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SMPTE STANDARD

for Television —
Material Exchange Format (MXF) —
Operational pattern 1A
(Single Item, Single Package)

Table of contents

1 Scope

This standard defines operational pattern 1a for the exchange of a MXF file with a single item of a playable essence container comprising either a single essence element or interleaved essence elements. It defines the operating restrictions, structural metadata objects and individual attributes that shall be applied to the MXF file format specification to achieve interoperability when exchanging an MXF file as a single, continuously playable item of audio-visual material.

Operational pattern 1a is intended to meet the requirements of acquisition, storage and interchange applications that are satisfied by a single item of content packaged in a single essence container. Operational pattern 1a does not require, but does allow the use of body partitions.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the edition indicated was 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 standard indicated below.

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

3 Glossary of acronyms, terms and data types

The full glossary of acronyms, terms and data types used in the MXF specification is given in the MXF file format specification. It is not repeated here to avoid any divergence of meaning.

4 Introduction

There are several parts to the MXF specification. This part defines an MXF operational pattern specification. The main part is a normative definition of the MXF file format. One or more normative documents define descriptive metadata schemes as a 'plug-in' to the MXF file format specification. A number of individual normative documents define both the audio-visual essence containers that may be used as the MXF file body and the mappings of the essence components into the essence container. In addition SMPTE EG 41, the MXF Engineering Guideline, provides an introduction and a general engineering description of MXF including the document layering.

In SMPTE EG 41, the concepts of operational patterns and the general conditions for audio-visual material interchange and interoperability are described in outline form. This standard specifies operational pattern 1a which defines a single playable essence container comprising either a single essence element or interleaved essence elements. This essence container may, for example, contain a single clip or a single item of program material. It is the baseline generalized operational pattern and restrictions placed on the use of the MXF file format specification for this operational pattern may have implications on the way in which a particular essence container type and the essence elements that it contains may be implemented.

Each operational pattern is described in a separate document and may be updated independently from other operational patterns. The reader is cautioned to check the following points:

1 Check for the latest version of each operational pattern.

2 Understand that there may be limitations to how the essence container type and the essence elements that it contains may be used in a particular operational pattern.

3 Cross-reference the appropriate documents of the MXF specification before and during implementation.

This standard defines the specific details of the structural header metadata that shall be supported together with agreed combinations of header metadata and essence container template for operational pattern 1a. The structural header metadata allows for the support of descriptive metadata sets as described in the associated normative descriptive metadata standard(s).

This standard also includes a list of any detailed limitations or support issues.

4.1 Using an operational pattern for interchange

To successfully interchange MXF files, an MXF decoder shall be able to parse the structure of any MXF file. A decoder may optionally understand and decode the contents of a specific file. Complete decoding of an MXF file requires a compatible combination of the operational pattern (file structure), the specific essence container(s) and optionally the descriptive metadata scheme that is agreed for interchange use.

The preface set in the header metadata of an MXF file includes the identifier of this operational pattern, zero or more identifiers of descriptive metadata schemes and, in the case of operational pattern 1a, the identifier of the single playable essence container. These identifiers are defined as three metadata items:

1 The operational pattern identifier is defined as a single SMPTE Universal label (UL).

2 The descriptive metadata scheme identifiers are defined as a collection of zero or more SMPTE Universal labels, one label for each descriptive metadata scheme used to provide descriptive metadata in the header metadata.

3 The essence container identifier is defined as a single SMPTE Universal label in the essence containers collection.

NOTES

1 The operational pattern, descriptive metadata and essence container Universal labels should be registered individually in the appropriate SMPTE Registry.

2 The partition pack of each partition carries a copy of the operational pattern Identifier value and the one or more essence container identifier values. Decoders can thus rapidly determine the contents of an MXF file in the first few bytes of the header partition

3 The essence container identifier is defined as a collection of ULs to provide consistency with other Operational patterns. The track descriptions in the header metadata shall correctly reflect the number of essence tracks in the sssence container. Note that multiple audio channels may be contained in a single audio track. Each track is independently editable, whereas multiple audio channels contained within a single track are treated as a single entity.

