SMPTE RP 2xxx-x:2019

**SMPTE RECOMMENDED PRACTICE**

Material Exchange Format –

Mapping ST-2117 Streams into the Generic Container

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Scope (1)  
This RDD specifies the MXF mapping of SMPTE ST-2117, AES3 audio and ANC packets into the MXF Generic Container or MXF Constrained Generic Container, and two types of essence location style that are compliant with the OP-1a Frame Wrapping.

Related Documents (2)

The following standards contain provisions which, through reference in this text, constitute provisions of this document. At the time of publication, the editions indicated were valid. All documents are subject to revision, and parties to agreements based on this document are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

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

# Introduction (3)

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. Also, SMPTE ST 379-2 defines the MXF Constrained Generic Container. SMPTE ST 381-3 defines how SMPTE ST-2117 streams, can be mapped in the MXF Generic Container and MXF Constrained Generic Container. SMPTE ST 382 defines how AES3 Audio can be mapped in the MXF Generic Container. SMPTE ST 385 defines the System Item that is compatible with SMPTE ST 326 (SDTI-CP) and also defines how SDTI-CP essence and metadata can be used in the MXF Generic Container.

This document specifies the MXF mapping of SMPTE ST-2117, AES3 audio and ANC packets into the MXF Generic Container or MXF Constrained Generic Container. This document also specifies the MXF file format that includes unique identifiers, Operation Pattern, Partitions, Index Table Segments and RIP. The common basic structure is described in this document.

# Outline of the MXF File Structure and Mapping (4)

## General (4.1)

SMPTE ST-2117, MXF files specified by this document shall have one of the two structures illustrated in Figure 1 and Figure 2 respectively



Figure 1 - Single Essence Location Style



Figure 2 - Multiple Essence Location Style

**HPP**: Header Partition Pack, **BPP**: Body Partition Pack, **FPP**: Footer Partition Pack

A list of major constraints common to these file structures is given in Table 1.

Table 1 - Constraints of SMPTE RP xxxx Streams

|  |  |
| --- | --- |
| **Item** | **Constraints** |
| Operational Pattern | 1a |
| Wrapping (Interleaving) | Frame by Frame (coded order) |
| KAG size | 1 |
| System Item | Compliant to SMPTE ST 326 and SMPTE ST 385, includes the Frame by Frame Timecode and UMID |
| Video mapping | Compliant to SMPTE ST 2117, byte stream |
| Audio sampling | 48 kHz locked to Video |
| Audio mapping | Compliant to SMPTE ST 382, AES3, 1ch/Element (min 2 to max 16 channels[[1]](#footnote-1)) |
| Data Item | Compliant to SMPTE ST 436-1, used for Ancillary packet |
| Timecode | System Item and Header Metadata |

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

## Single Essence Location Style (4.2)

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

## Multiple Essence Location Style (4.3)

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)

# SMPTE ST 2117 Picture Data and AES3 Data Mapping (5)

## General (5.1)

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.

## 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.



Figure 3 - Structure of Generic Edit Unit

## System Item Mapping (5.3)

### General (5.3.1)

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

### Overview of System Item (5.3.2)

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.



Figure 4 - Typical System Item Structure

### System Metadata Pack (5.3.3)

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

### Package Metadata Set (5.3.4)

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

## Picture Item Mapping (5.4)

### General (5.4.1)

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



Figure 5 - Mapping of ST-2117 Picture Item Element

### SMPTE ST-2117 Picture Element Key (5.4.2)

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.

### SMPTE ST-2117 Picture Element Length (5.4.3)

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

### SMPTE ST-2117 Picture Element Value (5.4.4)

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.

## AES3 Sound Item Mapping (5.5)

### General (5.5.1)

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

Figure 5 shows the mapping of generic AES Sound Item Element



Figure 6 - Mapping of AES in a Sound Item

### AES3 Sound Element Key (5.5.2)

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

### AES3 Sound Element Length (5.5.2)

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

### AES3 Sound Element Value (5.5.3)

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

## Data Item Mapping (5.6)

### General (5.6.1)

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.

 Figure 7 - 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.

