upper-right direction.
Right-down	Moves cursor lower-right direction.
Left-up	Moves cursor upper-left direction.
Left-down	Moves cursor lower-left direction.
Root menu	DVD operation name may be **"top menu"**. Displays initial menu to start GUI operation. The menu displayed with this command is target–dependent, so it might be **title menu**, contents menu, setup menu, favorite menu or the other menu, furthermore it may be changed dynamically according to the status of the target. This command may be used to finish GUI operation alternately.
Setup menu	Displays set up menu such as option set up. (Can be used as a shortcut.) The menu displayed with this command should be designed to be reached from the initial menu of the target.
Contents menu	DVD operation name may be **"menu"**. Displays contents menu. (Can be used as a shortcut.) For example, this command may be used to display the Electric Program Guide (EPG) or the contents list in a storage medium. The menu displayed with this command should be designed to be reached from the initial menu of the target.
Favorite menu	Displays user preset menu. (Can be used as a shortcut.) For example, this command may be used to display the list of user preset chapter. The menu displayed with this command should be designed to be reached from the initial menu of the target.
Exit	DVD operation name may be **"return"**. Closes current menu and go back previous menu. This command may also be used to finish GUI operation, but a target shall be implemented to be finished GUI operation without this command.

A controller which supports GUI operation shall be implemented with user operations of *select*, *up*, *down*, *left*, *right*, and *root menu*. The GUI of a target should be designed to be controlled all of its available functions by these user operations.

◊ **Table 6.2.1-2 : Numerical input operations**

User operation	Expected operation to be performed by a DVD player
0 – 9	Input a numerical value.
Dot	Used with 0-9 to input numerical value such as a sub channel in US.
Enter	Fix the entered numerical value. Target should be implemented to fix the entered value in any way without this command, such as time out.
Clear	Cancel the entered numerical value.

◊ **Table 6.2.1-3 : Other operations**

User operation	Expected operation to be performed by a DVD player
Sound select	Used to switch the sound such as multiple language selection.
Display information	Displays the information about current contents.
Page up	Scrolls up the whole screen or part of display.
Page down	Scrolls down the whole screen or part of display.
Play	Starts playing back the specified content at normal speed.
Stop	Stops playing back the content.
Pause	Stops playing back the content, and may resume to play it back alternatively.
Record	reserved for future use
Rewind	Moves the position toward the beginning of the medium.
Fast forward	Moves the position away from the beginning of the medium.
Eject	Ejects the medium from the device, and may close the door for loading the medium alternatively.
Forward	Switches the contents, such as music tune, or video chapter, which can be reproduced with "play" operation, to the forward one. The 'forward' means future direction in time, plus direction in number, and down direction in a list.
Backward	Switches the contents, such as music tune, or video chapter, which can be reproduced with "play" operation, to the backward one. The 'backward' means past direction in time, minus direction in number, and up direction in a list.
Angle	Switches the scene of the contents, if it has multi angle contents.
Sub picture	Switches or rotates the sub pictures, if it has some sub pictures data.
Vendor unique	Used to convey vendor unique information to a target. Information which can be conveyed with other operation id shall not be handled.

◊ **Table 6.2.1-4 : Function key operations**

User operation	Expected operation to be performed by a DVD player
F1 – F5	Input function keys of F1 – F5

*Operation_id*s for function keys are defined for the purpose of operating actions that are uniquely designed for a specific AV device type or a particular device to be controlled by a general purpose controller.

6.2.2 Conformance support level

It is required for the compliant DVD player to comply with conformance support level specified by the following table.

In the table;

- "Support level" classifies "user operation" as "M" (Mandatory for DVD player) or "O"(Optional).
- The DVD player shall support "user operation" indicated as "M" in support level and shall perform the expected proper operation when receiving those operations from the controller.
- It is strongly recommended that the controller such as a DTV which is used to control a DVD player can support "user operation" indicated as "M" in support level.
- Support level "O" are optional.
- All other Operation_ids are out of the scope of this guideline.

◊ Table 6.2.2-1 : Operation id List and conformance support level

Operation _id	User operation	Support level	Operation _id	User operation	Support level
00_{16}	Select	M	$2A_{16}$	Dot	O
01_{16}	Up	M	$2B_{16}$	Enter	O
02_{16}	Down	M	$2C_{16}$	Clear	O
03_{16}	Left	M	33_{16}	Sound select	O
04_{16}	Right	M	35_{16}	Display information	O
05_{16}	Right-up	O	37_{16}	Page up	O
06_{16}	Right-down	O	38_{16}	Page down	O
07_{16}	Left-up	O	44_{16}	Play	M
08_{16}	Left-down	O	45_{16}	Stop	M
09_{16}	Root menu	M	46_{16}	Pause	M
$0A_{16}$	Setup menu	M	48_{16}	Rewind	M
$0B_{16}$	Contents menu	M	49_{16}	Fast forward	M
$0C_{16}$	Favorite menu	O	$4A_{16}$	Eject	O
$0D_{16}$	Exit	M	$4B_{16}$	Forward	M
20_{16}	0	O	$4C_{16}$	Backward	M
21_{16}	1	O	50_{16}	Angle	O
22_{16}	2	O	51_{16}	Sub picture	O
23_{16}	3	O	71_{16}	F1	O
24_{16}	4	O	72_{16}	F2	O
25_{16}	5	O	73_{16}	F3	O
26_{16}	6	O	74_{16}	F4	O
27_{16}	7	O	75_{16}	F5	O
28_{16}	8	O	$7E_{16}$	Vendor unique	O
29_{16}	9	O	-	-	-

7. AV/C Descriptors for DVD

7.1 System Model for DVD Descriptor

General Information about what the DVD player is currently doing and information about the current disc in the player needs to be fed back to the User. Such information might be whether there is a disc in the player, what sort of disc it is and what the drive is doing. It is also often useful to display the current Track or Chapter.

When the player is connected to a visual presentation device such as a TV, this information can be output in the MPEG transport stream for display on the TV. However, some presentation devices, for instance an audio amplifier, may not contain such a sophisticated display or a MPEG decoder. In this case, machine readable status data is needed which allows the device to present information in an appropriate way.

The AV/C General Specification ([R17]and [R18]) and the Disc Subunit General specification [R19], define a descriptor system that can be used to feed back information to the User from a target device (the DVD player). These descriptors are areas in the target's memory that contain data in specified structures.

There are three descriptor areas:

- **Subunit Identifier Descriptor:** this contains information about the capabilities of the DVD player;
- **Subunit Status Descriptor:** this contains information about the current status of the player;
- **Root Contents List:** this contains information about the current disc in the player.

Information about the data structures is contained in [R17], [R19] and [R20]. Details of DVD-specific data is contained in AV/C Disc Media Type Specification – DVD, Version 1.0 ([R21]).

To read this information, a controlling device uses the READ DESCRIPTOR command (for the Subunit Identifier Descriptor and Root Contents List) or the READ INFO BLOCK command (for reading data in the Subunit Status Descriptor). Operands in these commands describe which information is required. Before a READ operation, the descriptor should first be opened with an OPEN DESCRIPTOR command. This indicates to the DVD player that an external controller (such as a TV or Amplifier) is interested in such information. It is only necessary for a target to keep up to date those descriptors which have been opened. Full details of these commands are contained in [R17] and [R18].

The information and reading methods described in the references above are potentially large and much of this is not needed for common DVD applications. DVD players can be implemented with different levels of functionality, which will require different levels of command and status support. The AV/C Disc Media Type Specification – DVD ([R21]), describes these applications, or Profiles, and also what information is needed to support each Profile. [R21] defines the first Profile, which has a Profile_ID of 10_{16}. This describes the necessary support for a user who is operating a single-deck player which is connected to a TV or an

Amplifier. Later versions of [R21] will define other Profiles with more functionality. Each Profile describes the minimum mandatory requirements for each Profile: a manufacturer may implement more, but the minimum requirements as specified in the relevant Profile shall always be implemented.

The minimum information for DVD are identified for Profile_ID = 10_{16}, as shown below. Items marked as Mandatory should be supported in all implementations of this Profile.

◊ Table 7.1-1 : Information for Profile_ID = 10_{16}

Description	AV/C Information Name	Support Level [1]
Media capabilities of the player (e.g. DVD-Video or DVD-Audio)	supported_media_type	M
Whether there is currently a disc in the drive	disc_in_drive	M
Type of disc in the drive	media_type	M
Status of drive (e.g. playing)	operating_mode	O
Current playing position	position_info_block	O
Total disc playback time	av_object_type_specific_info_block	O

M = Mandatory; O = Optional

[1] These support levels are as defined for Profile_ID = 10_{16}. Other Profiles are reserved for future use.

