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Mapping VC-6 into the MXF Generic Container

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**Title Page**

This page will be provided by SMPTE HQ Staff.

See AG-16 clause 3.1 (Title Page), and ISO Directive Part 2 clause 11 (Title).

Proposed SMPTE Standard

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# Foreword

See AG-16 3.2 (Foreword), and ISO Directive Part 2 clause 12 (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. This SMPTE Engineering Document was prepared by Technology Committee TC-31FS.

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:”

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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; then formal languages; then figures; and then any other language forms.

If this is a revision, a topical list of changes [should/shall be included here]

# Introduction

An Introduction section is Optional / Conditional

The introduction provides specific information or commentary about the technical content of the document, and about the reasons prompting its preparation. See AG-16 clause 3.3 (Introduction), AG-16 clause 4.2 (Conformance Terms), and ISO Directive Part 2 clause 13 (Introduction).

This section is entirely informative and does not form an integral part of this Engineering Document.

The MXF Generic Container is a streamable Essence Container that can be placed on any suitable transport and stored. SMPTE ST 379-1 defines the MXF Generic Container as the native Essence Container in MXF files. SMPTE ST 379-2 defines the MXF Constrained Generic Container. This document defines how SMPTE ST-2117-1 streams can be mapped in the MXF Generic Container and MXF Constrained Generic Container.

Other MXF mapping documents such as SMPTE ST 382 define how Audio can be mapped and synchronised with the video stream in the MXF Generic Container.

**Recommendation** - This document should be split into two. An MXF mapping standard and an RP for using it.

[Editors notes: The following paragraph will be replaced with the appropriate patent information during the SMPTE Headquarters publication process.]

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# 1 Scope

The scope clearly defines the subject of the document and the aspects covered, thereby indicating the limits of applicability of the document. See AG-16 clause 3.4 (Scope), and ISO Directive Part 2 clause 14 (Scope).

This Standard constrains the MXF mapping of SMPTE ST-2117-1 into the MXF Generic Container or MXF Constrained Generic Container.

# 2 Normative References

The normative references clause lists, for information, those documents which are cited normatively in the document. See AG-16 clause 3.5 (Normative References), AG-16 clause 4.3 (Normative References to Standards and Recommended Practices), and the ISO Directives Clause 15 (Normative References).

The following SMPTE STANDARD contains provisions that, through reference in this text, constitute provisions of this standard. [Dated references require that the specific edition cited shall be used as the reference. Undated citations refer to the edition of the referenced document (including any amendments) current at the date of publication of this document. All SMPTE STANDARD are subject to revision, and users of this engineering document are encouraged to investigate the possibility of applying the most recent edition of any undated reference.

SMPTE ST 326:2000, Television — SDTI Content Package Format (SDTI-CP)

SMPTE ST 331:2011, Element and Metadata Definitions for the SDTI-CP

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

Amendment 2:2012 to SMPTE ST 377-1:2011

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

SMPTE ST 379-1:2009, Material Exchange Format (MXF) — MXF Generic Container

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

SMPTE ST 381-2:2011, Material Exchange Format (MXF) — Mapping MPEG Streams into the MXF Constrained Generic Container

SMPTE ST 382:2007, Material Exchange Format — Mapping AES3 and Broadcast Wave Audio into the MXF Generic Container

SMPTE ST 385:2012, Material Exchange Format (MXF) — Mapping SDTI-CP Essence and Metadata into the MXF Generic Container

SMPTE ST 400:2012, SMPTE Labels Structure

SMPTE ST 436-1:2013, MXF Mappings for VI Lines and Ancillary Data Packet

# 3 Terms and Definitions

The terms and definitions clause provide definitions necessary for the understanding of certain terms used in the document. See AG-16 clause 3.6 (Terms and Definitions), AG-16 clause 4.4 (Terms and Definitions), and ISO Directive Part 2 clause 16 (Terms and Definitions).

Select one of the following sentences and delete the others:

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Your terms and definitions follow.

All Terms and Definitions are defined in SMPTE ST 377-1 and SMPTE ST 379-2.

# 4 MXF File Structure and Mapping

## 4.1 General

SMPTE ST-2117-1, MXF files specified by this document shall have one of the two structures illustrated in Figure 1 and Figure 2 respectively. **HPP** is an apbbrivciation for Header Partition Pack, **BPP** is an abbreviation for Body Partition Pack and **FPP** is a shorthand for Footer Partition Pack.

Figure 1 - Single Essence Location Style

Figure 2 - Multiple Essence Location Style

Detailed constraints are listed in Annex B Constraints of a Conformant Implementation.

