

SMPTE STANDARD

D-Cinema Packaging —
Stereoscopic Picture Track File



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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.

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SMPTE Standard 429-10 was prepared by Technology Committee DC28.

1 Scope

This document provides the definition of a single MXF file design for Stereoscopic Picture content wrapping. It also defines a new Composition Playlist (CPL) extension element to reference such Stereoscopic Picture Track File.

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.

3 Normative References

The following standards contain provisions which, 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.

ANSI/SMPTE 298M-1997, Television — Universal Labels for Unique Identification of Digital Data

SMPTE 377M-2004, Television — Material Exchange Format (MXF), File Format Specification

SMPTE 429-3-2006, D-Cinema Packaging — Sound and Picture Track File

SMPTE 429-7-2006, D-Cinema Packaging — Composition Playlist

SMPTE RP 210, Metadata Dictionary Registry of Metadata Element Descriptions

World Wide Web Consortium (W3C) (2004, February 4) — Extensible Markup Language (XML) 1.0 (Third Edition), see <http://www.w3.org/TR/2004/REC-xml-20040204/>

World Wide Web Consortium (W3C) (2004, October 28) — XML Schema Part 1: Structures (Second Edition), see <http://www.w3.org/TR/2004/REC-xmlschema-1-20041028/>

World Wide Web Consortium (W3C) (2004, October 28) — XML Schema Part 2: Datatypes (Second Edition), see <http://www.w3.org/TR/2004/REC-xmlschema-2-20041028/>

Internet Engineering Task Force (IETF) (1996, November), RFC 2396 — Uniform Resource Identifiers (URI): Generic Syntax

Internet Engineering Task Force (IETF) (2005, July), RFC 4122 — A Universally Unique Identifier (UUID) URN Namespace

4 Glossary of Acronyms and Terms

The general glossary of acronyms, terms and data types used in the MXF specification is given in SMPTE 377M. It is not repeated here to avoid any divergence of meaning.

CPL	Composition Playlist
MXF	Material eXchange Format
URI	Uniform Resource Identifier
XML	eXtensible Markup Language
2D	Non-stereoscopic

5 Stereoscopic Picture Track Files Structure

The starting point of this stereoscopic picture packaging method is a single “Stereoscopic Picture Essence Stream” corresponding to the frame based interleaving of the two sequences of frames associated respectively with the left eye and the right eye as presented in Figure 1:

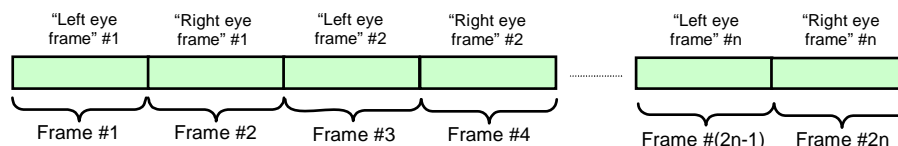


Figure 1 – Stereoscopic Picture Essence Stream Structure

This single Stereoscopic Picture Essence Stream shall contain the same number of left and right frames and shall be wrapped according to SMPTE 429-3, with the constraint that the KLV Fill item shall not be used between the left frame and the right frame of the same frames pair.

The left frame shall be the first frame in the left/right frames pair as presented in the Figure 1 above.

The Picture Essence Descriptor shall have a strong reference to a Stereoscopic Picture Essence Sub-Descriptor, defined in Annex A. This Stereoscopic Picture Essence Sub-Descriptor shall be used to identify a Track File as being a Stereoscopic Picture Track File belonging to this standard.

The Sample Rate property of the Picture Essence Descriptor shall be set to the frame rate of the essence stream. The Edit Rate in the Picture Track of the MXF header Packages shall be half the Sample Rate. The Index Table shall use Edit Units that are defined for the left/right frames pairs and as illustrated in Figure 2. The Index Start Position of the first Index Table Segment shall index the position of the first frame (which is a left eye frame) of the stereoscopic picture track.

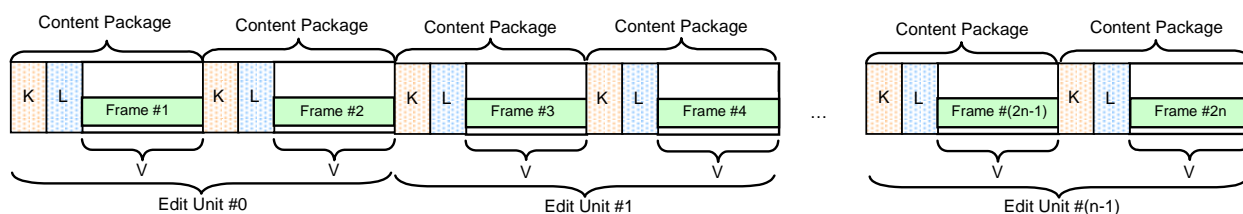


Figure 2 – Stereoscopic Picture Track File Body

Notes:

1 The relationship between Edit Units and Sample Rate is defined in SMPTE 377M and can be summarized as follows:

- Sample Rate is used in descriptors and defines the gross picture rate. This is typically either the rate of fields or frames in the picture.
- Edit Rate is the desired editing rate of the picture data. An edit unit (1/edit rate) is typically 1 picture, but may be larger in some applications.