Note that Table 7.1-1 above is included here for information only: actual requirements should be checked with the latest version of [R21].

In addition to this, [R17] and [R19] describes some other information, such as the time_stamp_info_block and some attribute bytes, which are also mandatory. These items are included in the following sections.

7.2 Disc Subunit Identifier Descriptor

This describes the capabilities of the player and also contains some media-specific information, such as attributes and sizes, which are needed. The total subunit identifier descriptor for a player that only supports one DVD format is shown below:

◊ Table 7.2-1 : Disc Subunit Identifier Descriptor for DVD-Video

Disc Subunit Identifier Descriptor					
Offset	**Contents**	**Value**	**M/O[1]**	**F/V[2]**	**Notes**
00 00_{16}	descriptor_length	00_{16}	M	F	1
00 01_{16}		19_{16}			
00 02_{16}	generation_ID	01_{16}	M	F	2
00 03_{16}	size_of_list_ID	02_{16}	M	F	3
00 04_{16}	size_of_object_ID	00_{16}	M	F	
00 05_{16}	size_of_object_position	02_{16}	M	F	
00 06_{16}	number_of_root_object_lists	00_{16}	M	F	4
00 07_{16}		01_{16}			
00 08_{16}	root_object_list_id_0	10_{16}	M	V	
00 09_{16}		00_{16}			
00 $0A_{16}$	disc_subunit_dependent_length	00_{16}	M	F	5
00 $0B_{16}$		$0F_{16}$			
00 $0C_{16}$	disc_subunit_dependent_info_fields_length	00_{16}	M	F	
00 $0D_{16}$		$0B_{16}$			
00 $0E_{16}$	attributes	01_{16}	M	F	6
00 $0F_{16}$	disc_subunit_version	10_{16}	M	F	7
00 10_{16}	number_of_supported_media_types	01_{16}*	M	F	8
00 11_{16}	supported_media_type	09_{16}*	M	F	9
00 12_{16}		02_{16}*			
00 13_{16}	implementation_profile_ID	10_{16}	M	F	10
00 14_{16}	media_type_attributes	00_{16}	M	F	11
00 15_{16}	type_dependent_length	00_{16}	M	F	12
00 16_{16}		02_{16}			
00 17_{16}	type_dependent_information	10_{16}	M	F	
00 18_{16}		FF_{16}			
00 19_{16}	manufacturer_dependent_length	00_{16}	M	F	13
00 $1A_{16}$		00_{16}			

[1] M = This data is Mandatory for a player conforming to Profile_ID = 10_{16}.

[2] F = Data Fixed in DVD implementation; V = Variable data, see relevant note

* These values will depend on the capability of the player drive and are included as an example only.

Notes:

1. **descriptor_length**: this contains the length of the descriptor from offset 00 02_{16} to the end of the supported_media information (inclusive). For one supported media_type this is 19_{16} bytes. Extra supported media_types add another 8_{16} bytes per media_type (see 7.2.1 below).
2. **generation_ID**: this is set to 01_{16} to indicate that this player conforms to Version 3 of the AV/C General Specification ([R17] and [R18]).
3. **size_of_list_ID, size_of_object_ID**, **size_of_object_position**: mandatory information needed by external controllers.
4. **root_object_lists**: a player implementing Profile_ID = 10_{16} shall have at least one root_object_list. This is identified by the root_object_list_id of the root_contents_list (10 00_{16}). Other object lists, such as for Performance List, etc, are optional. *Note: this value may change according to whether there is a disc in the drive and what sort of disc it is, see 7.2.1 .*
5. **disc_subunit_dependent_length** and **disc_subunit_dependent_info_fields_length**: the disc_subunit_dependent_length contains the length of the disc_subunit_dependent_information. The disc_subunit_dependent_info_fields_length gives the length from offset 00 $0E_{16}$ to the end of the supported_media_type information (this is up to and including the byte immediately preceding the manufacturer_dependent_length) and should include all formats supported (see 7.2.1 below). Similarly, the disc_subunit_dependent_length gives the length starting at offset 00 $0C_{16}$ up to the byte preceding the manufacturer_dependent_length.
6. **attributes**: for a player implementing Profile_ID = 10_{16}, this is set to 01_{16}.
7. **disc_subunit_version**: this is set to 10_{16} to indicate that this player implements Version 1.0 of the Disc Subunit General Specification, [R19].
8. **number_of_supported_media_types**: this indicates the number of supported media_types. A player which is only capable of playing, for instance, DVD-Video discs will set this to 01_{16}. A player which implements, for instance, DVD-Video, DVD-Audio and CD-DA will set this to 3.
9. **supported_media_type**: this is set to 09 01_{16} to indicate that this player supports DVD-Audio discs, or 09 02_{16} for DVD-Video discs.
10. **implementation_profile_ID**: this indicates the Profile_ID for this media_type. For DVD-Audio and DVD-Video players implementing [R21], this shall be set to 10_{16}.
11. **media_type_attributes**: for a player implementing Profile_ID = 10_{16} , this is set to 00_{16}.
12. **type_dependent_length** and **type_dependent_information**: type_dependent_length is set to 2 bytes for DVD. The type_dependent_information indicates the DVD media specification implemented and is set to 10 FF_{16} for a player conforming to [R21].
13. **manufacturer_dependent_length**: it is not necessary to implement manufacturer_dependent information. If this is not present, then this length is set to zero.

7.2.1 Supporting multiple formats

The example above contains one format only (DVD-Video). Implementations may support more than one media_type, e.g. DVD-Video, DVD-Audio and also possibly CD-DA. These capabilities are indicated by adding more supported_media_type definitions immediately before the manufacturer_specific_length (i.e. immedaitely before offset 00 19_{16}) of the descriptor shown in Table 7.2-1. The number_of_supported_media_types, descriptor_length and disc_subunit_dependent_info_fields_length must be adjusted accordingly.
Each supported media_type is 8 bytes long and the data for DVD formats is shown in Table 7.2.1-1. The offset shown in Table 7.2.1-1 should be adjusted so that the addressing is consecutive.

◊ Table 7.2.1-1 : supported_media_type information for DVD-Audio and DVD-Video

Offset	Contents	DVD-Audio	DVD-Video
00 00_{16}	supported_media_type	09_{16}	09_{16}
00 01_{16}		01_{16}	02_{16}
00 02_{16}	implementation_profile_ID	10_{16}*	10_{16}*
00 03_{16}	media_type_attributes	00_{16}	00_{16}
00 04_{16}	type_dependent_length	00_{16}	00_{16}
00 05_{16}		02_{16}	02_{16}
00 06_{16}	type_dependent_information	10_{16}	10_{16}
00 07_{16}		FF_{16}	FF_{16}

* for a DVD player implementing [R21]

For details of the CD-DA data, see [R19] and [R20].
Implementers of controllers should note that the implementation Profile may be different for different supported_media_types.

A partial example of the Subunit Identifier Descriptor for a multi-format player which supports DVD-Video, DVD-Audio and also CD-DA is shown in Table 7.2.1-2. Please note that the data shown below is for illustration only: designers should use the correct information for their particular implementation.

The value for the root_contents_list in the Subunit Identifier Descriptor may change according to whether there is a disc in the drive and, if there is a disc, what sort of disc is currently in the drive. For full details see the latest version of AVC Disc General Specification. It is important that controllers shall first check if there is a disc in the drive by reading the disc_in_drive bits in the media_and_edit_status_info_block, see7.3.3 .

◊ **Table 7.2.1-2 : An example for a player supporting multiple formats**

	as Table 7.2-1, up to offset 00 09_{16}		
00 $0A_{16}$	disc_subunit_dependent_length	00_{16}	
00 $0B_{16}$		$2F_{16}$	Length
00 $0C_{16}$	disc_subunit_dependent_info_fields_length	00_{16}	
00 $0D_{16}$		$2B_{16}$	Length
00 $0E_{16}$	attributes	01_{16}	
00 $0F_{16}$	disc_subunit_version	10_{16}	
00 10_{16}	number_of_supported_media_types	01_{16}	
00 11_{16}	supported_media_type = DVD-Video	09_{16}	DVD-Video
00 12_{16}		02_{16}	
00 13_{16}	implementation_profile_ID	10_{16}	
00 14_{16}	media_type_attributes	00_{16}	
00 15_{16}	type_dependent_length	00_{16}	
00 16_{16}		02_{16}	
00 17_{16}	type_dependent_information	10_{16}	
00 18_{16}		FF_{16}	
00 19_{16}	supported_media_type = DVD_Audio	09_{16}	DVD-Audio
00 $1A_{16}$		01_{16}	
00 $1B_{16}$	implementation_profile_ID	10_{16}	
00 $1C_{16}$	media_type_attributes	00_{16}	
00 $1D_{16}$	type_dependent_length	00_{16}	
00 $1E_{16}$		02_{16}	
00 $1F_{16}$	type_dependent_information	10_{16}	
00 20_{16}		FF_{16}	
00 21_{16}	supported_media_type = CD-DA	01_{16}	CD-DA
00 22_{16}		01_{16}	
00 23_{16}	implementation_profile_ID	20_{16}	
00 24_{16}	media_type_attributes	00_{16}	
00 25_{16}	type_dependent_length	00_{16}	
00 26_{16}		02_{16}	
00 27_{16}	type_dependent_information	10_{16}	
00 28_{16}		FF_{16}	
00 29_{16}	manufacturer_dependent_length	00_{16}	
00 $2A_{16}$		00_{16}	