4.2 Operational pattern overview

Standard MXF operational patterns are defined as a combination of the two dimensions as defined in the MXF file format specification. This operational pattern shall be defined as follows:

4.2.1 Item complexity

Single item: The file contains only one item. There is a single material package SourceClip which has the same duration as the single file package.

4.2.2 Package complexity

Single package: The material package can only access a single file package.

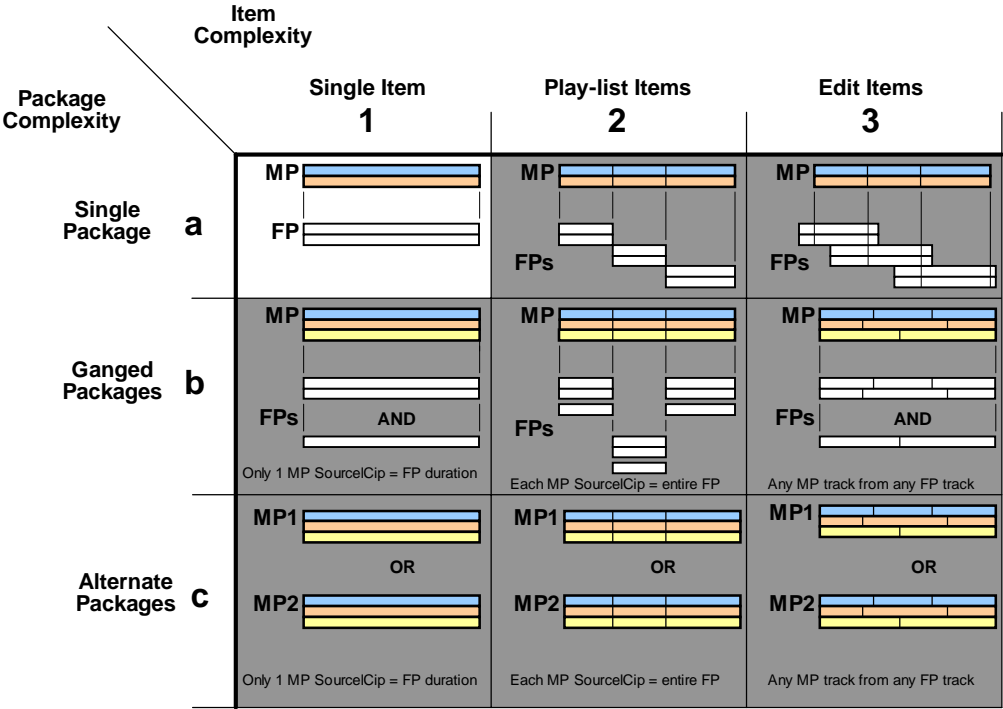These two dimensions are broadly illustrated in informative figure 1.

Figure 1 (informative) – Item and package complexity

This operational pattern defines an MXF file as a single item, single package as illustrated in the top-left box of figure 1. All other generalized operational patterns are a superset of operational pattern 1a.

