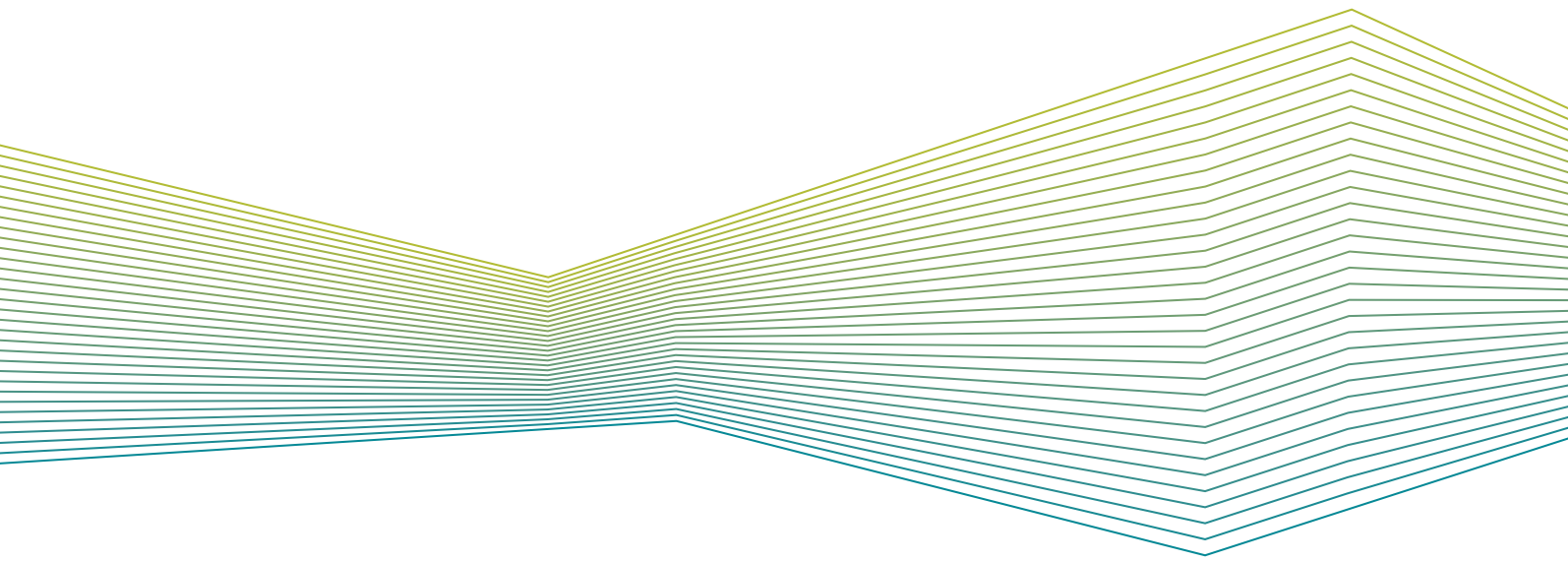




Dolby Vision bitstreams within the MPEG-2 transport stream format v1.1

Preliminary 25 March 2016



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1 Introduction

This document specifies the syntax and semantics requirements for transporting Dolby Vision streams in an MPEG-2 transport stream conforming to ISO/IEC 13818-1.

- [Dolby Vision encoding](#)
- [Dolby Vision stream multiplexing in an MPEG-2 transport stream](#)
- [Standards and Dolby documents](#)
- [Contacting Dolby](#)

1.1 Dolby Vision encoding

Dolby Vision video content can be encoded in one single layer or two separate layers along with Dolby Vision metadata. Both schemes allow the format to deliver more dynamic range and a wider color gamut, while providing backward compatibility with standard dynamic range (SDR) playback devices in some of the dual-layer cases.

When encoded using the dual-layer scheme, the Dolby Vision stream consists of a base layer, an enhancement layer, and a reference picture unit.

