

SMPTE STANDARD

Mapping a VC-2 Stream 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 its Standards Operations Manual.

SMPTE ST 2042-4 was prepared by Technology Committee 31FS.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to 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 document specifies the mapping of VC-2 coded pictures into MXF. Specifically, it defines how to map a VC-2 stream (or part of a stream) into a Picture Element of a MXF generic container.

This standard specifies the Key, Length and Value fields of a VC-2 Picture Element. This standard also defines the Essence Container Label and Picture Essence Compression Label, a VC-2 Sub-Descriptor and the mapping of information from the VC-2 stream to the CDCI Picture Essence Descriptor.

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: 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; then formal languages; then figures; and then any other language forms.

3 Normative References

The following standards contain provisions that, 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 recommended practice 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 2042-1:2012, VC-2 Video Compression

4 Glossary of Acronyms, Terms and Data Types

SMPTE ST 379-x: Throughout this standard, SMPTE ST 379-x refers to both SMPTE ST 379-1 and SMPTE ST 379-2.

The general glossary of acronyms, terms and data types used in the MXF specification is given in SMPTE ST 377-1 and is supplemented in SMPTE ST 379-x. These glossaries are not repeated here to avoid any divergence of meaning. In this document, terms are used as defined by SMPTE ST 377-1 in preference to any definition specific to SMPTE ST 379-1 or SMPTE ST 379-2.

4.1 VC-2 Terms and Notation

Definitions and representations of terms, abbreviations and symbols relating to VC-2 are given in SMPTE ST 2042-1.

Note: For example: `video_parameters[frame_height]` refers to the `frame_height` property of the `video_parameters` map, after the Sequence Header has been parsed. VC-2 defines a process for populating the `video_parameters` map, which involves first initializing the properties to default values that are then overridden if a value for a property appears in the Sequence Header. Therefore the VC-2 properties referenced in this standard will always have values defined.

5 Overview (Informative)

A summary is given below of some of the features of this standard that could be relevant when, for example, testing or deploying an implementation.

- A recommended Operating Mode is defined which places constraints on the wrapped VC-2 stream in order to simplify handling of the content. The use of this Operating Mode is optional.
- Even in the recommended Operating Mode the structure of the wrapped VC-2 stream is only partially constrained. For example: Sequence Headers can be repeated within an Edit Unit; Padding and Auxiliary data units can be included.
- This standard places no restrictions on the video pictures that can be encoded by the wrapped VC-2 stream. For example: no restrictions are placed on the video frame size, frame rate or color specification.
- This standard places no restrictions on the wavelet transform (coding) parameters used in the wrapped VC-2 stream. The values permitted are not restricted by this standard nor does this standard require that any of the wavelet transform parameters remain constant throughout the wrapped VC-2 stream.
- The VC-2 stream can be clip-wrapped or frame-wrapped.
- The size of the Edit Units can be constant throughout or variable.

6 VC-2 Stream Syntax (Informative)

SMPTE ST 2042-1 specifies the compressed stream syntax and reference decoder operations for a video compression system known as VC-2. A VC-2 stream can contain multiple, concatenated VC-2 sequences. The data contained in a VC-2 sequence corresponds to a single video sequence with constant video parameters (but not necessarily constant wavelet transform (coding) parameters). A VC-2 sequence can be extracted from a VC-2 stream and decoded as an independent entity.

The VC-2 sequence structure is illustrated in Figure 1 and is identical to that illustrated in SMPTE ST 2042-1 Figure 10.2. The VC-2 sequence is composed of:

- Parse Info headers: components of the VC-2 stream that provide information on how to parse the stream. They support navigating through the stream without having to decode every frame.
- Data Units: Sequence Header; Picture; Auxiliary; Padding.