7.2.2 Reading the Disc Subunit Identifier Descriptor

The Disc Subunit Identifier Descriptor gives details of the player's capabilities and should be read at the discovery stage. This is often when a User first wishes to interact with the player, but it could also happen at other times when a controller searches the IEEE 1394 Bus for a device with specific capabilities.
The descriptor shall be read using the READ DESCRIPTOR command. Before reading the Descriptor, a controller must first use the OPEN DESCRIPTOR command. Until a Descriptor is OPENed, a target does not have to keep data in the Descriptor up to date. When a Descriptor is OPENed, it indicates to a target that this information is required and also gives access rights to the controller. Full details of this mechanism are contained in [R17] and [R18].

7.2.2.1 The OPEN DESCRIPTOR Command for the Subunit Identifier Descriptor

The OPEN DESCRIPOR command is used for both opening and closing a descriptor, with subfunction defining the action.

◊ Table 7.2.2.1-1 : OPEN DESCRIPTOR for the Subunit Identifier Descriptor

Offset	Contents	Value	M/O[1]	F/V[2]	Notes
opcode	OPEN DESCRIPTOR	08_{16}	M	F	
operand[0]	descriptor_identifier = subunit_identifier_descriptor	00_{16}	M	F	1
operand[1]	subfunction = READ_OPEN or CLOSE	01_{16} or 00_{16}	M	F	2
operand[2]	reserved	00_{16}	M	F	

[1] M = This data is Mandatory for a player conforming to Profile_ID = 10_{16}.

[2] F = Data Fixed in Controller implementation

Notes:

1. **descriptor_identifier**: this identifies the Subunit Identifier Descriptor
2. **subfunction**: This is set to READ_OPEN (01_{16}) or CLOSE (00_{16}).

7.2.2.2 The READ DESCRIPTOR Command for the Subunit Identifier Descriptor

The Subunit Identifier Descriptor is read with the READ DESCRIPTOR command. The complete Subunit Identifier Descriptor should be read, rather than individual sections or bytes. The only requirement is to implement "Read All" (with data_length = 00 00_{16}), all other values may return the REJECTED response.

◊ **Table 7.2.2.2-1 : READ DESCRIPTOR Command for Subunit Identifier Descriptor**

Offset	Contents	Value	M/O[1]	F/V[2]	Notes
opcode	READ DESCRIPTOR	09_{16}	M	F	
operand[0]	descriptor_specifier_type = subunit_identifier_descriptor	00_{16}	M	F	1
operand[1]	read_result_status	FF_{16}	M	F	2
operand[2]	reserved	00_{16}	M	F	
operand[3]	data_length = read all	00_{16}	M	F	3
operand[4]		00_{16}			
operand[5]	address (ignored if data_length = 00 00_{16})	FF_{16}	M	F	
operand[6]		FF_{16}			

[1] M = This data is Mandatory for a player conforming to Profile_ID = 10_{16}.

[2] F = Data Fixed in Controller implementation

Notes:

1. **descriptor_identifier**: this identifies the Subunit Identifier Descriptor
2. **read_result_status**: when this command is used with a *ctype* of CONTROL, the controller sets this byte to FF_{16}
3. **data_length** and **address**: the complete Subunit Identifier Descriptor shall be read with one command, using a data_length of 00 00_{16}. In this case, the address field is ignored and is set to FF FF_{16}.

7.2.2.3 The READ DESCRIPTOR Response frame for the Subunit Identifier Descriptor

When a target replies, it appends the Subunit Identifier Descriptor data to the end of the READ DESCRIPTOR command (now with a *response* of ACCEPTED) and returns 10_{16} or other values in the read_result_status field.

◊ **Table 7.2.2.3-1 : READ DESCRIPTOR response frame for Subunit Identifier Descriptor**

Offset	Contents	Value	M/O[1]	F/V[2]	Notes
opcode	READ DESCRIPTOR	09_{16}	M	F	
operand[0]	descriptor_specifier_type = subunit_identifier_descriptor	00_{16}	M	F	
operand[1]	read_result_status	10_{16}	M	V	1
operand[2]	reserved	00_{16}	M	F	
operand[3]	data_length	00_{16}	M	V	2
operand[4]		$1B_{16}$*			
operand[5]	address	FF_{16}	M	F	
operand[6]		FF_{16}			
operand[7]	descriptor_length	00_{16}	M	F	3
operand[8]		19_{16}*			
operand[9]	generation_ID	01_{16}	M	F	
operand[10]	size_of list_ID	02_{16}	M	F	
…	…	…*	…	…	
operand[n]	…	…*	…	…	

[1] M = This data is Mandatory for a player conforming to Profile_ID = 10_{16}.

[2] F = Data Fixed in DVD implementation; V = Variable data, see relevant Note

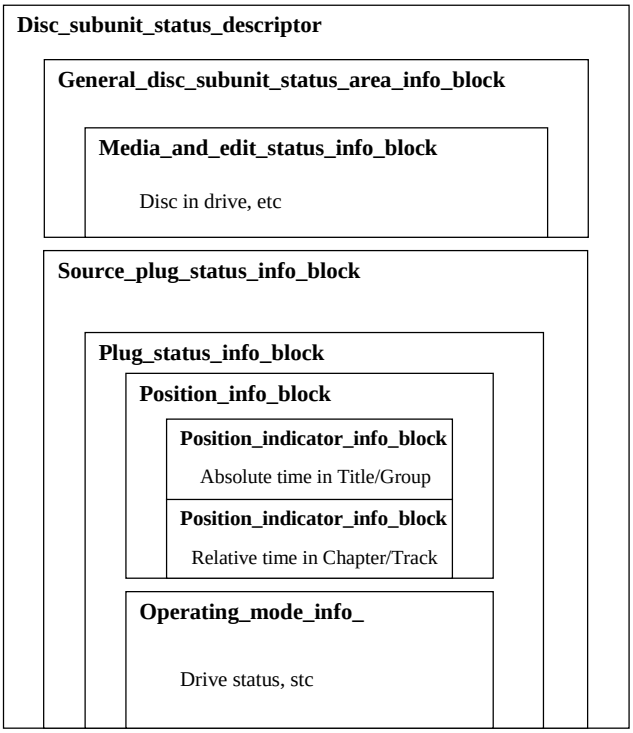
* depends on number of supported media_types, but fixed in the DVD implementation

Notes:

1. **read_result_status**: this indicates whether the read was successful or not. A successful read is indicated by the value of 10_{16}. For other values, see [R17], section 10.2.
2. **data_length** and **address**: If the read was successful, data_length returns the total number of bytes read in the descriptor. Note that this will depend in the number of supported_media_types, see section 7.2.1 . In the case that read_result_status is not equal to 10_{16}, data_length returns the number of bytes successfully read (if any) – see [R17], section 10.2. address is ignored and is filled with FF_{16}.
3. The **Subunit Identifier Descriptor data**, as shown in Table 7.2-1, is appended to the end of the returned command. The length and data will depend on the number of supported_media_types, see section 7.2.1 . Note that the value in the descriptor_length parameter does not include the length of descriptor_length parameter itself (2 bytes).

7.3 Disc Subunit Status Descriptor

The Disc Subunit Status Descriptor contains details of the current status of the drive, such as disc_in_drive, operating_mode and position_info_block (see Table 7.1-1). Information in this descriptor is held in info blocks which are individually read using the READ INFO BLOCK command, unlike the other two descriptors which are read as a whole using the READ DESCRIPTOR command. Therefore, it is not necessary to provide this information in one contiguous area of memory as is the case for the other descriptors. The conceptual structure is shown in Figure 7.3-1:



◊ **Figure 7.3-1 : Conceptual Structure of Disc Subunit Status Descriptor**

7.3.1 Disc Subunit Status Descriptor Info Block paths

When requesting data from the player, specific data is found by reading from a complete Info Block which contains that data. For instance, information as to whether there is a disc currently in the drive (Disc_in_drive) is found by reading the complete media_and_edit_status_info_block. Info Blocks are specified by a path from an identifiable root. For instance, the media_and_edit_status_info_block is contained in the general_disc_subunit_status_area_info_block, which is contained in the disc_subunit_status_descriptor. Levels are numbered from 0, which refers to the root of the path (the disc_subunit_status_descriptor).