2 Given a gross picture rate of 48, the Sample Rate property of the Picture Essence Descriptor would be set to 48 – as one sample unit corresponds to one frame in this design, the Sample Rate is the Frame Rate. Since the left/right pictures are grouped as pairs, the Edit Rate in the Picture Track of the MXF header Packages will be half the Sample Rate: 24. In this example, the MXF file will contain the following information:

- Sample Rate (Frame Rate) = 48
- Edit Rate = 24

3 The indexing of left/right frames pairs permits decoders to unambiguously determine the first frame of a stereoscopic frames pair at any point in the essence container.

6 MainStereoscopicPicture Element

In order to reference the Stereoscopic Picture Track File in a standard Composition Playlist, a `MainStereoscopicPicture` element is defined and shall be used as an extension element in the Reel element of a Composition Playlist as specified in SMPTE 429-7, Section 7.3.5.

The `MainStereoscopicPicture` element shall indicate stereoscopic picture essence to be projected onto the main screen and shall reference an external Track File as defined in Section 5. The `MainStereoscopicPicture` element shall be an instance of `PictureTrackFileAssetType` and its structure is defined in SMPTE 429-7, Section 8.4.

The `MainStereoscopicPicture` element structure defined in this standard is represented using the Extensible Markup Language (XML) [XML 1.0], and specified using XML Schema [XML Schema Part 1: Structures] and [XML Schema Part 2: Datatypes]. This `MainStereoscopicPicture` element specification shall be associated with a unique XML namespace name that shall be the string value “<http://www.smpte-ra.org/schemas/429-10/2008/Main-Stereo-Picture-CPL>”. This namespace name conveys both structural and semantic version information, and serves the purpose of a traditional version number field.

XML namespace names used in this standard are identified in Table 1. Namespace names are represented as Uniform Resource Identifier (URI) values [RFC 2396]¹.

¹ Readers unfamiliar with URI values as XML namespace names should be aware that although a URI value begins with a “method” element (“http” in this case), the value is designed primarily to be a unique string and does not necessarily correspond to an actual on-line resource. Applications implementing this standard should not attempt to resolve URI values on-line.

Table 1– XML Namespaces

Qualifier	URI
msp-cpl	http://www.smp-te-ra.org/schemas/429-10/2008/Main-Stereo-Picture-CPL
cpl	http://www.smp-te-ra.org/schemas/429-7/2006/CPL
xs	http://www.w3.org/2001/XMLSchema

URIs listed in Table 1 are normative, whereas the namespace qualifier values themselves (used in Table 1 and elsewhere in this standard) are not normative. Thus, namespace qualifier values may be replaced in instance documents by any arbitrary XML compliant namespace qualifier, meaning that conformant implementations shall expect any XML compliant namespace qualifier value that is associated with a URI from Table 1.

7 Composition Playlist Constraints

7.1 CPL Reels

If present in a Composition Playlist, the `MainStereoscopicPicture` element shall indicate the existence of stereoscopic content as specified in this document and the optional `MainPicture` element shall be omitted.

Note: The `MainStereoscopicPicture` element avoids erroneous 2D playback of a Stereoscopic Picture Track File.

7.2 MainStereoscopicPicture Assets

7.2.1 Edit Rate

The Edit Rate of each `MainStereoscopicPicture` asset in the CPL shall match the Edit Rate of the underlying Stereoscopic Picture Track File.

7.2.2 Frame Rate

The Frame Rate of each `MainStereoscopicPicture` asset in the CPL shall match the Sample Rate of the underlying Stereoscopic Picture Track File per SMPTE 429-7, Section 8.4.1.

Note: As highlighted in Section 5, the Frame Rate of a Stereoscopic Picture Track File is provided by the Picture Essence Descriptor Sample Rate property.

8 Schema

The XML schema of the `MainStereoscopicPicture` element is provided below:

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema targetNamespace="http://www.smp-te-ra.org/schemas/429-10/2008/Main-Stereo-Picture-CPL"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:cpl="http://www.smp-te-ra.org/schemas/429-7/2006/CPL"
  elementFormDefault="qualified" attributeFormDefault="unqualified">

  <xs:import namespace="http://www.smp-te-ra.org/schemas/429-7/2006/CPL" />

  <!--MainStereoscopicPicture-->
  <xs:element name="MainStereoscopicPicture" type="cpl:PictureTrackFileAssetType" />

</xs:schema>
```

In case of conflict between the prose and the schema, the prose shall be the authoritative expression of the `MainStereoscopicPicture` element definition.

9 Sample (Informative)

A CPL Reel sample is provided below in order to illustrate such CPL implementation:

```
<cpl:Reel>
  <cpl:Id>urn:uuid:4e2606b0-b4ae-6447-a90e-1e5bf99d7f54</cpl:Id>
  <cpl:AnnotationText>Reel #1 of The Stereoscopic Feature</cpl:AnnotationText>
  <cpl:AssetList>
    <cpl:MainSound>
      <cpl:Id>urn:uuid:7af1dace-936d-d74c-a7a5-569abd492e12</cpl:Id>
      <cpl:AnnotationText>Soundtrack for Reel #1 of The Stereoscopic Feature</cpl:AnnotationText>
      <cpl:EditRate>24 1</cpl:EditRate>
      <cpl:IntrinsicDuration>3600</cpl:IntrinsicDuration>
      <cpl:KeyId>urn:uuid:6716450c-7e93-3549-806f-e18d5f4206cd</cpl:KeyId>
      <cpl:Language>en-us</cpl:Language>
    </cpl:MainSound>
    <msp-cpl:MainStereoscopicPicture xmlns:msp-cpl="http://www.smpte-ra.org/schemas/429-10/2008/Main-Stereo-Picture-CPL">
      <cpl:Id>urn:uuid:7e427ee5-434a-c142-b845-6aa67e1e97ff</cpl:Id>
      <cpl:AnnotationText>Stereoscopic Picture for Reel #1 of The Stereoscopic Feature</cpl:AnnotationText>
      <cpl:EditRate>24 1</cpl:EditRate>
      <cpl:IntrinsicDuration>3800</cpl:IntrinsicDuration>
      <cpl:EntryPoint>100</cpl:EntryPoint>
      <cpl:Duration>3600</cpl:Duration>
      <cpl:KeyId>urn:uuid:1f894844-e1d8-8643-a48d-341b96659499</cpl:KeyId>
      <cpl:FrameRate>48 1</cpl:FrameRate>
      <cpl:ScreenAspectRatio>185 100</cpl:ScreenAspectRatio>
    </msp-cpl:MainStereoscopicPicture>
  </cpl:AssetList>
</cpl:Reel>
```


Annex A (Normative)

Stereoscopic Picture Sub-Descriptor

The Stereoscopic Picture Sub-Descriptor is a supplementary Essence Descriptor that can be strongly referenced by any Picture Essence Descriptor. In order that the strong reference can be made, the MXF Generic Descriptor (as defined in SMPTE 377M) has an additional optional property as defined in Table A.1.



The Local Tag value associated with this additional optional property (called “Sub Descriptors”) shall be dynamically allocated (dynamic) as defined in SMPTE 377M. The translation from each dynamically allocated Local Tag value to its full UL value can be found using the Primer Pack mechanism defined in SMPTE 377M. The full 16-byte UL value is defined in SMPTE RP 210.

Table A.1 – Additional Optional Property for the MXF Generic Descriptor

Item Name	Type	Len	Local Tag	Item Designator	Req ?	Meaning	Default
All elements from the Generic Descriptor defined in SMPTE 377M, Table 17							
 Sub Descriptors	Array of StrongRef (Sub Descriptors)	8+ 16n	dynamic	06.01.01.04. 06.10.00.00	Opt	Array of strong references to Sub Descriptor Sets	

Any Picture Essence Descriptor used to describe stereoscopic picture essence wrapped according to this standard shall have a strong reference to a Stereoscopic Picture Sub-Descriptor, defined in Table A.2 below. As the purpose of this Sub-Descriptor is only to identify a Track File as being a Stereoscopic Picture Track File belonging to this standard, it does not require any specific property.

Table A.2 – Stereoscopic Picture Sub-Descriptor

	Item Name	Type	Len	Local Tag	UL Designator	Req ?	Meaning	Default
	Stereoscopic Picture Sub-Descriptor	Set Key	16		See Table A.3 below	Req	Defines the Stereoscopic Picture Sub-Descriptor Set	
↔	Length	BER Length	var			Req	Set length – see statement below Table A.2	
	Instance UID	UUID	16	3C.0A	01.01.15.02. 00.00.00.00	Req	Unique ID of this instance [SMPTE RP 210 The ISO/IEC 11578 (Annex A) 16 byte Globally Unique Identifier]	
	Generation UID	UUID	16	01.02	05.20.07.01. 08.00.00.00	Opt	Generation Identifier [SMPTE RP 210 Specifies the reference to an overall modification]	

The Stereoscopic Picture Sub-Descriptor Set length should be BER long-form encoded using 4 bytes.

Table A.3 – Key for Stereoscopic Picture Sub-Descriptor

Byte No.	Description	Value (hex)	Meaning
1-13	Defined in the “Structural Header Metadata Implementation” section of SMPTE 377M, Table 13		
14	Set Kind (1)	01h	Defines the Key value for the Stereoscopic Picture Sub-Descriptor
15	Set Kind (2)	63h	
16	Reserved	00h	Reserved

Note: The method of adding a Sub-Descriptor was first used in SMPTE 422M.

Annex B (Informative)
Bibliography

SMPTE 336M-2007, Television — Data Encoding Protocol using Key-Length-Value

SMPTE 422M-2006, Material Exchange Format — Mapping JPEG 2000 Codestreams into the MXF Generic Container

SMPTE 429-4-2006, D-Cinema Packaging — MXF JPEG 2000 Application

SMPTE EG 41-2004, Television — Material Exchange Format (MXF), Engineering Guideline

SMPTE EG 42-2004, for Television — Material Exchange Format (MXF), MXF Descriptive Metadata