Dolby® Vision Streams Within the ISO Base Media File Format

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Table of Contents

List of Tables .................................................................................................................. vii

Chapter 1 Introduction .................................................................................................... 9
  1.1 New in this version ................................................................................................. 9
  1.2 Terms, Definitions, and Abbreviated Terms ....................................................... 9
    1.2.1 Terms and Definitions .................................................................................. 10
    1.2.2 Abbreviated Terms ................................................................................... 10
  1.3 Resources ............................................................................................................ 11
  1.4 Contacting Dolby ............................................................................................... 11
  1.5 Box hierarchy overview ...................................................................................... 12

Chapter 2 Dolby Vision VES Format .............................................................................. 13

Chapter 3 Dolby Vision Configuration Boxes and Decoder Configuration Record .... 14
  3.1 Definition ........................................................................................................... 14
  3.2 Syntax ............................................................................................................... 14
  3.3 Semantics .......................................................................................................... 15

Chapter 4 Dolby Vision EL AVC and HEVC Configuration Box .............................. 17
  4.1 Definition ........................................................................................................... 17
  4.2 Syntax ............................................................................................................... 17

Chapter 5 Dolby Vision Sample Entries .................................................................... 19
  5.1 Definition ........................................................................................................... 19
  5.2 Syntax ............................................................................................................... 19
  5.3 Semantics .......................................................................................................... 20

Chapter 6 Dolby Vision AVC-compatible Sample Entry ........................................... 21
  6.1 Syntax ............................................................................................................... 21

Chapter 7 Dolby Vision Files ....................................................................................... 22

Chapter 8 Dolby Vision Tracks In A Single File .......................................................... 23
  8.1 Single-track file ................................................................................................ 23
    8.1.1 SDR or HDR Compliant BL Dolby Vision Track ........................................ 23
    8.1.2 Non-SDR and Non-HDR Compliant BL Dolby Vision Track ............... 25
  8.2 Dual-track file .................................................................................................... 26
    8.2.1 BL Track .................................................................................................. 26
8.2.2 EL Track .................................................................................26
8.3 Constraints on the ISO base media file format boxes.................28
  8.3.1 Constraints on Movie Fragments .............................................28
  8.3.2 Constraints on Track Fragment Random Access Box ...............28
List of Tables

Table 1-1  Abbreviated Terms ................................................................................................................. 10
Table 8-1  Sample table box hierarchy for single-track Dolby Vision file with SDR or HDR Compliant BL ................................................................................................................. 24
Table 8-2  Sample table box hierarchy for single-track Dolby Vision file with Non-SDR and Non-HDR Compliant BL ................................................................................................................. 25
Table 8-3  Sample table box hierarchy for the EL track of a dual-track Dolby Vision file ................................................................................................................. 27
Introduction

This document defines the structures for the storage of Dolby® Vision video streams in a file format compliant with the ISO base media file format (ISOBMFF). Example file formats derived from the ISOBMFF include the Digital Entertainment Content Ecosystem (DECE) Common File Format (CFF), Protected Interoperable File Format (PIFF), and MP4 file format. The file format defined here is intended to be compliant with the DECE media specifications as appropriate.

1.1 New in this version

Changes have been made to the latest version of this document. For v2.0, the changes include:

- Introduction of an additional Dolby Vision Configuration Box, ‘dvvC’, for use with Profiles numbered greater than 7.
- Accompanying note to Dolby Vision Configuration Boxes that require Dolby Vision decoders to comply with ISOBMFF specification, ISO/IEC 14496, if an unrecognized Dolby Vision Configuration Box, Profile number, or Profile level ID are found in a stream. With Dolby Vision streams with Profile 8, 9 or later, this ensures that devices that support Profile 7, or earlier, play the compatible base-layer.
- A new section 1.4 which provides an overview of the Dolby Vision ISOBMFF box hierarchy.
- Addition of ‘hvc1’ box in certain places where missing and the only box listed was ‘hev1.’
- In section 5.3 Semantics, a definition was added for ‘ELConfig’ where missing in version 1.4.

1.2 Terms, Definitions, and Abbreviated Terms
1.2.1 Terms and Definitions

**SDR signal**

A Rec. 709 signal with peak luminance equal to 100nits.