In this example, the number of levels is 3, where Level 0 is the disc_subunit_status_descriptor, Level 1 is the general_disc_subunit_status_area_info_block and Level 2 is the media_and_edit_status_info_block. As another example, information about the current playing position is read from the position_info_block, which

has a path with 4 levels. These examples assume that the player has one source plug, which is numbered 0 in all instances.

[R17], [R18] and [R20] define many methods of specifying and reading these info_blocks.
All info_block shall be specified using just one method, with a descriptor_type of 30_{16} (object_ref_by_type_and_instance_count).

[R19] and [R20] give the info block ID values (e.g. 88 04_{16} for the media_and_edit_status_info_block).

7.3.2 The OPEN DESCRIPTOR Command for the Disc Subunit Status Descriptor

The OPEN DESCRIPTOR command for the Disc Subunit Status Descriptor is:

◊ Table 7.3.2-1 : OPEN DESCRIPTOR for the Disc Subunit Status Descriptor

Offset	Contents	Value	M/O[1]	F/V[2]	Notes
opcode	OPEN DESCRIPTOR	08_{16}	M	F	
operand[0]	descriptor_identifier =	80_{16}	M	F	1
operand[1]	subunit dependent (status descriptor)	00_{16}	M	F	
operand[2]	subfunction = READ_OPEN or CLOSE	01_{16} or 00_{16}	M	F	2
operand[3]	reserved	00_{16}	M	F	

[1] M = This data is Mandatory for a player conforming to Profile_ID = 10_{16}.

[2] F = Data Fixed in Controller implementation

Notes:

1. **descriptor_identifier**: this identifies the Status Descriptor, which is a subunit-defined type defined by the Disc Subunit.
2. **subfunction**: This is set to READ_OPEN (01_{16}) or CLOSE (00_{16}).

7.3.3 The media_and_edit_status info block

The media_and_edit_status info block contains the disc_in_drive bits which give information about whether there is a disc currently in the drive. Note that this does not give information about the type of disc that is currently loaded – this is found by reading the media_type in the contents list. For further details see Table 7.4-2.

7.3.3.1 READ INFO BLOCK Command for media_and_edit_status info block

◊ Table 7.3.3.1-1 : READ INFO BLOCK Command for media_and_edit_status info block

Offset	Contents	Value	M/O[1]	F/V[2]	Notes
opcode	READ INFO BLOCK (06_{16})	06_{16}	M	F	
operand[0]	number of levels	03_{16}	M	F	1
operand[1]	Level 0 path reference =	80_{16}	M	F	2
operand[2]	Disc Subunit Status Descriptor	00_{16}			
operand[3]	object_ref_by_type_and_instance_count	30_{16}	M	F	3
operand[4]	Level 1 path reference =	88_{16}	M	F	4
operand[5]	general_disc_subunit_status_area_info_block	00_{16}			
operand[6]	instance count	00_{16}	M	F	5
operand[7]	object_ref_by_type_and_instance_count	30_{16}	M	F	3
operand[8]	Level 2 path reference =	88_{16}	M	F	6
operand[9]	media_and_edit_status_info_block	04_{16}			
operand[10]	instance count	00_{16}	M	F	5
operand[11]	read_result_status	FF_{16}	M	F	7
operand[12]	reserved	00_{16}	M	F	
operand[13]	data_length	00_{16}	M	F	8
operand[14]		00_{16}			
operand[15]	address	FF_{16}	M	F	
operand[16]		FF_{16}			

[1] M = Mandatory for a player conforming to Profile_ID = 10_{16}

[2] F = Data Fixed in Controller implementation

Notes:

1. **number_of_levels**: Figure 7.3-1 shows the structure of the Status Descriptor. The media_and_edit_status_info_block has 3 levels in its path – see the general description of paths in section 7.3.1 .
2. **Level 0 path reference**: this specifies the Disc Subunit Status Descriptor.
3. **object_ref_by_type_and_instance_count**: all info_blocks are specified using this one method.
4. **Level 1 path reference**: this specifies the general_disc_subunit_status_area_info_block.
5. **instance count**: it is possible to have more than one occurrence of a particular info_block at any level (e.g. the two position_info_blocks), which are numbered from 0. However, there is only one instance of all other info_blocks and so this value is set to zero here.
6. **Level 2 path reference**: this specifies the media_and_edit_status_info_block.
7. **read_result_status**: when this command is used with a *ctype* of CONTROL, the controller sets this byte to FF_{16}.

8. **data_length** and **address**: the complete Info Block shall be read with one command, using a data_length of 00 00_{16}. In this case, the address field is ignored and is set to FF FF_{16}.

7.3.3.2 READ INFO BLOCK response frame for media_and_edit_status_info_block

◊ Table 7.3.3.2-1 : READ INFO BLOCK response frame for media_and_edit_status_info_block

Offset	Contents	Value	M/O[1]	F/V[2]	Notes
opcode	READ INFO BLOCK (06_{16})	06_{16}	M	F	
operand[0]	number of levels	03_{16}	M	F	1
operand[1]	Level 0 path reference = Disc Subunit Status Descriptor	80_{16}	M	F	
operand[2]		00_{16}			
operand[3]	object_ref_by_type_and_instance_count	30_{16}	M	F	
operand[4]	Level 1 path reference = general_disc_subunit_status_area_info_block	88_{16}	M	F	
operand[5]		00_{16}			
operand[6]	instance count	00_{16}	M	F	
operand[7]	object_ref_by_type_and_instance_count	30_{16}	M	F	
operand[8]	Level 2 path reference = media_and_edit_status_info_block	88_{16}	M	F	
operand[9]		04_{16}			
operand[10]	instance count	00_{16}	M	F	
operand[11]	read_result_status	10_{16}	M	V	2
operand[12]	reserved	00_{16}	M	F	
operand[13]	data_length	00_{16}	M	V	3
operand[14]		09_{16}			
operand[15]	address	FF_{16}	M	F	
operand[16]		FF_{16}			
operand[17]	compound_length	00_{16}	M	F	4
operand[18]		07_{16}			
operand[19]	info_block_type = media_and_edit_status infoblock	88_{16}	M	F	5
operand[20]		04_{16}			
operand[21]	primary_fields_length	00_{16}	M	F	6
operand[22]		03_{16}			
operand[23]	disc_in_drive | error_condition | reserved	xx00 0000b	M	V	7, 8
operand[24]	undo_status	00_{16}	M	F	9
operand[25]	difference | auto_update | reserved	40_{16}	M	F	

[1] M = This data is Mandatory for a player conforming to Profile_ID = 10_{16}.

[2] F = Data Fixed in DVD implementation; V = Variable data, see relevant Note

Notes:

1. These fields are the same as the READ INFO BLOCK command for the media_and_edit_status_info_block (see section 7.3.3.1)
2. **read_result_status**: indicates whether the read was successful or not. A successful read is indicated by the value of 10_{16}. For other values, see [R17], section 10.2.
3. **data_length** and **address**: If the read was successful, data_length returns the total number of bytes read in the info block. In the case that read_result_status is not equal to 10_{16}, data_length returns the number of bytes successfully read (if any) – see [R17], section 10.2. address is ignored and is filled with FF_{16}.
4. **compound_length**: indicates the total length of the media_and_edit_status_info_block (excluding the compound_length bytes)
5. **info_block_type**: indicates the media_and_edit_status_info_block
6. **primary_fields_length**: indicates the remaining length
7. **disc_in_drive**: this is a two-bit field indicating whether there is a disc in the drive:

◊ Table 7.3.3.2-2 : disc_in_drive bits

disc_in_drive bits	Meaning
00b	Unknown – The subunit is unable to determine if a disc is in the drive or not.
01b	Installed – There is a disc in the drive.
10b	Not installed – There is no disc in the drive.
11b	reserved for future specification

This table is included for information only; please refer to [R19]

8. **error_condition**, **reserved**: it is not mandatory to indicate the error condition (two bits) and so the remainder of this byte is set to 000000b. For further details, see [R19].
9. The remaining data is not needed for a player conforming to [R21] and so these bytes are set to 00 40_{16} to retain compatibility with other specifications.