### Acquisition Metadata Set (5.6.3)

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

# SMPTE Labels (6)

## ST 2117 Picture Essence (6.1)

|  |  |  |  |
| --- | --- | --- | --- |
| **Item Name** | **Symbol** | **Kind** | **Item UL** |
| ST-2117 Label | SampledHeight | NODE | urn:smpte:ul:060e2b34.040101vv.04010202.030x0000 |
| ST-2117 Pictures Container | MXFGCST2117EssenceContainerLabel | NODE | urn:smpte:ul:060e2b34.040101vv.0d010301.02xx0000 |
| Image Sampled Height | SampledHeight | LEAF | urn:smpte:ul:060e2b34.010101vv.04010501.07000000 |
| Image Sampled Width | SampledWidth | LEAF | urn:smpte:ul:060e2b34.010101vv.04010501.08000000 |
| Display Height | DisplayHeight | LEAF | urn:smpte:ul:060e2b34.010101vv.04010501.07000000 |
| Display Width | DisplayWidth | LEAF | urn:smpte:ul:060e2b34.010101vv.04010501.08000000 |
| Sample Rate | SampleRate | LEAF |  |
| Field Dominance | FieldDominance | LEAF | urn:smpte:ul:060e2b34.02vv0d01.04010501.08000000 |

## Sound Essence (6.3)

Table 1 shows the Universal Labels used in the Sound Descriptor of MXF file

Table 2 - Universal Labes in Sound Descriptor Sets

|  |  |  |  |
| --- | --- | --- | --- |
| **Item Name** | **Symbol** | **Kind** | **Item UL** |
| Essence Container | MXFGCFrameWrappedAES3AudioData | LEAF | urn:smpte:ul:060e2b34.04010101.0d010301.02060300 |
| Sound Essence Coding | SMPTE382DefaultUncompressedSoundCoding | LEAF | urn:smpte:ul:060e2b34.0401010a.04020201.01000000 |

# Application Issues (7)

## Partition Pack (7.1)

As shown in Figure 1 and Figure 2, a Partition Pack that summarizes the partition characteristics is placed at the top of each partition

Figure 8 shows the outline and the property names.



Figure 8 - Partition Pack

The Pack Key is 06.0E.2B.34.02.05.01.01.0D.01.02.01.01.nn.04.00, in accordance with SMPTE ST 377-1. The parameter nn indicates the type of the Partition, i.e. "2" for Header, "3" for Body, and "4" for Footer.

Each property shall be set as shown in Table 1.

Table 3 - MXF Fundamental Settings

|  |  |
| --- | --- |
| **Item Partition Pack** | **Setting** |
| Partition Status | Closed and Complete (Byte 15 of Pack key = 04h) or  Open and Incomplete (Byte 15 of Pack Key = 01h) |
| MXF Version Number | TBD |
| KAG Size | 1 / TBD |
| Operational Patter | OP1a |
| The Number of Essence Containers  (kinds of the UL) | 3 (GC Picture, Sound, Essence Multiple) or  4 (GC Picture, Sound, Data, Essence Multiple) |

The Essence Container batch should contain all Essence Container labels described in and Descriptor Sets.

The UL of Operational Pattern shall be 06.0E.2B.34.04.01.01.01.0D.01.02.01.01.01.09.00 for OP1a. The value of Byte 15, 09 h indicates that the form is internal Essences on a multi-track stream file.

The use of Run-in is prohibited in this specification. The Header Byte Count and Index Byte Count properties in Partition Packs include the trailing Fill item.

Index SID should be set to "1", and Body SID should be set to "2". When the Index Table or Essence Container data are not recorded in the Partition, these SID values shall each be set to “0”.

## Application of the KLV Fill Item (7.2)

The Fill item is used for padding. It is a kind of KLV Metadata and contains meaningless byte stream.

The Metadata Key is 06.0E.2B.34.01.01.01.02.03.01.02.10.01.00.00.00, in accordance with SMPTE ST 377-1.

In this specification, the KLV Fill item is used to pad items to the KAG boundary or to reserve space for additional data insertion.

## Application of MXF structure and indexing style (7.3)

### Single Essence Location Style (7.3.1) Indexing structure for CBE Picture format (7.3.1.1)

SMPTE ST-2117 CBG format in this specification uses CBE (Constant Bytes per Element) Picture Item. As shown in Figure 9, the MXF file consists of a Header Partition and a Footer Partition. The System, Picture, Sound, and Data Item are mapped into Essence Container and placed in the Header Partition.