**HDR signal**

A Rec. 2020 signal with peak luminance equal to 1000nits.

**SDR or HDR Compliant Base Layer Dolby Vision track**

A Dolby Vision track with the Base Layer, Enhancement Layer, and RPU combined into a single VES. The Base Layer signal in the combined VES carried in the track has a non-zero value for the BL signal compatibility ID, is compliant with ISO/IEC 14496-10, 14496-15, and ISO/IEC 23008-2 and is decodable by an AVC or HEVC compliant decoder to output an SDR or HDR signal compliant with a particular set of standards as defined in the Dolby Vision Profiles and Levels doc.

**Non-SDR and Non-HDR Compliant Base Layer Dolby Vision track**

A Dolby Vision track with the Base Layer, Enhancement Layer, and RPU combined into a single VES. The Base Layer in the combined VES carried in the track has a zero value for the BL signal compatibility ID, is compliant with ISO/IEC 14496-10, 14496-15, and ISO/IEC 23008-2 and is decodable by an AVC or HEVC compliant decoder to output a non-SDR and non-HDR signal that is not compliant with any standard.

1.2.2 Abbreviated Terms

The following table describes the terminology and abbreviations used throughout this document.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVC</td>
<td>Advanced Video Coding.</td>
</tr>
<tr>
<td>BL</td>
<td>Base layer.</td>
</tr>
<tr>
<td>DECE</td>
<td>Digital Entertainment Content Ecosystem.</td>
</tr>
<tr>
<td>DSI</td>
<td>Decoder specification information.</td>
</tr>
<tr>
<td>EL</td>
<td>Enhancement layer.</td>
</tr>
</tbody>
</table>
### Term | Definition
--- | ---
HEVC | High efficient video coding.
HDR | High Dynamic Range
NAL | Network abstraction layer.
OTT | Over the top.
PIFF | Protected interoperable file format.
PPS | Picture parameter set.
SPS | Sequence parameter set.
VES | Video elementary stream.
SDR | Standard Dynamic Range

### 1.3 Resources

The following resources supplement the information in this manual:

- *Signaling Dolby Vision Profiles and Levels*, available from [Dolby Laboratories, Inc](http://www.dolby.com).

### 1.4 Contacting Dolby

For technical questions about the system development materials, contact [dolbyonlinekits@dolby.com](mailto:dolbyonlinekits@dolby.com).

If you have questions or comments about this document, contact [documentation@dolby.com](mailto:documentation@dolby.com).
1.5 **Box hierarchy overview**

An ISO base media file that contains Dolby Vision stream is expected to be structured conforming to this documentation.

This table lists all possible boxes that can be used for signaling either a single- or dual-track Dolby Vision stream, and shows an overall view of the box encapsulation structure; indentation is used to show containment. Which boxes to be included in the sample description box (stsd) depends on the configuration of the Dolby Vision stream.

In the table, the value of the nesting level provided for each box is based on the structure of the complete ISO base media file, beginning with a nesting value of 0 for the ftyp and moov boxes.

<table>
<thead>
<tr>
<th>Nesting Level</th>
<th>stbl</th>
<th>stsd</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

One of:
- DolbyVisionAVC3SampleEntry (dvav)
- DolbyVisionAVC1SampleEntry (dva1)
- DolbyVisionHEV1SampleEntry (dvhe)
- DolbyVisionHVC1SampleEntry (dvh1)
- DolbyVisionAVCCompatibleSampleEntry (avc1)
- DolbyVisionAVCCompatibleSampleEntry(avc3)
- AVC2SampleEntry (avc2)
• AVC2SampleEntry (avc4)
• HEVCSampleEntry (hev1)
• HEVCSampleEntry (hvc1)

One of:
• AVC configuration box (avcC)
• HEVC configuration box (hvcC)

One of:
• Dolby Vision configuration box (dvcC)
• Dolby Vision configuration box (dvvC)

One of:
• Dolby Vision enhancement layer AVC configuration box (avcE)
• Dolby Vision enhancement layer HEVC configuration box (hvcE)

stts
stsc
stsz
stz2
stco
c064

Dolby Vision VES Format

For information on the storage format of Dolby Vision VES within the ISOBMFF, refer to Dolby Vision Decoder Specification and Dolby Vision VES Multiplexing Specification, see Resources. This storage format extends the definition of the storage format of AVC in ISO/IEC 14496-15 and HEVC in ISO/IEC 23008-2, see Resources.
The Dolby Vision decoder configuration record provides the configuration information that is required to initialize the Dolby Vision decoder.