4.3 Material, file and source package relationships

This operational pattern has a single essence container comprising either a single essence element or interleaved essence elements. The essence container comprises essence stream data that represents a continuous recording as indicated in figure 2.
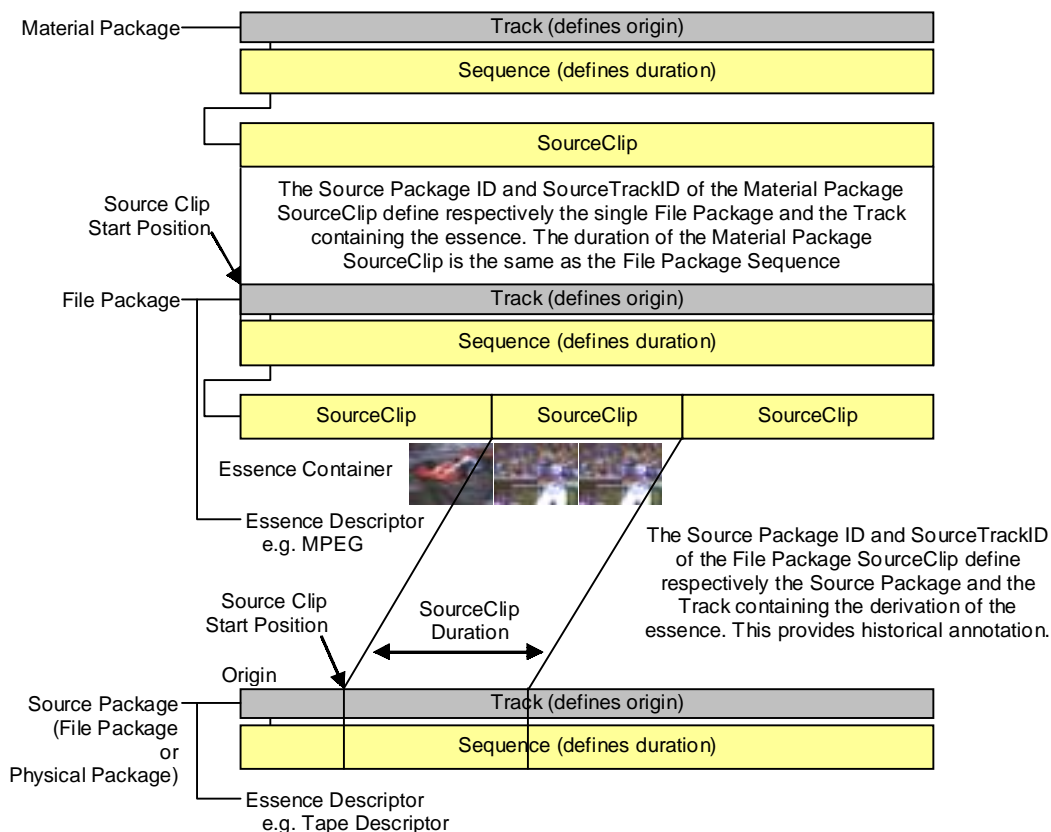
Figure 2 — Outline of operational pattern 1a

5 Application

Operational pattern 1a is the simplest generalized operational pattern and contains the audio-visual item as a single playable essence container. This essence container may, for example, contain a single clip or a single item of program material. The essence container shall provide for the continuous decoding of contiguous essence elements with no processing.

Operational pattern 1a is intended to satisfy the requirements of acquisition, simple storage and simple interchange applications.

The minimum implementation of operational pattern 1a will satisfy the requirement for the definition of a single clip with minimum metadata support.

5.1 Constraints

A list of general constraints for this operational pattern is given in table 1.

Table 1 – General constraints for operational pattern 1a

File Kind	MXF
"Operational pattern"	1a: (Single Item Single Package)
Role	Continuous Recording, exchange of audio-visual material as a single entity.
Essence	Single Essence Container, Operational Pattern Qualifiers apply (see MXF File Format Specification, SMPTE 377M)
Material Packages	1
Number of Material Package SourceClips	1
Top-level File Packages	1
Number of Essence container Types	1
Lower-level Source Packages	0 or more
Partition limits	None
Body Partitions	Decoder required.
Index Tables	Optional
Editing Support	None
Streaming Support	According to Operational Pattern Qualifiers (see section 6.4)

6 Header metadata specification

6.1 General

The structural metadata sets and the normative Universal label used to identify this operational pattern are defined in the MXF file format specification document with specific constraints and additions detailed below.

6.2 Constraints on the MXF packages

1) The material package shall have one SourceClip per track.

2) The file package shall have one track per essence element in the essence container.

3) All tracks / sequences in the material package and file package shall have the same duration.

4) The material package may define a different start time to the file package tracks to allow a change to the initial timecode on playout. The duration of the material package and the duration of the file package shall remain identical.

5) Source packages, where present, shall be used to define the historical context of editing.

6.3 Universal label for operational pattern 1a

The Universal label value to define this operational pattern shall be as defined in table 2.