7.3.4 The operating_mode info block

The operating_mode info block contains the operating_mode and its associated data. Operating_mode gives information about the current state of the drive, e.g. PLAY, STOP, etc.
Note that the DVD SKIP command is mapped onto the AV/C SEARCH command and that the DVD SEARCH command is mapped onto the AV/C PLAY command (with a speed faster than normal). The status information contained in the operating_mode info block is as follows:

◊ **Table 7.3.4-1 : Reporting of DVD PLAY, SEARCH and SKIP functions**

DVD function	Operating_mode	Operating_mode_specific_information
PLAY	PLAY	Normal speed forward
SEARCH	PLAY	Speed faster than normal, forward or reverse (depending on direction of SKIP)
SKIP	SEARCH	relative_unit

This table is included for information only; please refer to [R19] Table 7.19 for full details.
For further information about the operating_mode_specific_information parameters, see [R19] Table 10-64 (for DVD PLAY and DVD SEARCH) and [R19] Table 10-78 (for DVD SKIP).

7.3.4.1 READ INFO BLOCK Command for operating_mode info block

◊ **Table 7.3.4.1-1 : READ INFO BLOCK command for operating_mode info block**

Offset	Contents	Value	M/O[1]	F/V[2]	Notes
opcode	READ INFO BLOCK (06_{16})	06_{16}	O	F	
operand[0]	number of levels	04_{16}	O	F	1
operand[1]	Level 0 path reference = Disc Subunit Status Descriptor	80_{16}	O	F	
operand[2]		00_{16}			
operand[3]	object_ref_by_type_and_instance_count	30_{16}	O	F	
operand[4]	Level 1 path reference = source_plug_status_info_block	88_{16}	O	F	2
operand[5]		02_{16}			
operand[6]	instance count	00_{16}	O	F	3
operand[7]	object_ref_by_type_and_instance_count	30_{16}	O	F	
operand[8]	Level 2 path reference = plug_status_info_block	88_{16}	O	F	2
operand[9]		05_{16}			
operand[10]	instance count	00_{16}	O	F	3
operand[11]	object_ref_by_type_and_instance_count	30_{16}	O	F	
operand[12]	Level 3 path reference = operating_mode_info_block	88_{16}	O	F	2
operand[13]		06_{16}			
operand[14]	instance count	00_{16}	O	F	3
operand[15]	read_result_status	FF_{16}	O	F	4
operand[16]	reserved	00_{16}	O	F	
operand[17]	data_length	00_{16}	O	F	5
operand[18]		00_{16}			
operand[19]	address	FF_{16}	O	F	
operand[20]		FF_{16}			

[1] O = The command is Optional for a player conforming to Profile_ID = 10_{16}, but if it is used then it shall conform to the data and structure above.

[2] F = Data Fixed in Controller implementation

Notes:

1. **number of levels**: this is set to 4 for the operating_mode info block (see Figure 7.3-1).
2. **Level 1 path reference** is the source_plug_status_info_block; **Level 2 path reference** is the plug_status_info_block; **Level 3 path reference** is the operating_mode_info_block.
3. **instance count**: there is only one instance of each of these info_blocks, so this is set to zero.
4. **read_result_status**: when this command is used with a *ctype* of CONTROL, the controller sets this byte to FF_{16}.
5. **data_length** and **address**: the complete Info Block shall be read with one command, using a data_length of 00 00_{16}. In this case, the address field is ignored and is set to FF FF_{16}.

7.3.4.2 READ INFO BLOCK response frame for the operating_mode info block

The example below shows the data for the operating_mode info block while the drive is playing normally.

◊ Table 7.3.4.2-1 : READ INFO BLOCK response frame for the operating_mode info block

Offset	Contents	Value	M/O[1]	F/V[2]	Notes
opcode	READ INFO BLOCK (06_{16})	06_{16}	O	F	
operand[0]	number of levels	04_{16}	O	F	
operand[1]	Level 0 path reference = Disc Subunit Status Descriptor	80_{16}	O	F	
operand[2]		00_{16}			
operand[3]	object_ref_by_type_and_instance_count	30_{16}	O	F	
operand[4]	Level 1 path reference = source_plug_status_info_block	88_{16}	O	F	
operand[5]		02_{16}			
operand[6]	instance count	00_{16}	O	F	
operand[7]	object_ref_by_type_and_instance_count	30_{16}	O	F	1
operand[8]	Level 2 path reference = plug_status_info_block	88_{16}	O	F	
operand[9]		05_{16}			
operand[10]	instance count	00_{16}	O	F	
operand[11]	object_ref_by_type_and_instance_count	30_{16}	O	F	
operand[12]	Level 3 path reference = operating_mode_info_block	88_{16}	O	F	
operand[13]		06_{16}			
operand[14]	instance count	00_{16}	O	F	
operand[15]	read_result_status	10_{16}	O	V	2
operand[16]	reserved	00_{16}	O	F	
operand[17]	data_length	00_{16}	O	V	3
operand[18]		08_{16}			
operand[19]	address	FF_{16}	O	F	
operand[20]		FF_{16}			
operand[21]	compound length	00_{16}	O	F	4
operand[22]		06_{16}			
operand[23]	info_block_type = operating_mode	88_{16}	O	F	5
operand[24]		06_{16}			
operand[25]	primary_fields_length	00_{16}	O	F	6
operand[26]		02_{16}			
operand[27]	operating_mode	$C3_{16}$*	O	V	7
operand[28]	operating_mode_specific_information	75_{16}*	O	V	8

[1] O = The response is Optional for a player conforming to Profile_ID = 10_{16} , but if it is used then it shall conform to the data and structure above.

[2] F = Data Fixed in DVD implementation; V = Variable data, see relevant Note

* example values only for playing (PLAY FORWARD)

Notes:

1. These fields are the same as the READ INFO BLOCK command for the operating_mode_info_block (see section 7.3.4.1).
2. **read_result_status**: indicates whether the read was successful or not. A successful read is indicated by the value of 10_{16}. For other values, see [R17], section 10.2.
3. **data_length** and **address**: If the read was successful, data_length returns the total number of bytes read in the info block. In the case that read_result_status is not equal to 10_{16}, data_length returns the number of bytes successfully read (if any) – see [R17], section 10.2. address is ignored and is filled with FF_{16}.
4. **compound length**: gives the length of the info block (excluding itself)
5. **info_block_type**: indicates the operating_mode info block
6. **primary_fields_length**: gives the remaining length of the info block (excluding itself)
7. **operating_mode**: valid values of operating_mode for a player conforming to [R21] are shown in Table 7.3.4.2-2.

◊ Table 7.3.4.2-2 : Valid values for operating_mode for a player

operating_mode	Meaning
50_{16}	SEARCH (DVD SKIP) – The subunit is performing a search (DVD Skip) on a track which is on this plug.
$C3_{16}$	PLAY (DVD PLAY or DVD SEARCH) – The plug is playing an AV object.
$C5_{16}$	STOP – The stream on the plug is currently stopped.

This table is included for information only; please refer to [R19] section 7-19 for full details.

8. **operating_mode_specific_information**: see Table 7.3.4-1 and [R19] Table 10-64 (for DVD PLAY and DVD SEARCH) and [R19] Table 10-78 (for DVD SKIP). The example shown in Table 7.3.4.2-1 shows the value for play operation: the value of 75_{16} for PLAY (normal) is a mandatory value. Values used for other DVD PLAY and DVD SEARCH speeds are implementation dependent, but should reflect what the drive is currently doing – please refer to the note about "trick modes" after [R19] Table 10-64.

7.3.5 The position info block and position_indicator info blocks

Details of the current playing position are contained in the position info block. This contains two position_indicator info blocks indicating time in two different formats. For a player conforming to [R21], playing position shall be provided in two ways: time within the current DVD-Video Title or DVD-Audio Group (using the absolute_HMSF count); and time within the current DVD-Video Chapter or DVD-Audio Track (using the relative_segment_HMSF count). It is important that the two position_indicator info blocks are in the order shown in Figure 7.3-1, with the info block containing the absolute_HMSF count at the lower address offset.

For details of position reporting, including differences between DVD-Video and DVD-Audio, see [R21] section

5.3. The reporting of the various items using the relative_segment_HMSF format is shown below:

◊ **Table 7.3.5-1 : Reporting of DVD-Video and DVD-Audio Playing position**

DVD-Video	DVD-Audio	AV/C Status name
Title	Group	Mapped to descriptor_reference (list_ID)
Chapter	Track	Mapped to object_position_number
-	Index	Mapped to segment number
Time HMSF	Time HMSF	Time HMSF

This table is included for information only; please refer to [R21] section 5.3.2 for full details.

For details of the mapping of DVD-Video Chapters and DVD-Audio Tracks and Indexes to list_ID values, see [R21] Tables 6.1 and 5.3.

In both info blocks, time is reported in Hours:Minutes:Seconds:Frames (HMSF) format, using Binary Coded Decimal. Support for Frames is optional and the Frames byte shall be filled with FF_{16} if Frames are not implemented.