### 3.1 Definition

The Dolby Vision Configuration Box contains the following information.

**Box Type**

For $\text{dv\_profile} \leq 7$, ‘dvcC’;

for $\text{dv\_profile} > 7$, ‘dvvC’

**Note:** Dolby Vision devices that do not recognize a particular Dolby Vision Configuration Box, or the value for an element of the decoder configuration record, such as $\text{dv\_profile}$ or $\text{dv\_level}$, shall follow the requirements of ISO/IEC 14496 and shall ensure that they handle the stream properly based on the stream’s ISO/IEC 14496 codec Configuration Box.

**Container**

$\text{AVC2SampleEntry}('avc2' \text{ or } 'avc4')$,  
$\text{HEVCSampleEntry}('hev1' \text{ or 'hvc1}')$,  
$\text{DolbyVisionAVC3SampleEntry}('dvav')$,  
$\text{DolbyVisionAVC1SampleEntry}('dva1')$,  
$\text{DolbyVisionHEV1SampleEntry}('dvhe')$,  
$\text{DolbyVisionHVC1SampleEntry}('dvh1')$, or  
$\text{DolbyVisionAVCCompatibleSampleEntry}('avcl' \text{ or } 'avc3')$

**Mandatory** Yes

**Quantity** Exactly One

### 3.2 Syntax
The syntax of the Dolby Vision Configuration Box and decoder configuration record is described below.

```c
align(8) class DOVIDecoderConfigurationRecord
{
    unsigned int (8)       dv_version_major;
    unsigned int (8)       dv_version_minor;
    unsigned int (7)       dv_profile;
    unsigned int (6)       dv_level;
    bit (1)                rpu_present_flag;
    bit (1)                el_present_flag;
    bit (1)                bl_present_flag;
    unsigned int (4)       dv_bl_signal_compatibility_id;
    const unsigned int (28) reserved = 0;
    const unsigned int (32)[4] reserved = 0;
}

class DOVIConfigurationBox extends Box(‘dvcC’ or ‘dvvC’)
{
    DOVIDecoderConfigurationRecord() DOVIConfig;
}
```

### 3.3 Semantics

The semantics of the Dolby Vision decoder configuration record is described as follows.

- **dv_version_major** - specifies the major version number of the Dolby Vision specification that the stream complies with. A stream compliant with this specification shall have the value 1.

- **dv_version_minor** - specifies the minor version number of the Dolby Vision specification that the stream complies with. A stream compliant with this specification shall have the value 0.

- **dv_profile** - specifies the Dolby Vision profile. Valid values are Profile IDs as defined in Table 1 column 1 of *Signaling Dolby Vision Profiles and Levels*.

- **dv_level** - specifies the Dolby Vision level. Valid values are Level IDs as defined in Table 3 of *Signaling Dolby Vision Profiles and Levels*.

- **rpu_present_flag** - if 1 indicates that this track contains the RPU substream.
el_present_flag – if 1 indicates that this track contains the EL substream. For Dolby Vision profiles for which there is no EL video, this flag shall be set to 0.

bl_present_flag – if 1 indicates that this track contains the BL substream.

dv_bl_signal_compatibility_id – specifies a particular form of a base-layer sub-stream that can be decoded to a signal compliant with a particular set of standards, if any.
Dolby Vision EL AVC and HEVC Configuration Box

This section describes the AVC and HEVC configuration box for the Dolby Vision Enhancement Layer.

4.1 Definition

The Dolby Vision EL AVC and HEVC Configuration Box contain the following information.