Figure 9 - Layout of CBE Picture MXF File

When performing random accesses, the location of a target Edit Unit can be determined by a simple  
multiplication; this is because the Edit Unit length is constant. The Index Table shall be present in Header Partition, and the Index Table has empty Index Entry array and Delta Entry array.

CBE Picture MXF File for on-the-fly generation (7.3.1.2)  
This layout is an extension of the layout specified in the previous section. If an MXF file starts to be generated whilst recording and has not yet been closed, the duration of the clip and the offset of the Footer Partition relative to the Header Partition are not determined. In such a situation, the Header Metadata within the File Header will contain -1 for durations and possibly Distinguished Values for Best Effort items. Therefore, a valid Header Metadata block will instead be attached in the File Footer after the recording is finished as shown in Figure 10.



Figure 10 - Layout of CBE Picture MXF File after on-the-fly generation

Even while recording, it is possible to compute the Essence Container byte offset for the start of Edit Unit of stored Essence N as N \* Edit Unit Byte Count, where N=0 is the beginning of the sequence.

A file of this layout contains some particular values as follows (where *pFP* means Footer Partition property in the Partition Packs, *imUMID* means the 12th byte lower nibble of the UMID of Material Package).

* Header Partition is Open/Incomplete, *pFP* is set to 0, *imUMID* is Fh, and Duration properties are set to -1.
* Footer Partition is Closed/Complete, *imUMID* is set to 3h and Duration properties are set to the conclusive value. Index Table in Footer Partition may be present.

Note: *imUMID* value Fh means "Live stream" and 3h is the normal value in this specification.

#### Indexing structure for VBE Picture format (7.3.1.3)

SMPTE ST-2117 uses VBE (Variable Bytes per Element) Picture Item. Figure 11 shows an instance of the structure layout.



Figure 11 - Layout of VBE Picture MXF file in Single Essence Location Style

Though File Body is not partitioned, Index Table shall be segmented as specified in Annex B.6. The Random Index Pack shall be present to indicate that the Essence Container is stored just in the Header Partition and that it is not necessary to find more Index Tables.

Multiple Essence Location Style (7.3.2)Indexing structure for VBE Picture format (7.3.2.1)  
SMPTE ST-2117 in this specification use VBE (Variable Bytes per Element) Picture Item. Figure 12 shows an instance of the structure layout.



Figure 12 - Layout of VBE Picture MXF file in Multiple Essence Location Style

As an extension of the layout, Figure 13 shows the layout of VBE Picture MXF file with Repeated Index Table.



Figure 13 - Layout of VBE Picture MXF file with Repeated Index Table in Multiple Essence Location style

#### VBE Picture MXF File for on-the-fly generation (7.3.2.2)

This layout is an extension of the layout specified in the previous section. If an MXF file starts to be generated whilst recording and has not yet been closed, the duration of the clip and the offset of the Footer Partition relative to the Header Partition are not determined. In such a situation, the Header Metadata within the File Header will contain -1 for durations and possibly Distinguished Values for Best Effort items. Therefore, a valid Header Metadata block will instead be attached in the File Footer after the recording is finished as shown in Figure 14.



Figure 14 - Layout of VBE Picture MXF file after on-the-fly generation

Application of Index Table for Frame Wrapped SMPTE ST-2117 Picture and AES Sound Essence (7.4)  
Index Table structure (7.4.1)  
Index Table is a lookup table that converts a desired time offset on the timeline of a File Package into a stream offset within an Essence Container in an MXF file. An Index Table may be divided into multiple Index Table segments. Each segment consists of an Index Table Segment Set and Fill item as shown in Figure 15.

Figure 15 - Index Table Segment Set

The Set Key is 06.0E.2B.34.02.xx.01.01.0D.01.02.01.01.10.01.00, in accordance with SMPTE ST 377-1. In addition, in this specification, the 6th byte is restricted to be "53" that implies the size of each local length field shall be 2. Consequently, the size of each property is limited up to 65535 bytes.

Optional properties that are not mentioned in this specification should be placed prior to Delta Entry Array and Index Entry Array.

The properties in the array elements are shown in Figure 16 and are detailed in the following sections.