- The base layer may or may not be SDR compliant (that is, compliant with ITU-R Recommendation BT.709 [Rec. 709] standards). When compliant with Rec. 709 standards, the base layer offers backward compatibility, allowing playback of Dolby Vision streams from SDR-compliant devices that do not support Dolby Vision.
- The enhancement layer carries the color and brightness differences between the graded source (that is, source that is graded to Dolby Vision standards) and base-layer version of the source.
- The reference picture unit is a special Network Abstraction Layer (NAL) unit that contains the Dolby Vision metadata. It is also a complete Dolby Vision metadata access unit for the current picture.

For a dual-layer Dolby Vision stream, these layers are encoded in either one or two video elementary streams. The video elementary stream codec is either Advanced Video Coding (AVC) or High-Efficiency Video Coding (HEVC), as defined in ISO/IEC 14496-10, ISO/IEC 14496-15, and ISO/IEC 23008-2.

When encoded using the single-layer scheme, the Dolby Vision stream consists of the base layer and reference picture unit only (without the enhancement layer) and is encoded in one 10-bit HEVC elementary stream. Because the base layer in this case is not SDR compliant, the single-layer scheme does not offer backward compatibility.

For detailed information, refer to the *Dolby Vision VES multiplexing specification*.

1.2 Dolby Vision stream multiplexing in an MPEG-2 transport stream

A Dolby Vision stream can be transported in an MPEG-2 transport stream multiplex using a single or dual program, each with a unique PID.

For transmission on a single program, the base-layer, enhancement-layer if available, and reference-picture-unit substreams are combined into a single Dolby Vision stream. This Dolby Vision stream is used as input for encoding of a regular AVC or HEVC elementary

stream (using the T-STD model). The resulting elementary stream can be multiplexed into a single Dolby Vision program in an MPEG-2 transport stream.

For transmission on two programs, the base layer, enhancement layer, and reference picture unit substreams are carried on two separate programs. The base layer substream is directly encoded as a regular AVC or HEVC elementary stream (using the T-STD model) which is in turn multiplexed into an MPEG-2 transport stream on the primary Dolby Vision program. The enhancement layer and reference picture unit substreams can be combined as input for encoding of a regular AVC or HEVC elementary stream (using the T-STD model). The resulting elementary stream can be multiplexed into an MPEG-2 transport stream on the secondary Dolby Vision program. Alternatively, the enhancement layer may contain the reference picture unit substream only, in which situation, the reference picture unit substream is carried as a synchronized metadata stream on the secondary program.

There are two types of Dolby Vision stream configuration: a dual-layer Dolby Vision stream and a single-layer Dolby Vision stream. A dual-layer Dolby Vision stream is composed of both the base-layer and enhancement-layer substreams (and a reference-picture-unit substream). A single-layer Dolby Vision stream is composed of the base-layer and reference-picture-unit substreams only, without the enhancement layer.

A dual-layer or single-layer Dolby Vision stream can be multiplexed into a single program. A dual-layer Dolby Vision stream can also be multiplexed into two separate programs. A single-layer Dolby Vision stream can be multiplexed only into a single program.

In either stream configuration, the base-layer substream is compliant with ISO/IEC 14496-10, ISO/IEC 14496-15, and ISO/IEC 23008-2 and decodable by an AVC or HEVC-compliant decoder. Depending on whether or not the output of the decoder is an SDR signal, a Dolby Vision stream can be defined as an SDR or non-SDR-compliant stream, respectively.

For detailed information about the multiplexing process, refer to the *Dolby Vision VES Multiplexing Specification*.

1.3 Standards and Dolby documents

Standards and Dolby documents provide additional information to assist you in designing your product.

Standards

- ISO/IEC 13818-1:2013, *Information technology—Generic coding of moving pictures and associated audio information: Systems*, available from <http://www.iso.org>.
- ISO/IEC 13818-1:201X/PDAM 3, *Information technology—Generic coding of moving pictures and associated audio information: Systems amendment 3*, available from <http://www.iso.org>.
- ISO/IEC 14496-10:2014, *Information technology—Coding of audio-visual objects, part 10: Advanced video coding*, available from <http://www.iso.org>.
- ISO/IEC 14496-15:2014, *Information technology—Coding of audio-visual objects, part 15: Carriage of network abstraction layer (NAL) unit structured video in ISO base media file format*, available from <http://www.iso.org>.
- ISO/IEC 23008-2:2013, *Information technology—High efficiency coding and media delivery in heterogeneous environments, part 2: High efficiency video coding*, available from <http://www.iso.org>.