Box Type     ‘avcE’, ‘hvcE’
Container     AVC2SampleEntry(‘avc2’ or ‘avc4’), HEVCSampleEntry(‘hev1’ or ‘hvc1’), DolbyVisionAVC3SampleEntry(‘dvav’), DolbyVisionAVC1SampleEntry(‘dval’), DolbyVisionHEV1SampleEntry(‘dvhe’), DolbyVisionHVC1SampleEntry(‘dvh1’), or DolbyVisionAVCCompatibleSampleEntry(‘avc1’ or ‘avc3’)

Mandatory    No
Quantity      Zero or One

4.2 Syntax

The syntax for the Dolby Vision EL AVC and HEVC Configuration Box are described below.

```java
class DolbyVisionELAVCConfigurationBox() extends Box(‘avcE’) {
    AVCDecoderConfigurationRecord() AVCCConfig;
}
class DolbyVisionELHEVCConfigurationBox() extends Box(‘hvcE’)
```
{  
    HEVCDecoderConfigurationRecord() HEVCConfig; 
}
Dolby Vision Sample Entries

This section describes the Dolby Vision sample entries. It is used to describe tracks that contain substreams that cannot necessarily be decoded by AVC/HEVC compliant decoders.

5.1 Definition

The Dolby Vision sample entries contain the following information:

- **Box Type**: ‘dvav’, ‘dval’, ‘dvhe’, ‘dvhl’
- **Container**: Sample Description Box (‘stsd’)
- **Mandatory**: Yes
- **Quantity**: One or more sample entries of the same box type may be present

5.2 Syntax

The syntax for the Dolby Vision sample entries are described below.

```java
class DolbyVisionAVC3SampleEntry() extends AVCSampleEntry('dvav')
{
    DOVIConfigurationBox() config;
    DolbyVisionELAVCConfigurationBox() ELConfig; // optional
}

class DolbyVisionAVC1SampleEntry() extends AVCSampleEntry('dval')
{
    DOVIConfigurationBox() config;
    DolbyVisionELAVCConfigurationBox() ELConfig; // optional
}

class DolbyVisionHEVCSampleEntry() extends HEVCSampleEntry('dvhe')
{
    DOVIConfigurationBox() config;
}
```
DolbyVisionELHEVCConfigurationBox() ELConfig; // optional
}

class DolbyVisionHVC1SampleEntry() extends
HEVCSampleEntry('dvh1')
{
    DOVIConfigurationBox() config;
    DolbyVisionELHEVCConfigurationBox() ELConfig; // optional
}

5.3 Semantics

A Dolby Vision AVC/HEVC sample entry shall contain a Dolby Vision Configuration Box as defined 3.1. It also contains an optional AVC or HEVC configuration box for the Dolby Vision EL sample.

config - specifies the configuration information required to initialize the Dolby Vision decoder for a Dolby Vision EL track encoded in AVC/HEVC.

ELConfig - For a single-track Dolby Vision stream, this optional box specifies the enhancement-layer configuration information required to initialize the Dolby Vision decoder for the enhancement-layer substream. If this box is absent from the Dolby Vision single track, the downstream decoding product may extract information from the mdat box directly.

This box is not required for a dual-track Dolby Vision stream as the AVC or HEVC configuration box (avcC or hvcC) and Dolby Vision configuration box (dvcC or dvvC) provide the required information.

Compressorname in the base class VisualSampleEntry indicates the name of the compressor used, with the value "013DOVI Coding" being recommended (\013 is 11, the length of the string “DOVI coding” in bytes).
Dolby Vision AVC-compatible Sample Entry

This section describes the Dolby Vision AVC-compatible sample entry. It is used to extend the AVC sample entry to contain a Dolby Vision Configuration Box (‘dvcC’ or ‘dvvC’).

6.1 Syntax

The syntax of the Dolby Vision AVC-compatible Sample Entry used for ‘avc1’ and ‘avc3’ samples is:

```java
class DolbyVisionAVCCompatibleSampleEntry() extends AVCSampleEntry()
{
    DOVIConfigurationBox() config;
    DolbyVisionELAVCConfigurationBox() ELConfig;
}
```
The brand ‘dby1’ should be used in the compatible_brands field to indicate that the file is compliant with all Dolby Extensions as outlined in this document. The major_brand shall be set to the ISO-defined brand, e.g. ‘iso6’.
Dolby Vision Tracks In A Single File

A Dolby Vision video stream can be encapsulated in a single file in two ways:

- as a single-track file containing a BL, EL, and RPU packaged into one track, where the presence of EL substream is dependent on the Dolby Vision profile
- as a dual-track file containing separate BL and EL+RPU tracks

Each of these encapsulations is described in the following sections.

