SMPTE ST 381-3:2017
Revision of
ST 381-3:2013

SMPTE STANDARD

Material Exchange Format—Mapping AVC Streams into the MXF Generic Container

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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 Operations Manual.

SMPTE ST 381-3 was prepared by Technology Committee 31FS.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential for the implementation of this Engineering Document. 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.

1 Scope

This standard specifies the mapping of all AVC coding data as defined in ISO/IEC 14496-10 | Rec. ITU-T H.264 into the Material Exchange Format Generic Container (MXF-GC) based on the MXF MPEG mapping standard (SMPTE ST 381-2).

This standard does not apply to Annexes G (SVC) or H (MVC) of the AVC standard. The mapping of SVC and MVC might be covered by other SMPTE documents. This standard also does not support the AVC file format (ISO/IEC 14496-15).

This document specifies the carriage of parameter sets in an AVC essence stream “In-band”.

The MXF specification is written in several parts. This is an MXF mapping specification that defines header metadata sets and values, essence container elements and index table applications.

In order to achieve interoperability within any given Operational Pattern, restrictions may be placed on the way in which this Generic Container type can be implemented. The reader is advised to carefully study the appropriate Operational Pattern document before implementation.

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 379-1:2009) although, during a transitional phase, the document as published (printed or PDF) may bear an older designation (such as SMPTE 379-1-2009). Documents with the same root number (e.g. 379-1) and publication year (e.g. 2009) are functionally identical.

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were 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 standards indicated below.

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

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

ISO/IEC 13818-1:2015, Information technology – Generic coding of moving pictures and associated audio information: Systems

ISO/IEC 14496-10:2014 | Rec. ITU-T H.264 (2016), Information technology — Coding of audio-visual objects – Part 10: Advanced Video Coding or ITU-T Recommendation H.264 — Advanced Video Coding for Generic Audio-Visual Services

4 Definition of Acronyms, Terms and Data Types

4.1 The general glossary of acronyms, terms and data types used in the MXF specification is given in SMPTE ST 377-1, SMPTE ST 379-1 and SMPTE ST 379-2. Definitions of terms, abbreviations and symbols relating to AVC are given in ISO/IEC 14496-10 | Rec. ITU-T H.264.

4.1.1
AVC
Advanced Video Coding as documented in ISO/IEC 14496-10 I Rec. ITU-T H.264 (also termed MPEG-4 Part 10)

4.1.2
NAL
Network Abstraction Layer

4.2 The following terms are not defined in the AVC specification, but are defined here as properties in the Descriptor and the Index Table Entry. The terms are applicable only to the MXF AVC wrapping defined in this standard.

4.2.1
Picture
a collective term for a frame or a field

4.2.2
I Picture
picture consisting only of I-Slices

4.2.3
non-IDR I Picture
I Picture other than IDR-Picture

4.2.4
P Picture
picture consisting of P-Slices, or P-Slices and I-Slices

4.2.5
B Picture
picture consisting of B-Slices, or B-Slices and P-Slices, or B-Slices, P-Slices and I-Slices

4.2.6
Br Picture
B Picture with nal_ref_idc nonzero. A B Picture that is available as a reference for another Picture

4.2.7
GOP
this term is not defined in the AVC specification, but is widely used in the industry, and is defined for the purposes of this standard: Group of Pictures starting with I Picture in coded order

4.2.8
Key Picture
the earliest preceding I Picture required for decoding the indexed Picture

4.2.9
Parameter sets
sequence parameter sets and picture parameter sets

4.2.10
In-band
parameter sets are carried in an AVC essence stream

5 Technical Introduction (Informative)

5.1 AVC Coding Summary

The AVC (Advanced Video Coding) standard defined in the ISO/IEC 14496-10 | Rec. ITU-T H.264 has been developed as an advanced high performance compression technology. In the AVC coding streams, the bit stream can be in one of two formats: the NAL unit stream or the byte stream.

The NAL unit stream format consists of a sequence of NAL unit syntax structures.

The byte stream format can be constructed from the NAL unit stream by prefixing each NAL unit with a start code prefix and zero or more zero-valued bytes to form a stream of bytes.

5.2 Requirements of Mapping AVC Streams into MXF

The specification on the MXF AVC mapping was developed to meet the following requirements:

- The mapping needs to support the NAL unit stream format and the byte stream format.
- AVC streams need to be wrapped using the MPEG Picture Element Key as defined in SMPTE ST 381-2.
- The Picture Element can contain all variants of AVC coding streams using frame wrapping, clip wrapping, or custom wrapping.
- The mapping needs to support carriage of sequence parameter sets and picture parameter sets “In -band“.
- Full details of the precise AVC stream need to be specified in the Essence Descriptor, and AVC coding variants need to be specified in the Picture Essence Coding Label.
- A Sub-Descriptor needs to be specified to give information on AVC streams.

This document meets the above requirements for the MXF mapping of the AVC streams.

6 Mapping the AVC Streams to the MXF Generic Container

AVC streams shall be mapped using the MXF Generic Container in the Frame-based wrapping, Clip-based wrapping or the Custom wrapping as defined in SMPTE ST 379-1 and SMPTE ST 379-2.

7 Key-Length-Value Coding

7.1 Picture Element Key

AVC streams shall be wrapped using the MPEG Picture Element Key as defined in SMPTE ST 381-2. The values of the first 12 bytes of the Essence Element Key are defined in SMPTE ST 379-1 and SMPTE ST 379-2. The values of the last four bytes of the Picture Element Key are given in Table 1.

Table 1 – Key Value for the MPEG Picture Element (Informative)

Byte No.	Description	Value (hex)	Meaning
1-12	Specified by the MXF Generic Container Specification, SMPTE ST 379-1 and SMPTE ST 379-2		
13	Item Type Identifier	15_h	Generic Container Picture Item (as defined in SMPTE ST 379-1 and SMPTE ST 379-2)
14	Essence Element Count	kk_h	Count of Picture Elements in this Picture Item
15	Essence Element Type	05_h 06_h 07_h	Frame Wrapped Picture Element Clip Wrapped Picture Element Custom Wrapped Picture Element
16	Essence Element Number	nn_h	The Number (used as an Index) of this Picture Element in this Picture Item

7.2 Picture Element Length

The length field of the KLV coded Element shall be 4 bytes BER long-form encoded (i.e. 83h.xx.yy.zz) for Frame wrapping. The length field of the KLV coded Element shall be 8 bytes BER long-form encoded (i.e., 87h.aa.bb.cc.dd.ee.ff.gg) for Clip wrapping. For Custom wrapping, the length field shall be constant for all Edit Units of the essence container and shall be either 4 bytes or 8 bytes as appropriate.