Figure 16 - Array Elements in Index Table Segment Set

### Implementation of the Set (7.4.2)

As described in Section 5, the Length of System, Sound or Data Item is constant through a SMPTE ST-2117 MXF file. On the other hand, as for Picture Item, there are two patterns: CBE (Constant Bytes per Element) Picture and VBE (Variable Bytes per Element) Picture. The pattern is determined by the picture essence format, and the implementation of the Index Table is also different along with the pattern as follows.

The Index Table for CBE Picture that is used in constant or constraint bitrate video (i.e. SMPTE ST-2117 CBG) is described as follows.

* Only one Index Table Segment Set shall be present in the File Header.
  + Index Start Position and Index Duration shall be set to 0.
  + Edit Unit Byte Count shall be set to the value that is determined by the recording format.
* One slice
  + Slice Count shall be set to 0.
  + Slice in Delta Entry shall be set to 0.
* Index Entry Array shall be present and empty.
  + Array header ("nie", "len" in the figure) shall be set to 0 and no entries.
* Index Byte Count in the Header Partition Pack shall be 512

The Index Table for VBE Picture that is used in variable bitrate video (i.e. SMPTE ST-2117 VBR) is described as follows.

* In the case of Single Essence Location Style, one or more Index Table Segment Set(s) constituting a complete Index Table shall be present in the File Header. On the other hand, in the case of Multiple Essence Location Style, one Index Table Segment shall be present in each Body Partition except the first Body Partition immediately following Header Partition.
  + Index Start Position and Index Duration shall be set exactly to represent the Edit Unit number.
  + Edit Unit Byte Count shall be set to 0.
* Two slices
  + Slice Count shall be set to 1.
  + Slice in Delta Entry shall be set to 0 for System and Picture Items, and 1 for Sound and Data item.
* Index Entry Array shall be present.
  + The array contains Index Entries for all Edit Units within the segment.
  + All "Req" properties and Slice Offset property shall be described, and others should not be.

# Annex A UL Code List

# Annex B Constraints of a Conformant Implementation

This section describes the constraints on conformant implementations of SMPTE RP xxxx products.

## Structure (B.1)

This SMPTE RDD 32 file shall be an MXF file that has the following structure.

* A file shall have a KAG size of 1.
* A file shall be signalled as OP-1a.
* A file shall use the MXF Generic Container or MXF Constrained Generic Container.
* A file shall be Frame Wrapped.
* The order of Items in the Content Package shall be System, Picture, Sound and Data Items.
* A file shall include one CP System Item.
* A file shall include one MPEG Frame Wrapped Picture Elements.
* A file shall include two or more AES Frame Wrapped Sound Elements.
* A file shall include zero or one ANC Elements.

## Header and Body Partition Pack Values (B.2)

The Footer Partition Property specifies the byte offset of the start of the Footer Partition relative to the start of the Header Partition. In Open Partitions, the value of Footer Partition Property in the Header or Body Partition is zero (0). In Closed Partitions, the value of Footer Partition Property in the Header or Body Partition is as defined in Section 7.1 Partition Pack of SMPTE ST 377-1

## Essence Descriptors

The following Essence Descriptor and Sub Descriptor Sets are used to describe the parametric information of the essence data in each Essence Track in the File Package.

* CDCI Picture Essence Descriptor Set that is specified in SMPTE ST 377-1 describes the Picture Track. The Set Key is
  + 06.0E.2B.34.02.53.01.01.0D.01.01.01.01.01.28.00.
* Container Constraints Sub Descriptor defined in SMPTE ST 379-2 is necessary to describe MPEG-4 AVC Sub Descriptor specified in SMPTE ST 381-3. The Set Key is
  + 06.0E.2B.34.02.53.01.01.0D.01.01.01.01.01.67.00.
* MPEG-4 AVC Video Sub Descriptor Set that is specified in SMPTE ST 381-3 is strongly referenced from the CDCI Picture Descriptor and is also described for the Picture Track. The Set Key is
  + 06.0E.2B.34.02.53.01.01.0D.01.01.01.01.01.6E.00.
* MPEG Video Descriptor Set that is specified in SMPTE ST 381-1 is described for the Picture Track. The Set Key is
  + 06.0E.2B.34.02.53.01.01.0D.01.01.01.01.01.51.00.
* AES3 Sound Descriptor Set that is specified in SMPTE ST 382 is described for each Sound Track. The Set Key is
  + 06.0E.2B.34.02.53.01.01.0D.01.01.01.01.01.47.00.
* ANC Data Descriptor Set that is specified in SMPTE ST 436-1 is described for the ANC Element when the Data Track exists in the MXF file. The Set Key is
  + 06.0E.2B.34.02.53.01.01.0D.01.01.01.01.01.5C.00.

