# SMPTE STANDARD

# Stereoscopic 3D in MXF for Operations — OP1a Mapping



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May 13, 2014

## 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 2070-2 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 several times. 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 the 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 describes a MXF mapping for stereoscopic images within that application space. The ST 2070 suite of documents is not intended to be used in the D-Cinema application space.

# 1 Scope

This document defines a standard way to wrap an interleaved stereoscopic 3D video stream in MXF using OP1a per SMPTE ST 378. It follows the common provisions defined in part 1 of this multipart document and defines the interleaving structure to be used by a Generic Container implementation conforming to this suite of documents. This standard currently supports two stream stereoscopic images.

# 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

Note: All references in this document to other SMPTE documents use the current numbering style (e.g. SMPTE ST 378:2004) although, during a transitional phase, the document as published (printed or PDF) may bear an older designation (such as SMPTE 378M-2004). Documents with the same root number (e.g. 378) and publication year (e.g. 2004) are functionally identical.

The following standards contain provisions that, through reference in this text, constitute provisions of this recommended practice. 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 377-1:2011

SMPTE ST 378:2004, Material Exchange Format (MXF) — Operational Pattern 1A (Single Item, Single Package)

SMPTE ST 379-2:2010, Television — Material Exchange Format (MXF) — MXF Constrained Generic Container

SMPTE ST 2070-1:2014, Stereoscopic 3D in MXF for Operations — Common Provisions

## 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 Metadata Structure

Inside the MXF Header Metadata, the Content Storage shall reference one Material Package mapping the tracks of a single Source Package as an OP1a file per SMPTE ST 378, and shall contain two picture essence tracks, one for the left and one for the right eye. Each picture essence track shall identify the respective eye by the OperationsStereoscopic SubDescriptor, defined in SMPTE ST 2070-1. The file may also contain data tracks. Where a data track defines data essence related to one of the picture essence streams, this shall be indicated by the use of the OperationsStereoscopic SubDescriptor, as defined in SMPTE ST 2070-1, to identify the respective eye. The file may also contain optional data tracks, one for each video stream, matching each of the eyes, left and right respectively. As in regular OP1a files, the file may also contain an optional system item, optional audio streams and an optional generic data stream.

The scheme in Figure 1 illustrates how the Content Storage shall be structured.