It is recommended that both time formats be read at the same time by reading the complete position info block (containing both position_indicator info blocks). This will ensure that the data in both position_indicator info blocks refers to the same playing position. However, it should also be possible to read the individual position_indicator info blocks if playing position is required in only one format. This will reduce the size of the returned data, but at the overhead of a slightly larger (by 4 bytes) READ INFO BLOCK command (an extra Level is required, along with a specific instance for the required format – 0 for the absolute_HMSF_count and 1 for the relative_HMSF_count).

7.3.5.1 READ INFO BLOCK Command for the Position info block

This asks for the playing position in both formats.

◊ Table 7.3.5.1-1 : READ INFO BLOCK Command for the position info block

Offset	Contents	Value	M/O[1]	F/V[2]	Notes
opcode	READ INFO BLOCK (06_{16})	06_{16}	O	F	
operand[0]	number of levels	04_{16}	O	F	1
operand[1]	Level 0 path reference = Disc Subunit Status Descriptor	80_{16}	O	F	
operand[2]		00_{16}			
operand[3]	object_ref_by_type_and_instance_count	30_{16}	O	F	
operand[4]	Level 1 path reference = source_plug_status_info_block	88_{16}	O	F	2
operand[5]		02_{16}			
operand[6]	instance count	00_{16}	O	F	3
operand[7]	object_ref_by_type_and_instance_count	30_{16}	O	F	
operand[8]	Level 2 path reference = plug_status_info_block	88_{16}	O	F	2
operand[9]		05_{16}			
operand[10]	instance count	00_{16}	O	F	3
operand[11]	object_ref_by_type_and_instance_count	30_{16}	O	F	
operand[12]	Level 3 path reference = position_info_block	88_{16}	O	F	2
operand[13]		03_{16}			
operand[14]	instance count	00_{16}	O	F	3
operand[15]	read_result_status	FF_{16}	O	F	4
operand[16]	reserved	00_{16}	O	F	
operand[17]	data_length	00_{16}	O	F	5
operand[18]		00_{16}			
operand[19]	address	FF_{16}	O	F	
operand[20]		FF_{16}			

[1] O = The command is Optional for a player conforming to Profile_ID = 10_{16}, but if it is used then it shall conform to the data and structure above.

[2] F = Data Fixed in Controller implementation

Notes:

1. **number of levels**: this is set to 4 for the operating_mode info block (see Figure 7.3-1).
2. **Level 1 path reference** is the source_plug_status_info_block; **Level 2 path reference** is the plug_status_info_block; **Level 3 path reference** is the position_info_block.
3. **instance count**: there is only one instance of each of these info_blocks, so this is set to zero.
4. **read_result_status**: when this command is used with a *ctype* of CONTROL, the controller sets this byte to FF_{16}.

5. **data_length** and **address**: the complete Info Block shall be read with one command, using a data_length of $00\ 00_{16}$. In this case, the address field is ignored and is set to FF FF_{16}.

7.3.5.2 READ INFO BLOCK response frame for the position info block

The response frame from a player with a DVD-Audio disc is shown below. As an example, the player is playing Audio Group 2, Track 4, Index 5 with a total time in the group of 1 hour 2 minutes and 30 seconds and a time within the track of 6 minutes and 45 seconds:

◊ Table 7.3.5.2-1 : READ INFO BLOCK response frame for the position info block

Offset	Contents	Value	M/O[1]	F/V[2]	Notes
opcode	READ INFO BLOCK (06_{16})	06_{16}	O	F	
operand[00]	number of levels	04_{16}	O	F	1
operand[01]	Level 0 path reference = Disc Subunit Status Descriptor	80_{16}	O	F	
operand[02]		00_{16}			
operand[03]	object_ref_by_type_and_instance_count	30_{16}	O	F	
operand[04]	Level 1 path reference = source_plug_status_area_info_block	88_{16}	O	F	
operand[05]		02_{16}			
operand[06]	instance count	00_{16}	O	F	
operand[07]	object_ref_by_type_and_instance_count	30_{16}	O	F	
operand[08]	Level 2 path reference = plug_status_info_block	88_{16}	O	F	
operand[09]		05_{16}			
operand[10]	instance count	00_{16}	O	F	
operand[11]	object_ref_by_type_and_instance_count	30_{16}	O	F	
operand[12]	Level 3 path reference = position_info_block	00_{16}	O	F	
operand[13]		03_{16}			
operand[14]	instance count	00_{16}	O	F	
operand[15]	read_result_status	10_{16}	O	V	2
operand[16]	reserved	00_{16}	O	F	
operand[17]	data_length	00_{16}	O	V	3
operand[18]		24_{16}			
operand[19]	address	FF_{16}	O	F	
operand[20]		FF_{16}			
operand[21]	compound length	00_{16}	O	F	4
operand[22]		22_{16}			
operand[23]	info_block_type = position_info_block	00_{16}	O	F	5
operand[24]		03_{16}			
operand[25]	primary_fields_length	00_{16}	O	F	6
operand[26]		03_{16}			
operand[27]	list_descriptor_reference specified by list_ID	10_{16}	O	F	7
operand[28]	list_descriptor = Title or Group	10_{16}	O	V	8
operand[29]		02_{16}*			
operand[30]	compound length	00_{16}	O	F	9
operand[31]		$0A_{16}$			
	… / continued				

	… / continuation				
operand[32]	info_block_type = position_indicator_info_block	00_{16}	O	F	10
operand[33]		02_{16}			
operand[34]	primary_fields_length	00_{16}	O	F	11
operand[35]		06_{16}			
operand[36]	indicator_type = absolute_HMSF_count	02_{16}	O	F	12
operand[37]	Hours in Title or Group (MSB)	00_{16}*	O	V	13
operand[38]	Hours in Title or Group (LSB)	01_{16}*	O	V	
operand[39]	Minutes in Title or Group	02_{16}*	O	V	
operand[40]	Seconds in Title or Group	30_{16}*	O	V	
operand[41]	Frames in Title or Group	FF_{16}	O	V	
operand[42]	compound length	00_{16}	O	F	14
operand[43]		$0D_{16}$			
operand[44]	info_block_type = position_indicator_info_block	00_{16}	O	F	15
operand[45]		02_{16}			
operand[46]	primary_fields_length	00_{16}	O	F	16
operand[47]		09_{16}			
operand[48]	indicator_type =relative_segment_HMSF_count	08_{16}	O	F	17
operand[49]	object_position_number = Chapter or Track	00_{16}*	O	V	18
operand[50]		04_{16}*			
operand[51]	Segment = Index Number	00_{16}*	O	V	19
operand[52]		05_{16}*			
operand[53]	+/– Hours	00_{16}*	O	V	20, 21
operand[54]	Minutes	06_{16}*	O	V	22
operand[55]	Seconds	45_{16}*	O	V	
operand[56]	Frames	FF_{16}	O	V	

[1] O = The response is Optional for a player conforming to Profile_ID = 10_{16}, but if it is used then it shall conform to the data and structure above.

[2] F = Data Fixed in DVD implementation; V = Variable data, see relevant Note

* These values will depend on the current playing position and are included as an example only.

Notes:

1. These fields are the same as the READ INFO BLOCK command for the position info block, see Table 7.3.5.1-1.
2. **read_result_status**: indicates whether the read was successful or not. A successful read is indicated by an error code of 10_{16}. For other values, see [R17], section 10.2.
3. **data_length** and **address**: If the read was successful, data_length returns the total number of bytes read in the info block. In the case of an error, data_length returns the number of bytes successfully read (if any) – see [R17], section 10.2. address is ignored and is filled with FF_{16}.
4. **compound length**: this indicated the length (excluding itself) for the total indicator info block, which includes the two position_indicator info blocks.

5. **info_block_type**: this identifies the position info block.
6. **primary_fields_length**: this indicates the length of the primary fields of the position info block (i.e. before the two nested position_indicator info blocks).
7. **list_descriptor_reference**: indicates that the Title or Group are identified by list_ID
8. **list_descriptor**: identifies the current Title or Group
9. **compound length**: this byte indicates the length (excluding itself) of the first position_indicator info block, used for total time within a Title or Group. It is the first byte in that info block.
10. **info_block_type**: indicates a position_indicator info block
11. **primary_fields_length**: gives the remaining length of the absolute_HMSF_count info block
12. **indicator_type**: indicates the absolute_HMSF_count format
13. these bytes contain the total time within the Title or Group identified at operands 28 and 29, in Hours:Minutes:Seconds:Frames format. Note that Frames need not be implemented, in which case the Frames byte should be filled with FF_{16}.
14. **compound length**: this byte indicates the length (excluding itself) of the second position_indicator info block, used for time within a Chapter or Track only. It is the first byte in that info block.
15. **info_block_type**: indicates another position_indicator info block
16. **primary_fields_length**: gives the remaining length of the relative_segment_HMSF info block
17. **indicator_type**: indicates the relative_segment_HMSF info block
18. **object_position_number**: this contains the current Chapter or Track.
19. **segment**: this indicates the current Index Number. Note that Indexes are not defined for DVD-Video and so this should contain FF_{16} when a DVD-Video is being played.
20. **+/–**: the MS bit is set to zero to indicate that the time is positive with respect to the beginning of the Chapter or Track.
21. **hours**: the remaining bits of this byte indicate the number of hours elapsed since the beginning of the Chapter or Track.
22. These bytes indicate the Minutes and Seconds parts of the current position. Note that Frames need not be implemented, in which case the Frames byte should be filled with FF_{16}.