Dolby documents

- *Dolby Vision Video Elementary Stream multiplexing specification* (dovi_proenc_ves_muxing_spec.pdf), located in the documentation package of the kit.

- *Dolby Vision decoder specification*, located in the documentation package of the kit.

1.4 Contacting Dolby

Support services are available to address any questions and to provide advice about integrating Dolby technology into your product.

For product design or testing, contact Dolby at systemsupport@dolby.com. By utilizing Dolby expertise, especially during the design process, many problems that might require design revisions before a product is approved can be prevented.

Dolby is also available to review product plans, including preliminary design information, markings, displays, and control and menu layouts, with the goal of preventing problems early in the product development cycle.

If you have comments or feedback about this document, send us an email at documentation@dolby.com.

2 Fields and descriptors for signaling Dolby Vision streams in an MPEG-2 transport stream

Dolby Vision stream is encoded as a regular AVC or HEVC stream. In addition to AVC or HEVC video descriptors, Dolby Vision specific information is signaled using PMT entry and PES packet header.

- [PMT entry](#)
- [PES packet header](#)

2.1 PMT entry

In the PMT entry, the `stream_type` field, the `Registration descriptor`, and the `DOVI_video_stream_descriptor` are used to signal Dolby Vision stream.

2.1.1 `stream_type`

Use the `stream_type` field in the PMT to indicate the type of program element carried within the packets.

- For an AVC elementary stream, set the `stream_type` field to `0x1B`.
- For an HEVC elementary stream, set the `stream_type` field to `0x24`.
- Set the `stream_type` field to `0x06` to indicate that PES packets contain private data.

2.1.2 `Registration descriptor`

Use the `Registration descriptor` of MPEG-2 in the PMT to uniquely identify a Dolby Vision stream contained in an MPEG-2 transport stream multiplex.

To provide the unique identification for the Dolby Vision stream, set the `format_identifier` to `0x444F5649` (DOVI) in the MPEG-2 `Registration descriptor`, as shown in this table.

Syntax	No. of Bits	Mnemonic	Value
<code>registration_descriptor() {</code>			
<code>descriptor_tag</code>	8	Uimsbf	<code>0x05</code>
<code>descriptor_length</code>	8	Uimsbf	<code>0x04</code>
<code>format_identifier</code>	32	Uimsbf	<code>0x444F5649</code>
<code>}</code>			

The selection of the method to uniquely identify a Dolby Vision stream in the MPEG-2 transport stream multiplex is the responsibility of those defining how to construct the MPEG-2 transport stream multiplex. This specification only addresses the generic way of signaling Dolby Vision using the MPEG-2 `Registration Descriptor`.

2.1.3 DOVI_video_stream_descriptor

A `DOVI_video_stream_descriptor` must be included in the PMT entry to signal the configuration of a Dolby Vision stream contained in an MPEG-2 transport stream multiplex. For specific settings for each Dolby Vision configuration, see the *Dolby Vision stream configuration and signaling within an MPEG-2 transport stream* section.

Related information

[Dolby Vision stream configuration and signaling within an MPEG-2 transport stream](#) on page 11

Syntax

The syntax of the `DOVI_video_stream_descriptor` is listed in the table.