Note: More than one video track is forbidden in DECE CFF v2.0.

8.1 Single-track file

As a single-track file, Dolby Vision BL, EL, and RPU substreams are packaged together into a single ISOBMFF track. The presence of EL substream is dependent on the Dolby Vision profile.

The track shall meet the following constraints:

- The Dolby Vision Configuration Box ('dvcC' or 'dvvC') shall be present in the visual sample entry.
- The rpu_present_flag shall be set to 1.
- The el_present_flag shall be set to 0 or 1 according to the presence of EL for the Dolby Vision profile.
- The bl_present_flag shall be set to 1.

8.1.1 SDR or HDR Compliant BL Dolby Vision Track

When the Dolby Vision stream is encoded with SDR or HDR Compliant BL, it can be decoded and displayed with an AVC/HEVC compliant decoder.

For an HEVC-compatible stream, an HEVCSampleEntry ('hev1' or 'hvc1') shall be used. The HEVCSampleEntryBox shall contain an HEVC Configuration Box ('hvcC'), a Dolby Vision Configuration Box ('dvcC' or 'dvvC'), and a Dolby Vision EL HEVC Configuration Box ('hvcE').
For an AVC-compatible stream, a DolbyVisionAVCCompatibleSampleEntry (‘avc1’ or ‘avc3’) or AVC2SampleEntry (‘avc2’ or ‘avc4’) shall be used. Here, the DolbyVisionAVCCompatibleSampleEntry or AVC2SampleEntry shall contain an AVC Configuration Box (‘avcC’), a Dolby Vision Configuration Box (‘dvcC’ or ‘dvvC’), and a Dolby Vision EL AVC Configuration Box (‘avcE’).

The track shall meet the following additional constraints:

- The dv_profile field in the Dolby Vision Configuration Box (‘dvcC’ or ‘dvvC’) shall be set according the encoded Dolby Vision profile.
- The dv_level field in the Dolby Vision Configuration Box (‘dvcC’ or ‘dvvC’) shall be set according the encoded Dolby Vision level.

The following tables show the box hierarchy of the single-track Dolby Vision file with SDR or HDR Compliant BL.

**Note:** This is not an exhaustive list of boxes.

<table>
<thead>
<tr>
<th>Nesting Level</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>stbl</td>
<td></td>
</tr>
<tr>
<td>stsd</td>
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<td></td>
</tr>
</tbody>
</table>

**Table 8-1** Sample table box hierarchy for single-track Dolby Vision file with SDR or HDR Compliant BL
8.1.2 Non-SDR and Non-HDR Compliant BL Dolby Vision Track

When the Dolby Vision stream is encoded with Non-SDR and Non-HDR Compliant BL, the BL is not compliant with SDR and HDR. In this case, a DolbyVisionHEVCSampleEntry (‘dvhe’), DolbyVisionHVC1SampleEntry (‘dvh1’), DolbyVisionAVC3SampleEntry (‘dvav’) or DolbyVisionAVC1SampleEntry (‘dval’) shall be used. The visual sample entries shall contain an AVC or HEVC Configuration Box (‘avcC’ or ‘hvcC’), a Dolby Vision Configuration Box (‘dvcC’ or ‘dvvC’) and a Dolby Vision EL AVC or HEVC Configuration Box (‘avcE’ or ‘hvcE’).

The track shall meet the following additional constraints:

- In the handler reference box, the handler_type field shall be set to ‘vide’.
- The media information header box shall contain a video media header box.
- The dv_profile field in the Dolby Vision Configuration Box (‘dvcC’ or ‘dvvC’) shall be set according the encoded Dolby Vision profile.
- The dv_level field in the Dolby Vision Configuration Box (‘dvcC’ or ‘dvvC’) shall be set according the encoded Dolby Vision level.