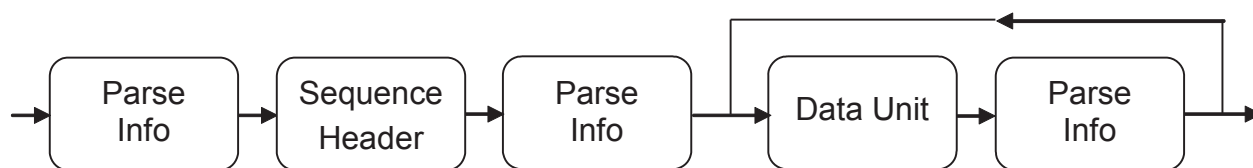


Figure 1 – Illustration of the VC-2 Sequence Structure

7 The Wrapped VC-2 Stream

7.1 Edit Units of the Wrapped VC-2 Stream

When concatenated consecutively the Edit Units shall form a valid and complete VC-2 stream except that:

- The first Parse Info header in the wrapped VC-2 stream need not have a `previous_parse_offset` value of zero.
- An end of sequence Parse Info header need not be present at the end of the wrapped VC-2 stream.

Each Edit Unit shall be a portion, or the entirety, of a single valid VC-2 sequence and shall begin with a Parse Info header, followed by a Sequence Header.

Within an Edit Unit there shall be all of the VC-2 Picture data units for a single video frame and no other VC-2 Picture data units.

7.2 Understanding the Wrapped VC-2 Stream (Informative)

The wrapped VC-2 stream (which is the consecutive concatenation of all of the Edit Units) could contain data from more than one VC-2 sequence. In Operating Mode A (see Section 13) there is exactly one VC-2 sequence for each Edit Unit.

In Operating Mode A the wrapped VC-2 stream will always be a valid and complete VC-2 stream.

If video is VC-2 coded as frames there will be one VC-2 Picture data unit per Edit Unit.

If video is VC-2 coded as fields there will be two VC-2 Picture data units per Edit Unit and the earlier of the two will have an even `picture_number`. This precludes the case of wrapping individual fields described by SMPTE ST 379-x.

In general a VC-2 stream can contain both video coded as frames and video coded as fields. In each VC-2 sequence the method being used is signaled by `picture_coding_mode` in the Sequence Header. In Operating Mode A all of the Sequence Headers must be byte-for-byte identical throughout the entire wrapped VC-2 stream and so in Operating Mode A the video will either be coded as frames throughout or as fields throughout. Even if Operating Mode A is not in use and the Sequence Headers are not identical throughout the wrapped VC-2 stream then the considerations in Section 7.3 mean that the video must be coded as frames throughout or as fields throughout (so that the wrapped VC-2 stream can be accurately described by the Essence Descriptor / Sub-Descriptor).

An Edit Unit could contain additional Sequence Header data units, as well as Auxiliary data units and Padding data units. SMPTE ST 2042-1 requires that all Sequence Headers in a VC-2 sequence are byte-for-byte identical and so all of the Sequence Headers in an Edit Unit will be byte-for-byte identical.

The sizes of the Edit Units can be constant or variable.

7.3 Wrapping a VC-2 Stream Comprised of Multiple VC-2 Sequences (Informative)

If the wrapped VC-2 stream contains multiple VC-2 sequences then the Sequence Headers could be non-identical throughout the wrapped VC-2 stream. Therefore, for example, `video_parameters` could not be fixed throughout the wrapped VC-2 stream. However, Section 11 requires the use of a single CDCI Picture Essence Descriptor and a single VC-2 Sub-Descriptor and these must describe the entire wrapped VC-2 stream accurately. Therefore the amount of permitted variation in the Sequence Headers is limited.

VC-2 properties mapped to mandatory elements of the Essence Descriptor / Sub-Descriptor will have to be fixed throughout the wrapped VC-2 stream. VC-2 properties mapped to optional elements of the Essence Descriptor / Sub-Descriptor can potentially have more than one value across the wrapped VC-2 stream: if this is the case then these optional elements of the Essence Descriptor / Sub-Descriptor will have to be omitted.

In Operating Mode A all Sequence Headers will be identical throughout the wrapped VC-2 stream.

8 KLV Coding of the VC-2 Stream

8.1 Picture Element Key

The value of the Picture Element Key shall be 06.0E.2B.34.01.02.01.01.0D.01.03.01.15.xx.yy.zz where the values of bytes 14 and 16 shall be as defined by SMPTE ST 379-x, and the value of byte 15 shall be as given in Table 1.

Note 1: Byte 14 is a count of the Picture Elements in the Picture Item.

Note 2: Byte 16 is the Essence Element Number (an identifier) of this Picture Element in the Picture Item.