Syntax	Word size in bits	Identifier
<code>DOVI_video_stream_descriptor() {</code>		
<code> descriptor_tag</code>	8	uimsbf
<code> descriptor_length</code>	8	uimsbf
<code> dv_version_major</code>	8	uimsbf
<code> dv_version_minor</code>	8	uimsbf
<code> dv_profile</code>	7	bslbf
<code> dv_level</code>	6	bslbf
<code> rpu_present_flag</code>	1	bslbf
<code> el_presnet_flag</code>	1	bslbf
<code> bl_present_flag</code>	1	bslbf
<code> If (!bl_present_flag) {</code>		
<code> dependency_pid</code>	13	bslbf
<code> reserved</code>	3	bslbf
<code> }</code>		
<code>}</code>		

Semantics

The semantics of the parameters within the `DOVI_video_stream_descriptor` for a Dolby Vision stream are:

- The `descriptor_tag` must be set to `0xB0`.
- The `descriptor_length` is an 8-bit field that specifies the number of bytes of the descriptor immediately following `descriptor_length` field.
- The `dv_version_major` specifies the major version number of the Dolby Vision specification that the stream complies with. The `dv_version_major` must be set to 1 for a Dolby Vision stream that is compliant with this specification.
- The `dv_version_minor` specifies the minor version number of the Dolby Vision specification that the stream complies with. The `dv_version_minor` must be set to 0 for a Dolby Vision stream that is compliant with this specification.
- The `dv_profile` specifies the Dolby Vision profile. Valid values are profile IDs as defined in *Dolby Vision profiles and levels*.

- The `dv_level` specifies the Dolby Vision level. Valid values are level IDs as defined in *Dolby Vision profiles and levels*.
- The `rpu_present_flag` must be set to 1 when the Dolby Vision program carries the reference picture unit substream.
- The `e1_present_flag` must be set to 1 when the Dolby Vision program carries the enhancement layer substream.
- The `b1_present_flag` must be set to 1 when the Dolby Vision program carries the base layer substream.

2.2 PES packet header

In the PES packet header, the `stream_ID` field is used to signal the presence of Dolby Vision streams. For the specific `stream_ID` value for each Dolby Vision configuration, see the *Dolby Vision stream configuration and signaling within an MPEG-2 transport stream* section.

Related information

[Dolby Vision stream configuration and signaling within an MPEG-2 transport stream](#) on page 11

3 Dolby Vision stream configuration and signaling within an MPEG-2 transport stream

The Dolby Vision-related fields in the PMT and PES header must be set correctly to signal the configuration of a Dolby Vision stream transported in a generic MPEG-2 transport stream.

- [Single-program Dolby Vision stream](#)
- [Dual-program Dolby Vision stream](#)

The PMT settings are also subject to whether the Dolby Vision base-layer is SDR compliant or not. An SDR compliant base-layer stream can be decoded to a Rec. 709 signal with peak luminance equal to 100 nits.

3.1 Single-program Dolby Vision stream

The base layer, enhancement layer, and reference picture unit substreams can be combined into a single elementary stream for transmission on a single Dolby Vision program. The combo Dolby Vision stream is carried as a regular AVC or HEVC stream using the T-STD model.

3.1.1 SDR compliant base-layer Dolby Vision stream

Configure the transport stream parameters to signal the single program Dolby Vision stream that contains the SDR compliant base-layer.

In the PMT entry:

- Set the value of `stream_type` to indicate the codec type.
 - Set to `0x1B` for an AVC-compatible stream.
 - Set to `0x24` for an HEVC-compatible stream.
- Insert appropriate video descriptors for AVC or HEVC codec, as defined in ISO/IEC 14496-10 or ISO/IEC 23008-2.
- Insert the `D0VI_video_stream_descriptor`, and set these fields.
 - Set the `npu_present_flag` field to 1.
 - Set the `e1_present_flag` field to 1.
 - Set the `b1_present_flag` field to 1.
 - Set the `dv_profile` field according to the encoded Dolby Vision profile. For valid values for this fields, see *Dolby Vision Profiles and Levels*.
 - Set the `dv_level` field according to the encoded Dolby Vision level. For valid values for this fields, see *Dolby Vision Profiles and Levels*.

In the PES packet header:

- Set the value of `stream_id` to `0xEX`. Here, the last X indicates the video stream number.

3.1.2 Non-SDR compliant base-layer Dolby Vision stream

Configure the transport stream parameters to signal the single program Dolby Vision stream that contains the Non-SDR compliant base-layer.