The following table shows the box hierarchy of the single-track Dolby Vision file.

Note: This is not an exhaustive list of boxes.

<table>
<thead>
<tr>
<th>Nesting Level</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>stbl</td>
<td>ISO/IEC 14496-12</td>
</tr>
</tbody>
</table>

Note: If the sample entry is not set to ‘avc3’ or ‘hev1’ it will not be compliant with DECE CFF v2.0.
8.2 Dual-track file

As a dual-track file, Dolby Vision BL and EL+RPU substreams are packaged in separate video tracks. Each track has different sample descriptions.

8.2.1 BL Track

The BL track is SDR or HDR compliant and can be decoded and displayed with a compliant AVC/HEVC decoder.

Note: If the sample entry is not set to ‘avc3’ or ‘hev1’ it will not be compliant with DECE CFF v2.0.

8.2.2 EL Track

The EL track is not SDR and HDR compliant. In this case, a DolbyVisionHEVCVisualSampleEntry (‘dvhe’), DolbyVisionHVC1VisualSampleEntry (‘dvh1’), DolbyVisionAVC3VisualSampleEntry (‘dvav’) or
DolbyVisionAVC1VisualSampleEntry (‘dval’) shall be used. The visual sample entries shall contain an AVC or HEVC Configuration Box (‘avcC’ or ‘hvcC’), and a Dolby Vision Configuration Box (‘dvcC’ or ‘dvvC’). Notice that the Dolby Vision EL AVC or HEVC Configuration Box (‘avcE’ or ‘hvcE’) shall not be present.

The track shall meet the following constraints:

- In the handler reference box, the handler_type field shall be set to ‘vide’.
- The media information header box shall contain a video media header box.
- The dependency between the Dolby Vision base and enhancement track shall be signaled by the ‘tref’ box. The reference_type shall be set to ‘vdep’.
- The dv_profile field in the Dolby Vision Configuration Box (‘dvcC’ or ‘dvvC’) shall be set according the encoded Dolby Vision profile.
- The dv_level field in the Dolby Vision Configuration Box (‘dvcC’ or ‘dvvC’) shall be set according the encoded Dolby Vision level.
- The rpu_present_flag shall be set to 1.
- The el_present_flag shall be set to 0 or 1.
- The bl_present_flag shall be set to 0.

The following table shows the box hierarchy of the EL track of a dual-track Dolby Vision file.

Note: This is not an exhaustive list of boxes.

<table>
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<tr>
<th>Nesting Level</th>
<th>Reference</th>
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</thead>
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</tr>
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<td>7</td>
<td>ISO/IEC 14496-12</td>
</tr>
<tr>
<td>stbl</td>
<td></td>
</tr>
<tr>
<td>stsd</td>
<td></td>
</tr>
<tr>
<td>dvav, dval, dveh or dvh1</td>
<td>Section 4.1</td>
</tr>
<tr>
<td>avcC or hvcC</td>
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</tr>
<tr>
<td>dvcC or dvvC</td>
<td>Section 3.1</td>
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<td>stts</td>
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### Nesting Level

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<td></td>
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</tr>
</tbody>
</table>

### 8.3 Constraints on the ISO base media file format boxes

#### 8.3.1 Constraints on Movie Fragments

For a dual-track file, the movie fragments carrying the BL and EL shall meet the following constraints:

- The adjacent movie fragments (‘moof’ and ‘mdat’) for the base and enhancement track shall be interleaved with BL followed by EL. BL and EL samples shall be placed in separate Movie Fragments and that each BL Movie Fragment shall be immediately followed by an EL movie fragment containing the same number of samples with identical composition timestamps.

- The track fragment run box (‘trun’) for the base and enhancement track shall contain the same number of samples.

#### 8.3.2 Constraints on Track Fragment Random Access Box

The track fragment random access box (‘tfra’) for the base and enhancement track shall conform to the ISO/IEC 14496-12 (section 8.8.10) (see Resources) and meet the following additional constraint:

- The value of the `time` field in the track fragment random access box indicates the presentation time of a random accessible sample. This `time` value shall be identical for every corresponding random accessible sample in the base and enhancement track.