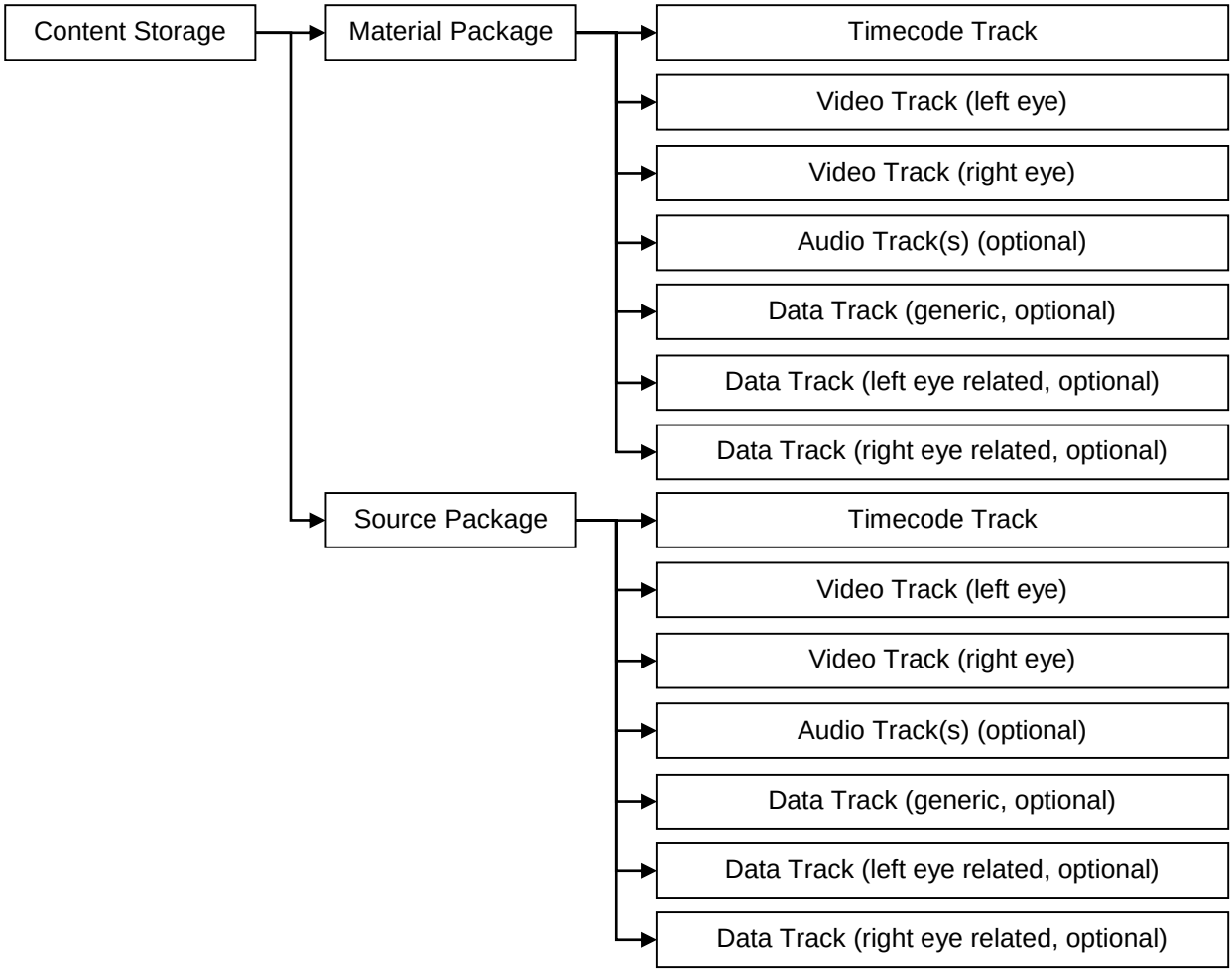


**Figure 1 – Content Storage illustrative example**

Note: Figure 1 omits significant details in the interest of simplicity.

## 6 Generic Container Structure

The Generic Container shall be frame wrapped as described in SMPTE ST 379-2. Clip wrapping is not possible since there are at least two tracks of video essence.

Any Picture Essence Descriptor shall have a strong reference to the OperationsStereoscopic SubDescriptor, defined in SMPTE ST 2070-1. Any Data Essence Descriptor used to describe stereoscopic data essence wrapped according to this standard shall have a strong reference to the OperationsStereoscopic SubDescriptor, as defined in SMPTE ST 2070-1.

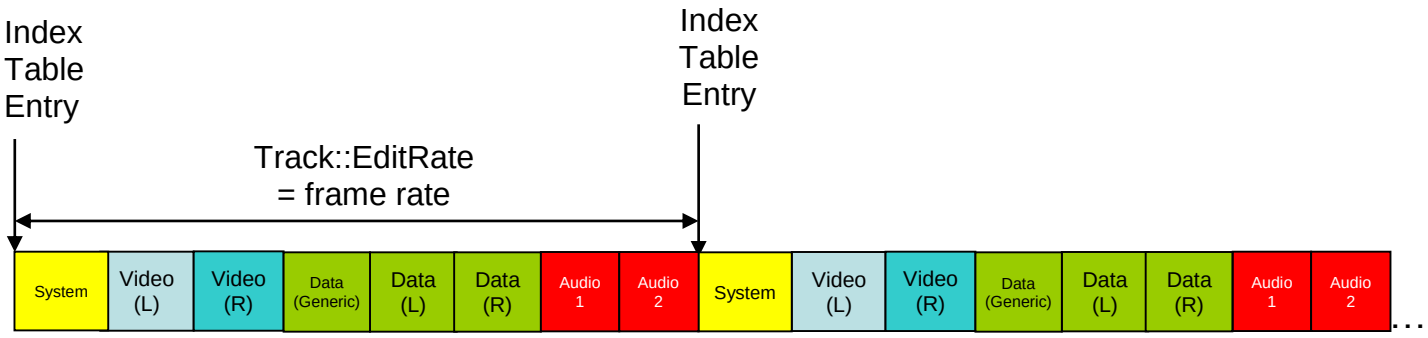


**Figure 2 – Example Generic Container structure**

Note: The above diagram is simply an illustration, as the actual stream might not contain VANC and might contain either System Items or separate data tracks.

# Annex A Bibliography (Informative)

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

SMPTE ST 2070-3:2014, Stereoscopic 3D in MXF for Operations — OP-Atom or Single Track OP-1a Mapping