## 4.2 Single Essence Location Style

As shown in Figure 1, this style consists of a Header Partition, a Footer Partition, and a Random Index Pack.

The Index Table is placed prior to the Essence Container.

Some of the aspects of this style are shown below.

* It is easy to handle because of a simple structure
* It is easy to edit while file transferring
* It is easy to pick extract a “Partial file”

It is recommended to have the following Index Layout Properties defined in Amendment 2 to SMPTE ST 377-1.

* Index Table Segment::Single Index Location TRUE (Single Location)
* Index Table Segment::Single Location TRUE (Single Location)
* Index Table Segment::Forward Index Direction TRUE (Forward)
* Preface:: is RIP present TRUE

## 4.3 Multiple Essence Location Style

As shown in Figure 2, this style consists of a Header Partition, segmented Body Partition(s), a Footer Partition, and a Random Index Pack. Every Partition except Header and the first Body Partitions has one Index Table Segment that carries the Index Entries indexing the Edit Units.

The purpose of this essence location style is to place the Index Table Segment just after the corresponding essence data. All Index Table Segments follow Essence Container Segments that they index. Thus, when receiving a streamed file, decoders can use Index Table Segments for indexing without a long delay.

Some of the aspects of this style are shown below

* It is only necessary to include one Index Table Segment for each Body Partition period on the sender side
* It is easy to perform the function “Play while receiving file” on the receiver side
* It is easy to pick extract a “Partial file”

It is recommended to have the following Index Layout Properties

* Index Table Segment::Single Index Location FALSE (Distributed Location)
* Index Table Segment::Single Essence Location FALSE (Distributed Location)
* Index Table Segment::Forward Index Direction FALSE (Backward)
* Preface:: is RIP present TRUE
* Essence Container Data:: Following Index Table TRUE (A Complete Index Table follows all Essence)

# 5 Mapping VC-6 Bytestream

## 5.1 General

The mapping of SMPTE ST-2117, is as defined in SMPTE ST 381-3. The mapping of AES3 digital audio data is defined by SMPTE ST 382. This specification uses Frame Wrapping as defined by SMPTE ST 379-2. The System Item is defined by SMPTE ST 326 and mapped into the MXF by SMPTE ST 385. The order of Items in each Edit Unit is System, Picture, Sound and Data.

## 5.2 Edit Unit Structure

The SMPTE ST 2117 MXF Mapping shall make use of Frame Wrapping as defined by SMPTE ST 379-2 Section 8.4.1.

An arrangement of System, Picture, Sound, and Data Items in a Frame Wrapping, i.e. the structure of Edit Unit is shown in Figure 3.

Structure of Generic Edit Unit

Structure of Generic Edit Unit

## 5.3 System Item Mapping

## 5.4 General

The System Item in each Edit Unit consists of System Metadata Pack, a Package Metadata set and Picture Metadata Set.

### 5.4.1 Overview of System Item

The System Item is placed at the beginning of every Edit Unit and contains information on the essence item and the metadata attached to the frames, and it shall comply with SMPTE ST 385.

Typical System Item consists of the following two KLV packets and a fill item, and its size is the same as one KAG size (1h).

* System Metadata Pack contains Package Rate, Multiple EC UL, LTC
* Package Metadata Set contains Body UMID
* Fill Item

Figure 4 shows the outline of System Item.

Typical System Item

Typical System Item

### 5.4.2 System Metadata Pack

The Pack Key is 06.0E.2B.34.02.05.01.01.0D.01.03.01.04.01.01.00, in accordance with SMPTE ST 385. The Length of this pack shall be fixed, i.e. 57-byte payload.

Also, each property shall be described in the provided field without tag and length. The sequence and values shall comply with SMPTE ST 326

* System Metadata Bitmap (“SMB” in the figure) indicates the presence of metadata in the Pack, and of essence data within the Edit Unit, should be set to 0101\_1100b, when Data Item is not recorded or 0101\_1110b when Data Item is recorded.
* The value of Continuity Count (“CC” in the figure) shall be monotonically increasing within a file. It does not have to start from 0, and reverts to 0000h following full count FFFFh.
* SMPTE Universal Label (“GC EC label” in the figure) shall be set to the same label as the Essence Container Property of Multiple Descriptor Set
* Package Creation Date should be blank. Tag (“T” in the figure) and the remains are filled with 00h
* LTC shall be described in the User Date column. Since it complies with SMPTE ST 331, it starts with CP-Tag 81h and digits of Frame, Second, Minute, and Hour are placed with flags such as DF, and then Binary Group data (4 bytes) is placed and remaining 8 bytes are filled with 0. In the 50p/59.94p system, the LTC is handled in half the rate of the Main-Stream video, and the field mark flag in the Time Code is used to identify the first or second frame of a frame pair

### 5.4.3 Package Metadata Set

The Set Key is 06.0E.2B.34.02.43.01.01.0D.01.03.01.04.01.02.nn, in accordance with SMPTE ST 385. This nn indicates the number of Metadata Block in the Set and is typically 1 for Body UMID in this specification.