7.4 The Root Contents List

The root contents list contains information about the disc currently in the drive. These includes details of the type of disc currently in the drive (media_type), list attributes, disc read/write capability and status, and a counter which is updated every time a disc is inserted. The information in Table 7.4-1 is mandatory and should be read with a single READ DESCRIPTOR command. As an option, the total playing time of an Audio disc can be reported using the AV Object Type-Specifc Capacity info block – see Table 7.4-3. This is added at the end of the mandatory section shown in Table 7.4-1, starting at offset 00 23_{16}.

◊ **Table 7.4-1 : The Root Contents List**

Root Contents List Descriptor					
Offset	**Contents**	**Value**	**M/O**[1]	**F/V**[2]	**Notes**
00 00_{16}	descriptor_length	00_{16}	M	F/V	1
00 01_{16}		21_{16}			
00 02_{16}	list_type = Root Content List	80_{16}	M	F	2
00 03_{16}	list attributes	08_{16}	M	F	3
00 04_{16}	size_of_list_specific_information	00_{16}	M	F	4
00 05_{16}		$1B_{16}$			
00 06_{16}	non_info_block_fields_length	00_{16}	M	F	5
00 07_{16}		04_{16}			
00 08_{16}	disc_subunit_list_attributes	03_{16}	M	F	6
00 09_{16}	media_type (e.g. DVD-Video)	09_{16}*	M	V	7
00 $0A_{16}$		02_{16}*			
00 $0B_{16}$	disc_recordable_information	40_{16}	M	F	8
00 $0C_{16}$	compound_length	00_{16}	M	F	9
00 $0D_{16}$		$0B_{16}$			
00 $0E_{16}$	info_block_type = time_stamp_info_block	00_{16}	M	F	10
00 $0F_{16}$	(descriptor modification time)	07_{16}			
00 10_{16}	primary_fields_length	00_{16}	M	F	11
00 11_{16}		07_{16}			
00 12_{16}	Valid | Type | Year(MSB)	1100 000b	M	F	12, 13
00 13_{16}	Year (LSB)	00_{16}	M	F	
00 14_{16}	Month	00_{16}	M	F	
00 15_{16}	Day	00_{16}	M	F	
00 16_{16}	Hours	00_{16}	M	F	
00 17_{16}	Minutes (Counter MSB)	xx_{16}*	M	V	
00 18_{16}	Seconds (Counter LSB)	xx_{16}*	M	V	
00 19_{16}	compound_length	00_{16}	M	F	14
00 $1A_{16}$		06_{16}			
00 $1B_{16}$	info_block_type = default_play_list	80_{16}	M	F	15
00 $1C_{16}$		$0B_{16}$			
00 $1D_{16}$	primary_fields_length	00_{16}	M	F	16
00 $1E_{16}$		02_{16}			
00 $1F_{16}$	default_playlist = root_contents_list	10_{16}	M	F	17
00 20_{16}		00_{16}			
00 21_{16}	number_of _entries	00_{16}	M	F	18
00 22_{16}		00_{16}			

[1] M = This data is Mandatory for a player conforming to Profile_ID = 10_{16}.

[2] F = Data Fixed in DVD implementation; V = Variable data, see relevant Note

* These values will depend on the current disc in the drive and are included as an example only

Notes:

1. **descriptor_length**: this is the length of the complete descriptor (excluding itself). This length shall include the AV_Object_type_specific_info_block, if present (see Table 7.4-3).
2. **list_type:** this identifies this list as the root contents list.
3. **list attributes**: for a player conforming to [R21], this is set to indicate that the descriptor is up_to_date. For further details, see [R17] section 8.2.
4. **size_of_list_specific_information**: this give the remaining length of the list_specific_information (excluding itself) up to and including the default_playlist starting at offset 00 $1F_{16}$.
5. **non_info_block_fields_length**: this contains the length up to and including the disc_recordable_information byte (at operand 00 $0B_{16}$) – see section 9.3.1 of [R19]
6. **disc_subunit_list_attributes**: for a player conforming to [R21], this is set to descriptor_locked – see Table 9-3 of [R19]
7. **media_type**: this describes the type of disc currently in the player. Currently defined values for DVD discs are:

◊ Table 7.4-2 : media_type for DVD

media_type (MSB)	Value	media_type (LSB)	Value
DVD	09_{16}	DVD-Audio	01_{16}
		DVD-Video	02_{16}
		other	$0E_{16}$
		reserved	all others

This table is included for information only; please refer to [R21] Table 6-2 for full details.

Players also supporting other formats, such as CD-DA, should report the appropriate media_type. Please refer to the relevant specification (such as Table 9-5 of [R19]) for these values.

8. **disc_recordable_information**: this contains details of the read, write and locked status of the current disc. For a player conforming to [R21], this is set to "protected".
9. **compound_length**: this contains the length (excluding itself) to the end of the time_stamp info block (up to and including offset 00 18_{16})
10. **time_stamp_info_block**: this indicates the info block as a time_stamp type, referring to descriptor_creation time – see [R18], section 6.5. Note that the type bit (see next byte and Note 12) actually indicates that this info block is implemented as a counter, rather than a time stamp.
11. **primary_fields_length**: indicates the remaining length of the time_stamp info block.
12. **valid**, **type**: valid indicates that the "time stamp" is valid and is set to "valid". Type is set to 1b to indicate that this info block is implemented as a counter which is incremented every time a disc is inserted into the drive, allowing controllers to determine if the disc has been changed.

13. The time_stamp info block is implemented as a 16-bit counter, using the "seconds" field as the least significant byte and the "minutes" field as the most significant byte.
14. **compound_length**: this indicated the length (excluding itself) of the default_playlist info block
15. **info_block_type**: this indicates the default_playlit info block.
16. **primary_fields_length**: this indicates the remaining length (excluding itself) of the default_playlist info block.
17. **default_playlist**: this indicates that the default playlist is the root_contents_list.
18. **number_of_entries**: this indicates the number of object entries following. For a player conforming to Profile_ID = 10_{16}, it is not necessary to have further object entries, in which case these bytes are set to zero.

It is an option to be able to report the total playing time for a DVD-Audio disc. This is reported using the optional AV Object Type-specific info block, see Table 7.4-3. If the implementation uses this info_block, then this info_block shall only contain valid data if a DVD-Audio disc is in the player.

◊ **Table 7.4-3 : optional AV Object Type-specific info block**

Offset	Contents		Value	Notes
00 23_{16}	compound_length		00_{16}	1
00 24_{16}			$1B_{16}$	
00 25_{16}	info_block_type = AV_object_type_specific_info_block		80_{16}	2
00 26_{16}			03_{16}	
00 27_{16}	primary_fields_length		00_{16}	3
00 28_{16}			17_{16}	
00 29_{16}	object_type = Audio Track		80_{16}	4
00 $2A_{16}$	capacity_format_indicator = time in HMSF		00_{16}	5
00 $2B_{16}$	object_type_specific_total_playback _capacity_length		00_{16}	6
00 $2C_{16}$			05_{16}	
00 $2D_{16}$	object_type_specific_ total_playback_capacity	Hours (High)	00_{16}*	7, 8
00 $2E_{16}$		Hours (Low)	01_{16}*	
00 $2F_{16}$		Minutes	12_{16}*	
00 30_{16}		Seconds	30_{16}*	
00 31_{16}		Frames	FF_{16}*	
00 32_{16}	object_type_specific_maximum_recording _capacity_length		00_{16}	6
00 33_{16}			05_{16}	
00 34_{16}	object_type_specific_ maximum_recording_ capacity	Hours (High)	00_{16}*	9, 8
00 35_{16}		Hours (Low)	01_{16}*	
00 36_{16}		Minutes	12_{16}*	
00 37_{16}		Seconds	30_{16}*	
00 38_{16}		Frames	FF_{16}*	
00 39_{16}	object_type_specific_remaining_recording _capacity_length		00_{16}	6
00 $3A_{16}$			05_{16}	
00 $3B_{16}$	object_type_specific_remaining _recording_capacity		00_{16}	10
00 $3C_{16}$			00_{16}	
00 $3D_{16}$			00_{16}	
00 $3E_{16}$			00_{16}	
00 $3F_{16}$			00_{16}	

