SMPTE REGISTERED DISCLOSURE DOCUMENT

MXF Interoperability Specification of Sony MPEG Long GOP Products

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Proponent contact information:

Hiroshi Nakano
Sony Corporation
4-14-1 Asahi-cho, Atsugi
Kanagawa, 243-0014
Japan

Email: hiroshi.nakano@jp.sony.com

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1 Scope

This document specifies the mapping of MPEG-2 Picture (ES), AES3 audio and ANC packets into the MXF Generic Container. The MXF files created according to the details of this specification comply with the MXF specifications defined in the normative references, with a variation with respect to one new rule introduced in SMPTE ST 377-1. In conjunction with the referenced Standards, this RDD is intended to provide sufficient information to enable a developer to construct MXF files that will be compatible with Sony MPEG-2 Long GOP products.

2 Reference Documents

Note: All references in this document to other SMPTE documents use the current numbering style (e.g. SMPTE ST 326:2000) although, during a transitional phase, the document as published (printed or PDF) may bear an older designation (such as SMPTE 326-2000). Documents with the same root number (e.g. 326) and publication year (e.g. 2000) are functionally identical.

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 381-1:2005, Television — Material Exchange Format (MXF) — Mapping MPEG Streams into the MXF 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, Television — SMPTE Labels Structure

SMPTE ST 436:2006, Television — MXF Mappings for VBI Lines and Ancillary Data Packets

SMPTE RP 210, Metadata Element Descriptions

SMPTE RP 224, SMPTE Labels Register

SMPTE RDD 18:2012, Acquisition Metadata Sets for Video Camera Parameters

Recommendation ITU-R BT.709-5 (04/02), Parameter Values for the HDTV Standards for Production and International Programme Exchange

3 Introduction

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 381-1 defines how MPEG streams, as identified by an ISO 13818-1 stream_id value, can be mapped in the MXF Constrained Generic Container. SMPTE ST 382 defines how AES3 and Broadcast Wave 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 mapping of MPEG Picture (ES) compatible with MPEG stream and AES3 audio into the MXF Generic Container. This document also specifies the MXF file format which includes unique identifiers, Operation Pattern, Partitions, Index Table Segments and RIP. The common basic structure is described in this document

4   Outline of MXF File Structure for this Mapping

Figure 1 shows the outline of the MXF file structure. The file consists of a Header Partition, segmented Body partition(s), a Footer Partition and a Random Index pack. Picture, Sound and System Items are mapped into the Essence Container and placed in each Body Partitions. The Data Item is optional. Because of the MPEG Long GOP structure of Picture Item, segmented Index Table is used together with Random Index pack. More detailed explanation can be found in Section 8 (Application Issues).
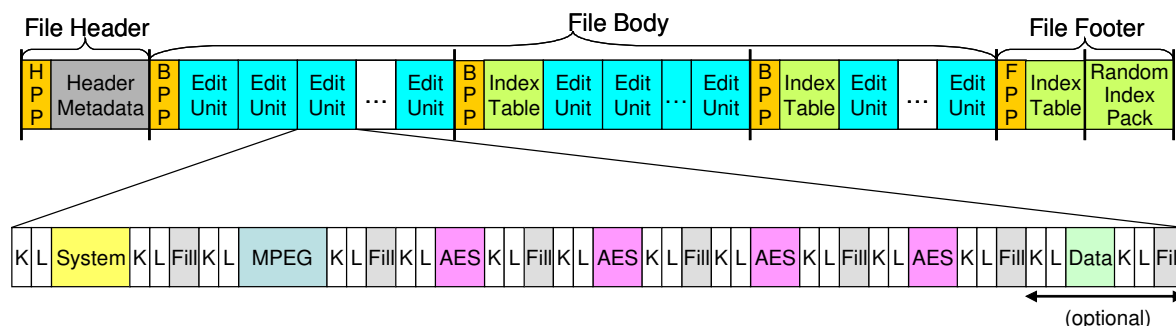
Figure 1 – Outline of MXF File

- **HPP**: Header Partition Pack
- **BPP**: Body Partition Pack
- **FPP**: Footer Partition Pack
- **Fill**[2]: The length of the KLV Fill Item should be required to align to a KAG boundary.

Some of the aspects of this structure 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".
- A list of major constraints for this file structure is given in Table 1.
- Detailed constraints are listed in Annex B.

Note: In Figure 1, the order of Items in the Content Package is System, Picture, Sound and Data Items, as described in other documents (e.g. SMPTE ST 379-1, SMPTE ST 386, SMPTE ST 387, and so on), while SMPTE ST 436 defines Data Item precedes Picture and Sound Items. This Element ordering issue is being discussed in the ST 436:2006 revision group and it is expected to be resolved in its revision.

Table 1 – Constraints for RDD 9 Stream Products

Item	Constraints
Operational Pattern	1a - *Origin* and *Duration*[1] are used to express GOP Pre-Charge and Roll-Out.
Wrapping (Interleaving)	Frame by Frame (coded order)
KAG[2] size	512
System Item	Compliant to ST 326 and ST 385, includes the Frame by Frame Timecode and UMID
Video packetization	Compliant to ST 381-1, MPEG-2 ES

GOP structure	Max 15 frames/GOP (N<=15, M<=3, open GOP / closed GOP) // 1920x1080i
	Max 12 frames/GOP (N<=12, M<=3, open GOP / closed GOP) // 1280x720p
	Variable length GOPs are permitted.

Audio sampling	48 kHz locked
Audio packetization	Compliant to ST 382, AES3, 1ch/Element (min 2 to max 8 channels)
Data Item (optional)	Compliant to ST 436, Optionally used for Ancillary packet
Timecode	System Item and Header Metadata

5 MPEG Picture Data and AES3 Data Mapping

The mapping of MPEG Picture (ES) data is as defined in SMPTE ST 381-1. The mapping of AES3 digital audio data is defined by SMPTE ST 382. This specification uses Frame Wrapping as defined by SMPTE ST 379-1. 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 (where the Data Item is optional).

5.1 Frame Wrappings

This document requires the use of Frame Wrapping as defined by SMPTE ST 379-1, Section 5.4.1.

In the case of audio locked to video at 25 (or 50) content packages per second, each Element will contain the same number of samples, for example 1920 (or 960).

In the case of audio locked to video at 30*1000/1001 content packages per second, the number of samples in each Element will vary to maintain a correct aggregate rate. Typically the number of samples varies according to a 5-frame sequence, 1602, 1601, 1602, 1601, and 1602.

In the case of audio locked to video at 60*1000/1001 content packages per second, the number of samples in each Element will vary to maintain a correct aggregate rate. Typically the number of samples varies according to a 5-frame sequence, 801, 801, 800, 801, and 801.

The number of samples in each content package is calculated from the Length field of the surrounding KLV packet, divided by the value of the BlockAlign Property of the AES3 Audio Essence Descriptor.

In the case of audio locked to video at 24*1000/1001 content packages per second, each Element will contain the same number of samples, for example 2002.

An arrangement of System, Picture, and Sound Items in a Frame Wrapping is shown in Figure 2. It shows the case of 4 channels AES3 audio.

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[1] In legacy RDD 9 files (version 1.2), the duration of the top level file package does not contain the Pre-Charge or Roll-Out as defined in SMPTE ST 378. In RDD 9 files (version 1.3), the duration of the top level file package contains the Pre-Charge but doesn't contain Roll-Out as defined in SMPTE ST 377-1.

[2] Refer to Section 8.1 Application of the KLV Fill Item.