Note: MPEG Video Descriptor that extends the CDCI Picture Essence Descriptor is used for XAVC HD Intra profile. On the other hand, CDCI Picture Essence Descriptor and SMPTE ST-2117 Video Sub Descriptor are used for other profiles described in this document.

The Structural Metadata Sets shall contain the properties that are marked with "Req" in SMPTE MXF documents. Also, all "E/req" / "B.Effort" properties, and listed "D/req" / "Opt" properties in the following table should be included.

Table 4 - D/Req and Opt Properties in Structural Metadata Sets

|  |  |  |
| --- | --- | --- |
| **Set** | **Symbol** | **Tag** |
| Content Storage | Essence Container Data | 19.02 |
| Essence Container Data | IndexSID | 3F.06 |
| Track | TrackID | 48.01 |
| Structural Component | Duration | 02.02 |
| Sequence or Source Clip  (inheriting Structural Component) |  |  |
| Descriptor | Linked Track ID | 30.06 |
| Sub Descriptors | Dynamic Tag |
| Picture Descriptor  (inheriting Descriptor) | SampledHeight | 32.04 |
| SampledWidth | 32.05 |
| SampledXOffset | 32.06 |
| SampledYOffset | 32.07 |
| DisplayHeight | 32.08 |
| DisplayWidth | 32.09 |
| DisplayXOffset | 32.0A |
| DisplayYOffset | 32.0B |
| TransferCharacteristic | 32.10 |
| ImageAlignmentOffset | 32.11 |
| ImageStartOffset | 32.13 |
| ImageEndOff | 32.14 |
| PictureEssenceCoding | 32.01 |
| CDCI Picture Essence Descriptor (inheriting Picture Descriptor) | ColorSiting | 33.03 |
| BlackRefLevel | 33.04 |
| WhiteRefLevel | 33.05 |
| ColorRange | 33.06 |
| PaddingBits | 33.07 |
| VerticalSubsampling | 33.08 |
| ReversedByteOrder | 33.0B |
| ST-2117 Video Sub-Descriptor |  |  |
| Sound Descriptor  (inheriting Descriptor) | Locked/Unlocked | 3D.02 |
| Audio Ref Level | 3D.04 |
| Sound Essence Coding | 3D.06 |
| AES3 Audio Descriptor  (inheriting Sound Descriptor) | Channel Status Mode | 3D.10 |
| Fixed Channel Status Data | 3D.11 |

## Identification Set Value (B.4)

The optional Generation UID Property of the Interchange Object Class is not to be encoded in Identification Set instances as defined in SMPTE ST 377-1.

## Timecode Representation in MXF Header and an Essence Container (B.5)

* In Material Package, there shall be only one continuous Timecode Track.
* In File Package, there shall be only one continuous Timecode Track.
* System Item timecode may contain discontinuities.

## Index Table Segments (B.6)

The number of frames contained in an Index Table Segment Set is…

* The Size of Index Table Segment is the sum of an Index Table Segment Set and the following KLV Fill item.
* This restriction shall not be applied to the final Index Table Segment within the file.
* The final Index Table Segment contains remaining frames, so the Index Duration and Duration may be fewer than the values in Table B.2.
* The Size of Index Table Segments should be uniform in an MXF file.

## Random Index Pack (B.7)

The Random Index Pack (RIP) shall be present.

## Essence (B.8)

### System Item (B.8.1)

This RP xxxx file includes one CP System Item as defined in Annex B.1.

### Picture Item (B.8.2)

The Picture Item includes one or more SMPTE ST-2117 Video Elements as defined in Annex B.1

### Sound Item (B.8.3)

The Sound Item includes one or more AES3 Elements as defined in Annex B.1.

