

SMPTE STANDARD

Stereoscopic 3D in MXF for Operations — Common Provisions



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Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices, and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in its Standards Operations Manual.

SMPTE ST 2070-1 was prepared by Technology Committee 31FS.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Engineering Document. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

Introduction

There are requirements for both interleaved and separated stereoscopic 3D content. While the timing relationship between each pair of images is especially important during stereoscopic acquisition and display, during post-production and distribution image pairs may be dealt with in non-real time as outlined in this suite of documents.

When content is created for distribution, left eye and right eye pictures might be interleaved. When content needs to be edited or manipulated in post-production, it might be stored as separated files. In stereoscopic acquisition, either an interleaved or separated structure can be used. As a stereoscopic 3D asset moves from production, through post-production to distribution (whether broadcast, web, on-demand or other), these can be transcoded and rewrapped. Upon playout of a file compliant with this suite of standards, the timing relationships between left-eye images and right-eye images must be recreated. SMPTE ST 2063 discusses this requirement (and others germane to high quality stereoscopic 3D production) in detail, and may be helpful to implementers.

The SMPTE ST 2070 document suite therefore addresses such use cases based on the common provisions defined in this (part 1) document. The part 2 document specifies the interleaved wrapping using OP-1a and the part 3 document provides the single track wrapping using OP-Atom or OP-1a.

Dual image stereoscopic 3D imaging systems deliver two images (left eye and right eye) that are arranged to be seen simultaneously, or near simultaneously, by the left and right eyes. Viewers then perceive increased depth in the picture, which becomes more like the natural binocular viewing experience. Regardless of how the pair of images are created, it is assumed that they are properly aligned in space and time at the input of the MXF file system. This standard therefore describes means by which the MXF file system can be as transparent as possible to the time and space alignment of the image pair.

The SMPTE D-Cinema family of standards also describes a MXF mapping for stereoscopic images within that application space. The SMPTE ST 2070 suite of documents is not intended to be used in the D-Cinema application space.

1 Scope

This document is the first part of a multipart document set that defines metadata and index structure of stereoscopic 3D video streams in MXF for operational applications. This document covers the common provisions that are required by this family of standards. This standard currently supports streams of stereoscopic images, either as uncompressed image pairs, intra- or inter-frame compressed formats.

2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword "reserved" indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword "forbidden" indicates "reserved" and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition; Tables shall be next; followed by formal languages; then figures; and then any other language forms.

3 Normative References

The following standards contain provisions that, through reference in this text, constitute provisions of this standard. 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 edition of the standards indicated below.

SMPTE ST 377-1:2011, Material Exchange Format (MXF) — File Format Specification

Amendment 1:2012 to SMPTE ST 377-1:2011

Amendment 2:2012 to SMPTE ST 377-2:2011

4 Definition of Acronyms, Terms and Data Types

For the purposes of this document, the terms and definitions given in SMPTE ST 377-1 apply.

5 Image Format Requirements

This family of standards (SMPTE ST 2070-1 and related parts) supports uncompressed and compressed image streams. The stereoscopic images shall be uncompressed images or from the same compression family with identical compression parameters including GOP structures and GOP cadence. Both image streams, coincident in time, shall be full video frames or individual video fields.

Note: Image compression systems which have additional requirements can document those provisions in another standard or Recommended Practice.

6 Metadata Structure

Each File Descriptor that is associated with any Source Package track that contains part of a stereoscopic stream pair, for any kind of picture or data essence, shall contain a SubDescriptor Strong Reference pointing to a concrete instance of the Stereoscopic SubDescriptor defined in this standard.

6.1 Stereoscopic SubDescriptor

MXF Stereoscopic 3D (S3D) streams conforming to this standard shall be described in the Source Package using the Stereoscopic SubDescriptor in conjunction with the File Descriptor concrete classes adequate to describe the encoded streams.

6.1.1 Stereoscopic SubDescriptor Key

The OperationsStereoscopic SubDescriptor shall be strongly referenced by the Generic Descriptor which is the Superclass of Picture and Data Essence Descriptors as specified in SMPTE ST 377-1. The Set key (UL) shall be as defined in Table 1.

Table 1 – Key for OperationsStereoscopic SubDescriptor

Byte No.	Description	Value (hex)	Meaning
1-13	Defined in Table 18 of the Structural Header Metadata Implementation section of SMPTE ST 377-1 (File Format Specification)		
14	Set Kind (1)	01h	Structural MetadataSet
15	Set Kind (2)	72h	OperationsStereoscopic SubDescriptor
16	Reserved	00h	Reserved

6.1.2 OperationsStereoscopic SubDescriptor Structure

Table 2 contains the permissible Universal Label values that shall be used to identify each of the eyes.