Table 2 – Value of the MXF operational pattern identification Universal label

Byte No.	Description	Value (hex)
1-12	Defined in the MXF File Format Specification Operational patterns Section	-
13	Operational Pattern: Item Complexity	01h
14	Operational Pattern: Essence container Complexity	01h
15	Operational Pattern: Qualifiers (application dependent)	0xh
16	Reserved for future use	00h

The meanings of the bytes in this label are specified in the operational pattern section of the MXF file format specification. Bytes 13 and 14 uniquely identify this operational pattern specification and byte 15 contains generic qualifiers which are defined in the MXF file format specification.

6.4 Operational pattern qualifiers

This operational pattern shall support the qualifiers as specified in byte 15 of the operational pattern Universal label. Each bit of byte 15 shall be correctly set, as defined by SMPTE 377M, to reflect the status of the essence container.

6.4.1 Essence container location

The essence container should be embedded in the file body for interchange applications.

The essence container may be externally referenced for certain specialized applications. Example applications might include shared-storage networks, archives and other applications where the access to an essence container is localized and the locator value (defined in the locator set in SMPTE 377M) is persistent.

If the essence container is internal to the file, then bit 1 shall be set to zero.

6.4.2 Interleaving of multiple essence tracks

Essence containers used in this operational pattern should be streamable.

If the essence container is streamable, then bit 2 shall be set to zero.

6.4.3 Number of essence tracks

This operational pattern supports a single essence container with one or more essence tracks.

If the essence container has a single essence track, then bit 3 shall be set to zero.

6.5 Minimum implementation

All constraints given in the MXF file format specification shall apply unless specifically overridden or extended in this standard. The minimum implementation of operational pattern 1a has the following limits in reference to the MXF File format specification:

> 1 preface set, 1 or more identification sets, 1 content storage set and 1 essence container data set.

One material package including:

> the sets for the timecode track;
> the sets for each picture track as required by the essence container;
> the sets for each sound track as required by the essence container;
> the sets for each data track as required by the essence container.

One file package including:

> the sets for the timecode track;
> the sets for each picture track as required by the essence container;
> the sets for each sound track as required by the essence container;
> the sets for each data track as required by the essence container.

NOTE – Support for descriptive metadata is optional, but at least one scheme should be included in order to get the best from an MXF file.

The annexes of the MXF format specification give the properties of the sets which should be implemented. All required set properties should be supported by MXF encoders that comply with this operational pattern.

7 MXF file interchange: Essence container issues

7.1 Essence container identification

The value of the essence container Universal label shall be defined by the appropriate essence container specification document. This value shall be recorded in the essence containers property of the preface set and all partition packs and in the essence container property of the appropriate d set.

7.2 Essence container requirements in operational pattern 1a

7.2.1 Number of essence elements

There are no constraints on the number of essence elements in an individual essence container. It is possible that an operational pattern 1a file may contain descriptive metadata only and no essence container. Although not encouraged, it is permitted.

7.2.2 Interleaving of essence elements

For operational pattern 1a, when supporting streaming capability for essence containers containing more than one essence element, the essence elements should be interleaved over a limited duration (typically 1 frame). Each essence element is encoded using KLV coding according to the rules in the essence container specification.

7.2.3 Continuity of essence elements

As stated in section 5, the essence container shall provide for the continuous decoding of contiguous essence elements with no processing. The essence container or essence element specifications may add extra restrictions to this condition.

The essence container tracks are each described by an essence descriptor set which defines the source coding and any compression coding. Each essence descriptor property value, which could otherwise prevent continuous decoding, shall be constant for the duration of the essence track.

7.2.4 Number of essence tracks

The number of picture, sound and data essence tracks are defined by the number of picture, sound and data essence elements in the essence container.

7.2.5 Use of body partitions

Optional for the MXF encoder. Required for the MXF decoder.

NOTE – Files meeting this operational pattern can be created without using body partitions. However, body partitions maybe used to provide certain features needed to satisfy some of the user requirements outlined in the MXF Engineering Guideline.

Annex A (informative)
Bibliography

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

SMPTE 336M-2001, Television — Data Encoding Protocol using Key-Length-Value

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