Each metadata block is described with 1-byte CP-Tag and 2-byte Length field. Typical metadata in this specification, shown in Figure 4 is defined as follows:

* Body UMID should be described as the first Metadata Block
  + Extended UMID (64 bytes) should be described with CP-Tag 83h
  + Decoders should support the case of having just Basic UMID (32 bytes) or blank data (i.e. Local Length is zero) in the Metadata Block

## 5.5 Picture Item Mapping

### 5.5.1 General

Figure 5 shows the SMPTE ST-2117 picture element, the byte stream shall comply with SMPTE ST-2117.

Mapping of ST-2117 Picture Item Element

Mapping of ST-2117 Picture Item Element

### 5.5.2 SMPTE ST-2117 Picture Element Key

The Key is 06.0E.2B.34.01.02.01.01.0D.01.03.01.15.kk.05.nn, in accordance with SMPTE ST-2117, as it is a Frame Wrapped GC-Picture element.

The parameter kk specifies the count of Picture Elements in the Picture Item, and nn indicates the index number of the Element. In this specification, the tail of the key shall be set to 15.01.05.00.

### 5.5.3 SMPTE ST-2117 Picture Element Length

The length field of the KLV coded Element is 4 bytes BER long-form encoded (i.e. 83h.xx.yy.zz) for Frame wrapping.

### 5.5.4 SMPTE ST-2117 Picture Element Value

The Picture Element complies with SMPTE ST-2117.

* The constraints on the conformant implementations are described in Annex B.8.2.
* Operating Points of the elementary stream are described in Annex C.
* The property values of Picture Essence Descriptor are described in Annex D.

## 5.6 AES3 Sound Item Mapping

### 5.6.1 General

This element contains a Linear-PCM Audio data stream and shall comply with SMPTE ST 382.

Figure 6 shows the mapping of generic AES Sound Item Element

Mapping of AES in a Sound Item

Mapping of AES in a Sound Item

### 5.6.2 AES3 Sound Element Key

The Key is 06.0E.2B.34.01.02.01.01.0D.01.03.01.16.kk.03.nn, in accordance with SMPTE ST 382 as it is a Frame Wrapped AES GC-Sound element. The parameter kk specifies the count of Sound Elements, and nn indicates the index number of the Element. In this specification, nn shall be assigned as an incremental integer number starting from zero., for the 3rd element of 8 channels, the tail of the key is set to 16.08.03.02

### 5.6.3 AES3 Sound Element Length

The length field of the KLV coded Element is 4 bytes BER long-form encoded (i.e. 83h.xx.yy.zz) for Frame wrapping.

### 5.6.4 AES3 Sound Element Value

The Sound Element Value complies with SMPTE ST 382

* The constraints on the conformant implementations are described in Annex B.8.3.
* The property values of Sound Essence Descriptor are described in Annex D

## 5.7 Data Item Mapping

## 5.8 General

This element contains data stream, e.g. caption or sub-title, and shall comply with SMPTE ST 436-1. Figure 6 shows the mapping of ANC Data Item Element.

Mapping of ANC Data in a Data Item Element

Mapping of ANC Data in a Data Item Element

The Set Key is 06.0E.2B.34.01.02.01.01.0D.01.03. 01.17.01.02.01, in accordance with SMPTE ST 436-1, because it allows one Frame Wrapped ANC Data Element in an Edit Unit.

### 5.8.1 Acquisition Metadata Set

Acquisition Metadata Sets are specified in SMPTE RDD 18 and may be attached as ANC packets in the Data Item.

**Information for Document Editors (this page is to be deleted prior to FCD ballot)**

The following documents have useful reference material for document editors. SMPTE AG 16:2018 – SMPTE Engineering Document Style Guidelines

International Organization for Standardization (ISO) / International Electrotechnical Commission (IEC), Directives, Part 2:2016-05, Principles and rules for the structure and drafting of ISO and IEC documents, 7.0

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