* These values will depend on the current disc in the drive and are included as an example only.
(total time is 1 hour, 12 minutes and 30 seconds in this example)

Notes:

1. **compound_length**: this gives the overall length (excluding itself) of the AV_object_type_specific_info_block.
2. **info_block_type**: indicates that this is the AV_object_type_specific_info_block
3. **primary_fields_length**: indicates the remaining length (excluding itself) of the info block
4. **object_type**: identifies that this refers to an Audio Track
5. **capacity_format_indicator**: indicates the format (time in HMSF)
6. **capacity_lengths**: information is stored in 3 areas, each of 5 bytes.
7. **object_type_specific_total_playback_capacity**: indicates the total AV disc capacity (time) of the disc
8. **time capacity data**: time information is stored in the following BCD format:

◊ Table 7.4-4 : Time capacity format

Relative Offset	Name	HMSF Data	
00 00_{16}	Hours (High)	Hours (thousands)	Hours (hundreds)
00 01_{16}	Hours(Low)	Hours (tens)	Hours (units)
00 02_{16}	Minutes	Minutes (MSB)	Minutes (LSB)
00 03_{16}	Seconds	Seconds (MSB)	Seconds (LSB)
00 04_{16}	Frames	Frames (MSB)	Frames (LSB)

This table is included for information only; please refer to [R21] Table 6-3 for full details.

Note that if Frames are not supported, the Frames byte should be set to FF_{16}.

9. **object_type_specific_maximum_recording_capacity**: for a player conforming to [R21], this will be set to the same data as the preceding object_type_specific_total_playback_capacity.
10. **object_type_specific_remaining_recording_capacity**: for a player conforming to [R21], this will be set to zero.

7.4.1 Reading the Root Contents List

The root contents list should be read every time a disc is changed. A controller shall poll the target to see if the time stamp info block (which is implemented as a counter) has a different count, indicating that the disc may have changed. The complete root contents list should be read with one single command.

Some implementations may have much more information in their root contents list than is specified here – see section 9 of [R20] for possible CD-DA information. If this information is not required, then it is recommended not to set the data_length to "read all", but to set it to the expected length (23_{16} for the basic root contents list, or 40_{16} if the AV Object Type-specific info block is required).

7.4.1.1 The OPEN DESCRIPTOR Command for the Root Contents List

◊ Table 7.4.1.1-1 : The OPEN DESCRIPTOR Command for the Root Contents List

Offset	Contents	Value	M/O[1]	F/V[2]	Notes
opcode	OPEN DESCRIPTOR = 08	08_{16}	M	F	
operand[0]	descriptor_identifier = object_list_descriptor specified by list_ID	10_{16}	M	F	1
operand[1]	descriptor_type_specific_reference = root_contents_list	10_{16}	M	F	2
operand[2]		00_{16}			
operand[3]	subfunction = READ_OPEN or CLOSE	01_{16} or 00_{16}	M	F	3
operand[4]	reserved	00_{16}	M	F	

[1] M = This data is Mandatory for a player conforming to Profile_ID = 10_{16}

[2] F = Data Fixed in Controller implementation

Notes:

1. **descriptor_identifier**: this specifies how the object_list is specified (by list_ID).
2. **descriptor_type_specific_reference**: this specifies the Root Contents List.
3. **subfunction**: defines the action

7.4.1.2 The READ DESCRIPTOR Command for the Root Contents List

The descriptor is read using a single command. It is recommended to restrict the number of bytes read rather than "read all".

◊ Table 7.4.1.2-1 : The READ DESCRIPTOR Command for the Root Contents List

Offset	Contents	Value	M/O[1]	F/V[2]	Notes
opcode	READ DESCRIPTOR (09_{16})	09_{16}	M	F	
operand[0]	descriptor_specifier_type = object_list_descriptor specified by list_ID	10_{16}	M	F	1
operand[1]	descriptor_type_specific_reference = root_contents_list	10_{16}	M	F	
operand[2]		00_{16}			
operand[3]	read_result_status	FF_{16}	M	F	2
operand[4]	reserved	00_{16}	M	F	
operand[5]	data_length	00_{16}	M	F	3
operand[6]		23_{16} or 40_{16}			
operand[7]	address	00_{16}	M	F	
operand[8]		00_{16}			

[1] M = Mandatory for a player conforming to Profile_ID = 10_{16}

[2] F = Data Fixed in Controller implementation

Notes:

1. These bytes specify the root contents list - see the OPEN DESCRIPTOR command above for details
2. **read_result_status**: when this command is used with a *ctype* of CONTROL, the controller sets this byte to FF_{16}.
3. **data_length** and **address**: it is recommended to restrict the number of bytes read from the root contents list. If the basic root contents list only is needed, then 23_{16} bytes should be read. If the AV Object Type-specific info block is needed with total playing time, then 40_{16} bytes should be read. Because data_length is not zero, the base address should be fixed so that the read operation starts with the first byte (i.e. at offset 00 00_{16}).

7.4.1.3 The READ DESCRIPTOR Response frame for the Root Contents List

The player replies by adding the requested data from the root contents list (with the AV Object type-specific data if requested) to the end of the READ DESCRIPTOR command.

◊ Table 7.4.1.3-1 : The READ DESCRIPTOR Response frame for the Root Contents List

Offset	Contents	Value	M/O[1]	F/V[2]	Notes
opcode	READ DESCRIPTOR (09_{16})	09_{16}	M	F	
operand[0]	descriptor_specifier_type = object_list_descriptor specified by list_ID	10_{16}	M	F	
operand[1]	descriptor_type_specific_reference = root_contents_list	10_{16}	M	F	
operand[2]		00_{16}			
operand[3]	read_result_status	10_{16}	M	V	1
operand[4]	reserved	00_{16}	M	F	
operand[5]	data_length	00_{16}	M	V	2
operand[6]		23_{16} or 40_{16}			
operand[7]	address	00_{16}	M	F	
operand[8]		00_{16}			
operand[9]	descriptor_length	00_{16}	M	V	3
operand[10]		21_{16} or $3E_{16}$			
operand[11]	list_type = Root Content List	80_{16}	M	F	
…	…	…	M	F/V	
operand[n]	…	…	M	F/V	

[1] M = This data is Mandatory for a player conforming to Profile_ID = 10_{16}

[2] F = Data Fixed in DVD implementation; V = Variable data, see relevant Note

Notes:

1. **read_result_status:** this indicates whether the read was successful or not. A successful read is indicated by an error code of 10_{16}. For other values, see [R17], section 10.2.
2. **data_length** and **address:** If the read was successful, data_length returns the total number of bytes read in the descriptor. Note that this will depend on whether the AV Object Type-specific info block was requested. In the case of an error, data_length returns the number of bytes successfully read (if any) – see [R17], section 10.2. address should be 00 00_{16}.
3. The **Root Contents List data**, as shown in Table 7.4-1 and optionally in Table 7.4-3, is appended to the end of the READ DESCRIPOR command. The length will depend on whether the AV Object Type-specific info block was requested.

7.5 Command Checking

When a command is received by a target, it should perform a series of checks on the opcode and operands of the command before executing that command:

1. Check for a valid subunit. If not valid, the target should return NOT IMPLEMENTED.
2. Check for a supported opcode and ctype. If not valid, the target should return NOT IMPLEMENTED.
3. Check for compatible frame size. If not valid, the target should return NOT IMPLEMENTED.
4. Check for supported operands as defined in Table 7.5-1:

◊ Table 7.5-1 : Operand values to be checked

Command	Operand values to be checked
OPEN DESCRIPTOR	All, as specified the relevant sections above
READ DESCRIPTOR	All, as specified the relevant sections above
READ INFO BLOCK	All, as specified the relevant sections above

   If these values are not valid, then the target should return NOT IMPLEMENTED.
5. If the current state of the target does not allow the command to be executed at this time, the target should return REJECTED.

Working Group 1 and Working Group 4 members of the DVD Forum who participated in making this guideline

Harman International
Hitachi, Ltd.
KENWOOD CORPORATION
Koninklijke Philips Electronics N.V.
LG Electronics Inc.
Matsushita Electric Industrial Co., Ltd.
Mitsubishi Electric Corporation
NEC Corporation
PIONEER CORPORATION
SAMSUNG ELECTRONICS CO., LTD.
SHARP CORPORATION
Sony Corporation
THOMSON multimedia
Toshiba Corporation
Victor Company of Japan, Limited
YAMAHA CORPORATION

Guideline of Transmission and Control
for DVD-Video / Audio through IEEE1394 Bus
Version 0.9 — September 2001 **Revision 0; October, 2001**