In the PMT entry:

- Set the value of `stream_type` to `0x06` (indicating that PES packets contain private data).
- Insert appropriate video descriptors for AVC or HEVC codec, as defined in ISO/IEC 14496-10 or ISO/IEC 23008-2.
- In the MPEG-2 Registration descriptor, set the `format_identifier` to `0x444F5649` (DOVI).
- Insert the `DOVI_video_stream_descriptor`, and set these fields.
 - Set the `rpu_present_flag` field to 1.
 - If the program contains an enhancement-layer substream, set the `e1_present_flag` field to 1; if the program is reference picture unit-only substream with no enhancement-layer substream present, set the `e1_present_flag` field to 0.
 - Set the `b1_present_flag` field to 1.
 - Set the `dv_profile` field according to the encoded Dolby Vision profile. For valid values for this fields, see *Dolby Vision Profiles and Levels*.
 - Set the `dv_level` field according to the encoded Dolby Vision level. For valid values for this fields, see *Dolby Vision Profiles and Levels*.

In the PES packet header:

- Set the value of `stream_id` to `0xEX`. Here, the last X indicates the video stream number.

3.2 Dual-program Dolby Vision stream

A Dolby Vision stream can be transported on two separate programs, with the base layer substream on the primary program followed by the secondary program that carries the enhancement layer and reference picture unit substreams.

3.2.1 Primary Dolby Vision program

In the dual-program Dolby Vision stream, the base-layer substream is carried on the primary program.


SDR compliant base-layer Dolby Vision stream

Depending on the codec type of the dual-program Dolby Vision stream, signal the primary Dolby Vision program that contains the SDR compliant base-layer as a regular AVC or HEVC video stream.

Non-SDR compliant base-layer Dolby Vision stream

Configure the transport stream parameters to signal the primary Dolby Vision program that contains the non-SDR compliant base-layer.

In the PMT entry:

 **Note:** Do not insert the `DOVI_video_stream_descriptor` for this configuration.

- Set the value of `stream_type` to `0x06` (indicating that PES packets contain private data).

- Insert appropriate video descriptors for AVC or HEVC codec, as defined in ISO/IEC 14496-10 or ISO/IEC 23008-2.
- In the MPEG-2 Registration descriptor, set the `format_identifier` to `0x444F5649` (DOVI) .

In the PES packet header:

- Set the value of `stream_id` to `0xEX`. Here, the last X indicates the video stream number.

3.2.2 Secondary Dolby Vision program

In the dual-program Dolby Vision stream, the secondary Dolby Vision program carries the enhancement layer and reference picture unit substreams or the reference picture unit substream only.

Enhancement layer substream with reference picture unit

Configure the transport stream parameters to signal the secondary Dolby Vision program that contains the enhancement layer and reference picture unit substreams.

In the PMT entry:

- Set the value of `stream_type` to `0x06` (indicating that PES packets contain private data).
- Insert appropriate video descriptors for AVC or HEVC codec, as defined in ISO/IEC 14496-10 or ISO/IEC 23008-2.
- In the MPEG-2 Registration descriptor, set the `format_identifier` to `0x444F5649` (DOVI) .
- Insert the `DOVI_video_stream_descriptor`, and set these fields.
 - Set the `rpu_present_flag` field to 1.
 - Set the `e1_present_flag` field to 1.
 - Set the `b1_present_flag` field to 0.
 - Set the `dependency_pid` field to the primary Dolby Vision program that carries the base-layer substream.
 - Set the `dv_profile` field according to the encoded Dolby Vision profile. For valid values for this fields, see *Dolby Vision Profiles and Levels*.
 - Set the `dv_level` field according to the encoded Dolby Vision level. For valid values for this fields, see *Dolby Vision Profiles and Levels*.

In the PES packet header:

- Set the value of `stream_id` to `0xEX`. Here, the last X indicates the video stream number.

Reference picture unit-only substream

Configure the transport stream parameters to signal the secondary Dolby Vision program that contains the reference picture unit substream only.