Table 2 – Universal Label for OperationsStereoscopic Eye ID

Byte No.	Description	Value (hex)	Meaning
1	Object Identifier	06h	
2	Label size	0Eh	
3	Designator	2Bh	ISO, ORG
4	Designator	34h	SMPTE
5	Registry Category Designator	04h	Labels
6	Registry Designator	01h	Labels Registry
7	Structure Designator	01h	Labels Structure
8	Version Number	0Dh	Version of the Registry
9	Item Designator	04h	Parametric
10	Essence Kind	See Table 3	Picture or Data Essence
11	Coding Characteristics	02h	Picture or Data Coding Characteristics
12	Eye Labeling	10h	Picture or Data Eye Labeling
13	Stereoscopic Eye Labeling ST_2070-1	01h	Eye Labeling for Stereoscopic streams conforming to this specification
14	Stereoscopic Eye ID	See Table 3	Stereoscopic Eye Identifier
15	Reserved	00h	
16	Reserved	00h	

The values of byte 10 and byte 14 shall be as follows:

Table 3 – Stereoscopic Eye ID Universal Labels bytes 10 and 14

Essence Kind	Eye	Value of Byte 10 (hex)	Value of Byte 14 (hex)	Comments
Picture	Left	01h	01h	Picture track corresponding to Left Eye
Picture	Right	01h	02h	Picture track corresponding to Right Eye
Data	Left	03h	01h	Data track corresponding to Left Eye
Data	Right	03h	02h	Data track corresponding to Right Eye

The Stereoscopic SubDescriptor structure and metadata elements are defined in Table 4.

Table 4 – OperationsStereoscopic SubDescriptor

Item Name	Type	Len	Local Tag	Item UL	Req ?	Meaning	Default
OperationsStereoscopic SubDescriptor	Set Key	16		06.0E.2B.34. 02.7F.01.01. 0D.01.01.01. 01.01.72.00	Req	Defines the Stereoscopic3DEyeID SubDescriptor Set	
Length	BER Length	var			Req	Set length	
All elements from the SubDescriptor MetadataSet defined in SMPTE ST 377-1 Annex B.3							
Stereoscopic Eye ID	Universal Label	16	dyn.	06.0E.2B.34. 01.01.01.0E. 01.03.07.03. 01.00.00.00	Req	Universal Label that identifies the eye (as defined in Table 2)	
Stereoscopic Data Essence Coding	Universal Label	16	dyn	06.0E.2B.34. 01.01.01.0E. 01.03.07.03. 02.00.00.00	Opt	Specifies the data Essence coding type Values are listed in SMPTE ST 400 (RP 224). The value for the UL should not contain an RP 224 node. [RP 210 Specifies the Coding scheme used]	

The OperationsStereoscopic SubDescriptor shall be used as a SubDescriptor for a Generic Picture Essence Descriptor, or one of its subclasses, to identify each stream’s eye.

Where a data track defines data essence related to one of the picture essence streams, the OperationsStereoscopic SubDescriptor shall also be used as a SubDescriptor for a Generic Data Essence Descriptor, or one of its subclasses, to identify the eyes for the data streams.

7 Index Tables

In the case where the left-eye and right-eye video streams appear in the same container, with or without other tracks, and the video streams are reordered temporally, the left- and right-eye pictures of each frame shall be reordered and coded identically because the single Index Table Entry for each frame has only a single set of flags.

In the case where the left-eye and right-eye video streams appear in different containers, each corresponding Index Table Entry of the two Index Tables shall have identical Index Table Entry flags.

Note: These rules are necessary to enforce matching coding cadences between each eye’s video streams.

Annex A Bibliography (Informative)

Note: All references in this document to other SMPTE documents use the current numbering style (e.g. SMPTE ST 298:2009) although, during a transitional phase, the document as published (printed or PDF) may bear an older designation (such as SMPTE 298-2009). Documents with the same root number (e.g. 298) and publication year (e.g. 2009) are functionally identical.

SMPTE ST 298:2009, Universal Labels for Unique Identification of Digital Data

SMPTE RP 210, Metadata Dictionary Registry of Metadata Element Descriptions

SMPTE RP 224, SMPTE Labels Register

SMPTE ST 429-10:2008, D-Cinema Packaging — Stereoscopic Picture Track File

SMPTE ST 2063:2012, Stereoscopic 3D Full Resolution Contribution Link Based on MPEG-2 TS

SMPTE ST 2067-2:2013, Interoperable Master Format – Core Constraints