* Sound data stream is coded in 2's complement, in little endian, and void bits shall be set to 0.
* Preferable 5-frame sequence of audio sampling number is 801-801-800-801-801 for 59.94fps, or 1602-1601-1602-1601-1602 for 29.97fps.
* Extracted AES3 Channel Status data shall be described into the Audio Descriptor in Header Metadata.

### Data Item (B.8.4)

The Data Item includes zero or one ANC Frame Element as defined in Annex B.1.

* Typical settings, e.g. for a minimum implementation, are defined as follows:
  + Wrapping Type value is chosen from VANC codes. HANC is not used.
  + Payload Sample Coding value is set to 8-bit luma sample type.
* CS(Check Sum) in each ANC Packet may be omitted.
* Each Payload Byte Array shall be padded to achieve 4-byte alignment.
* The size of Data Item, i.e. from the first byte of the Element Key to the end of Fill, shall be less than or equal to 11776 bytes. The size shall always be multiple of 1 bytes due to the KAG size.
* The size of Data Item shall be constant through the file.

# Annex C Operating Points

# Annex D Property Values of the Essence Descriptors

Table D.1 to Table D.6, Table D.8 and Table D.9 enumerate the Property values of Picture, Sound and Data Essence that specify the constraints on the conformant implementation of the SMPTE RP xxxx file.

**Table D.1 – An Instance of ST-2117 Video Descriptor**

|  |  |  |  |
| --- | --- | --- | --- |
| **Item Name** | **Symbol** | **Kind** | **Item UL** |
| SMPTE ST-2117 |  |  |  |
| File Descriptor | | | |
| **Item Name** | **Symbol** | **Kind** | **Item UL** |
| Sample Rate |  |  |  |
| Essence Container |  |  |  |

**Table D.2 – Property Values of Color Items in Generic Picture Essence Descriptor (Informative)**

|  |  |  |  |
| --- | --- | --- | --- |
| ITU-R BT.709 | | | |
| **Item Name** | **Symbol** | **Kind** | **Item UL** |
| Transfer Characteristic | TransferCharacteristic\_ITU709 | LEAF | urn:smpte:ul:060e2b34.040101vv.04010101.01020000 |
| Color Primaries | ColorPrimaries\_ITU709 | LEAF | urn:smpte:ul:060e2b34.040101vv.04010101.03030000 |
| Coding Equations | CodingEquations\_ITU709 | LEAF | urn:smpte:ul:060e2b34.040101vv.04010101.02020000 |
| ITU-R BT.2020 | | | |
| **Item Name** | **Symbol** | **Kind** | **Item UL** |
| Transfer Characteristic | TransferCharacteristic\_ITU2020 | LEAF | urn:smpte:ul:060e2b34.040101vv.04010101.01090000 |
| Color Primaries | ColorPrimaries\_ITU2020 | LEAF | urn:smpte:ul:060e2b34.040101vv.04010101.03040000 |
| Coding Equations | CodingEquations\_ITU2020\_NCL | LEAF | urn:smpte:ul:060e2b34.040101vv.04010101.02060000 |

**Table D.8 – An Instance of AES3 Audio Essence Descriptor**

|  |  |  |  |
| --- | --- | --- | --- |
| **Item Name** | **Symbol** | **Kind** | **Item UL** |
| AES3 Audio  Essence  Descriptor | 060e2b34.02530101.0d010101.01014700 |  |  |
| File Descriptor | | | |
| **Item Name** | **Symbol** | **Kind** | **Item UL** |
| Essence  Container | 060e2b34.04010102.0d010301.02060300 |  |  |

**Table D.9 – An Instance of ANC Packets Descriptor**

|  |  |  |  |
| --- | --- | --- | --- |
| **Item Name** | **Symbol** | **Kind** | **Item UL** |
| ANC Data Descriptor | FieldDominance | NODE | urn:smpte:ul:060e2b34.02vv0d01.04010501.08000000 |
| File Descriptor | | | |
| **Item Name** | **Symbol** | **Kind** | **Item UL** |
|  |  |  |  |
| Essence Container | MXFGCGenericANCDataMappingUnifiedPayload | LEAF | urn:smpte:ul: 060e2b34.04010109.0d010301.020e0000 |
| Generic Data Essence Descriptor | | | |
| No Property | | | |
| ANC Data Descriptor | | | |
| No Property | | | |

1. Even Numbers Only [↑](#footnote-ref-1)