In the PMT entry:

- Set the value of `stream_type` to `0x06` (indicating that PES packets contain private data).
- Insert appropriate video descriptors for AVC or HEVC codec, as defined in ISO/IEC 14496-10 or ISO/IEC 23008-2.
- In the MPEG-2 Registration descriptor, set the `format_identifier` to `0x444F5649` (DOVI) .
- Insert the `DOVI_video_stream_descriptor`, and set these fields.

- Set the `npv_present_flag` field to 1.
- Set the `e1_present_flag` field to 0.
- Set the `b1_present_flag` field to 0.
- Set the `dependency_pid` field to the primary Dolby Vision program that carries the base-layer substream.
- Set the `dv_profile` field according to the encoded Dolby Vision profile. For valid values for this fields, see *Dolby Vision Profiles and Levels*.
- Set the `dv_level` field according to the encoded Dolby Vision level. For valid values for this fields, see *Dolby Vision Profiles and Levels*.

In the PES packet header:

- Set the value of `stream_id` to 0xBD to indicate `private_stream_1`.

4 PES constraints

A PES that carries the Dolby Vision stream must meet certain conditions to ensure the correct operation of a downstream Dolby Vision decoding device.

- [Access unit re-ordering for the reference picture unit substream](#)
- [Contents of the PES packet payload](#)
- [Dolby Vision programs alignment](#)

4.1 Access unit re-ordering for the reference picture unit substream

Dolby Vision base-layer, enhancement layer, and reference picture unit sub-streams are encoded separately in different decoding order. Before being multiplexed into the Dolby Vision stream, the access units for the reference picture unit must be re-ordered according to the decoding order of the base-layer or enhancement layer access units, so that access units that are meant to be decoded together are adjacent to one another in the stream.

4.1.1 Single-program configuration

For a Dolby Vision stream transmission using a single program, access units for the reference picture unit must be re-ordered according to the decoding order of the base-layer access units.

This guarantees that the access units for the reference picture unit and base-layer with the same decode time stamp (DTS) are interleaved together. For detailed information about the multiplexing process, refer to the *Dolby Vision VES Multiplexing Specification*.

4.1.2 Dual-program stream configuration

For a Dolby Vision stream transmission using two programs, the reference picture unit substream is transported on the secondary program either alone or accompanying the enhancement layer substream.

Before being multiplexed with the enhancement layer substream for transmission on the secondary program, access units for the reference picture unit must be re-ordered according to the decoding order of the enhancement layer access units. This guarantees that the access units for the reference picture unit and enhancement layer with the same DTS are interleaved together.

When the reference picture unit is the only substream carried on the secondary program, ensure that access units for the reference picture unit must be re-ordered according to the decoding order of the base-layer access units which are carried on the primary program.

For detailed information about the multiplexing process, refer to the *Dolby Vision VES Multiplexing Specification*.

4.2 Contents of the PES packet payload

Building a PES packet payload from a Dolby Vision stream must meet certain conditions.

- Ensure that each PES packet payload contains one and only one complete access unit.

- Ensure that each PES packet header must contains a PTS value.

4.3 Dolby Vision programs alignment

In a dual-program Dolby Vision multiplex configuration, the primary and secondary Dolby Vision programs must be aligned in these aspects.

- The PTS value for the first access unit of the elementary stream carried on the primary and the secondary Dolby Vision program must be identical.
- The maximum decode delay value which limits the difference between the access unit DTS and PCR for the elementary stream carried on the primary and secondary Dolby Vision program must be identical.

Glossary

AVC

Advanced Video Coding. See [H.264](#).

HEVC

High-Efficiency Video Coding. See [H.265](#).

MPEG

Moving Picture Experts Group. An ISO/IEC working group that develops video and audio encoding standards. Also the name of a family of digital video and audio coding standards.

PES

Packetized elementary stream. An elementary stream that is split into small chunks (packets) for transmitting and combining multiple streams within a transport stream. Each PES is identified by a unique packet identifier (PID).

PMT

Program Map Table. A table within an MPEG-2 transport stream that defines the set of elementary streams associated with a specific program.