

SMPTE STANDARD

Interoperable Master Format —
Essence Component



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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.

SMPTE Engineering Documents are drafted in accordance with the rules given in Part XIII of its Administrative Practices.

SMPTE ST 2067-5 was prepared by Technology Committee 35PM.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Standard. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

Introduction

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

The Interoperable Master Format (IMF) is a file-based framework designed to represent one or more high-quality versions of the same finished work destined for distribution channels worldwide. IMF architecture separates composition metadata and essence into separate file objects to promote re-use and efficient operation.

In IMF, essence data (and associated, essence-specific metadata) is stored within MXF Generic Containers contained in MXF files. This document provides a common set of characteristics (a common *formulation*) for these MXF files, termed Essence Components.

1 Scope

This standard defines the IMF Essence Component, an OP1a MXF structure for interchange of audio, picture and data essence. It defines data structures for interchange at the signal interfaces of networks or storage media, but does not define internal storage formats for compliant devices or mappings for particular essence encodings. It also defines metadata expressions used to communicate allowable variations in the formulation of an IMF Essence Component.

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.

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

3 Normative References

Note: All references in this document to other SMPTE documents use the current numbering style (e.g. SMPTE ST 278:2004) although, during a transitional phase, the document as published (printed or PDF) may bear an older designation (such as SMPTE 278M-2004). Documents with the same root number (e.g. 278) and publication year (e.g. 2004) are functionally identical.

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

SMPTE ST 330:2011, Unique Material Identifier (UMID)

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

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, Material Exchange Format (MXF) — MXF Constrained Generic Container

SMPTE ST 380:2004, Television – Material Exchange Format (MXF) — Descriptive Metadata Scheme-1

SMPTE ST 410:2008, Material Exchange Format — Generic Stream Partition

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

4 Overview

The design of IMF Essence Component recognizes that some flexibility is required in the formulation of the MXF to accommodate a range of use cases to which IMF architecture may be applicable. To limit the variety of formulation a decoder must support (and to simplify the description of these variations), this specification includes a *shim* concept that describes the variant aspects of IMF Essence Component using keyword parameters (with constrained values) that can be used to describe a specific formulation. This has the goal that engineers can develop IMF Applications, using IMF Essence Component as a core component, knowing that allowable variations can be defined by the Application. This allows IMF applications to satisfy their respective requirements (by taking advantage of IMF Essence Component's flexibility) while reusing the same core specification and retaining interoperability.

4.1 File Format Requirements (Informative)

IMF Essence Component addresses the problem of having a common essence file format in an architecture that is expected to accommodate many essence encodings.

In an ideal world, a single essence representation would be standardized on. Unfortunately, over time, requirements for a facility change. The facility that started as SD introduces HD. The compression format of today gets replaced with a better one from tomorrow. Stereo audio gets upgraded to multi-channel and multi-lingual. In parallel, a facility operates with a constant pressure to reduce the cost of production, distribution and publishing.

In order to build systems that work at the MXF level rather than, *e.g.*, at the MPEG or JPEG2000 level, IMF Essence Component provides a set of rules that MXF encoders and MXF decoders must follow. This brings many advantages. It allows a device to query the picture size without having to implement a decoder for each essence type — you simply read the MXF metadata. It allows a business process to be specified with an action such as:

If (16:9), then transcode (center-cut-out)

This action can be specified without the executor of process, human or system, needing to know the details of underlying codec type — that is something for the transcoder or reproducer to address. In general, this allows business systems to deliver work order requests to content-manipulation devices, which are in turn configured to support delivery specifications.

4.2 General IMF Essence Component and Shims

To maximize commonality across applications, this specification is divided into general provisions that apply to all applications, and specific constraint sets, called *shims*, that apply to defined applications.

The general provisions shall apply to all IMF Essence Components, and thus represent the maximum required capability of ingest servers, catch servers, playout servers, transcoders and other IMF compatible devices. Within these general provisions however are many potential variants - a shim may be used to identify a particular variant.

A shim is not intended to be a runtime element of a system that processes files as defined by this standard. Rather, it is provided as a defined means of expressing constrained variants of this standard by application designers.

Each shim shall provide a further set of constraints that reduce the range of variability that may be needed in well-defined categories of applications. For example, these categories may address particular type of programming or programming genres, or they may address requirements of particular broadcast station groups.

Documents that reference this standard may extend the shim to address domain-specific variants, but shims shall not be used to add new required capability to the general provisions. They shall be limitations on the general provisions. Thus, the general provisions may be non-restrictive in some areas and this is intentional.

In any given facility design or interchange specification based on IMF Essence Component, there may be one or more tightly defined shims. Typical examples are to have a shim for SD content, a shim for HD content and a shim for web content. Each of these shims tightly defines the codecs and layout for the particular business application.

In this specification, shim parameters will be highlighted as follows:

Shim parameter	Definition
<i>example</i>	Semantic definition of the example shim parameter

5 Essence Component File Parameters and Constraints

5.1 Essence Track Parameters and Constraints

5.1.1 General

IMF Essence Components shall each contain a single MXF essence Track of a single essence type. They shall be subject to the general constraints listed below.

1. Essence in an IMF Essence Component shall be wrapped using the MXF Generic Container (GC), either SMPTE ST 379-1 or SMPTE ST 379-2.
2. An IMF Essence Component shall be a mono-essence MXF file.
3. An IMF Essence Component shall be frame wrapped for picture essence, per the designated GC.
4. An IMF Essence Component shall be clip wrapped for audio essence, per the designated GC.
5. An IMF Essence Component shall be clip wrapped or frame wrapped for data essence, per the designated GC.
6. An IMF Essence Component shall be regularly partitioned when frame wrapped.
7. Each body partition in an IMF Essence Component shall exclusively have metadata, index tables, or essence.
8. An IMF Essence Component shall be signaled as closed and complete in the header or footer partition.
9. An IMF Essence Component shall have distributed and complete index tables.
10. An IMF Essence Component shall be signaled as OP1a, per SMPTE ST 378.
11. An IMF Essence Component should not have a system item.