SMPTE OV 2073-0:2023
Revision of SMPTE OV 2073-0:2018

SMPTE OVERVIEW DOCUMENT

VC-5 Video Essence – Document Suite Overview

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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.

Introduction

The SMPTE 2073 document suite defines the syntax and semantics of the VC-5 bitstream. This version of the overview document includes the addition of SMPTE ST 2073-7 Metadata and the revision to the SMPTE RP 2073-2 Conformance Specification for metadata conformance testing.

The VC-5 codec is a variable-bit-rate codec intended for high-quality video acquisition and post-production, and is capable of encoding diverse image and video formats.

The key design goals of the VC-5 codec are:

(1) very high visual quality (visually lossless in most applications),

(2) efficient implementation of both decoders and encoders,

(3) support for any color space or color difference component sampling,

(4) direct encoding of camera sensor output without conversion to a different format, and

(5) adaptability and ease of use in video editing and post-production.

Before encoding, an image unpacking process converts an image into an ordered set of component arrays that are represented in the VC-5 bitstream. A component array is like an image plane and typically contains a single type of color or data with up to 24 bits per component. A VC-5 bitstream can represent thousands of components. The image unpacking process is not specified in the SMPTE 2073 document suite.

The VC-5 codec is not restricted to a particular set of image dimensions, pixel formats, or color standards. Common image formats, including images with RGB and YCbCr color components with an optional alpha channel and subsampled color difference components (for example, YCbCr with 4:2:2 or 4:2:0 sampling), can be represented in a VC-5 bitstream. Color Filter Array (CFA) images, including Bayer pattern images, and non-color data, such as disparity values, can be unpacked into component arrays and encoded into a VC-5 bitstream.

The encoded bitstream represents the ordered set of component arrays such that a decoding process can reconstruct the set of component arrays, except for losses due to compression, in the same order as input to the encoding process.

The decoding process can be followed by an image repacking process that converts the ordered set of component arrays into a packed representation of the image. The image repacking process is not specified in the SMPTE 2073 document suite.

The dependencies between documents in the SMPTE 2073 document suite are illustrated in Figure 1. The arrows indicate the hierarchy of normative references and that a higher numbered part depends on details defined in a lower numbered part.

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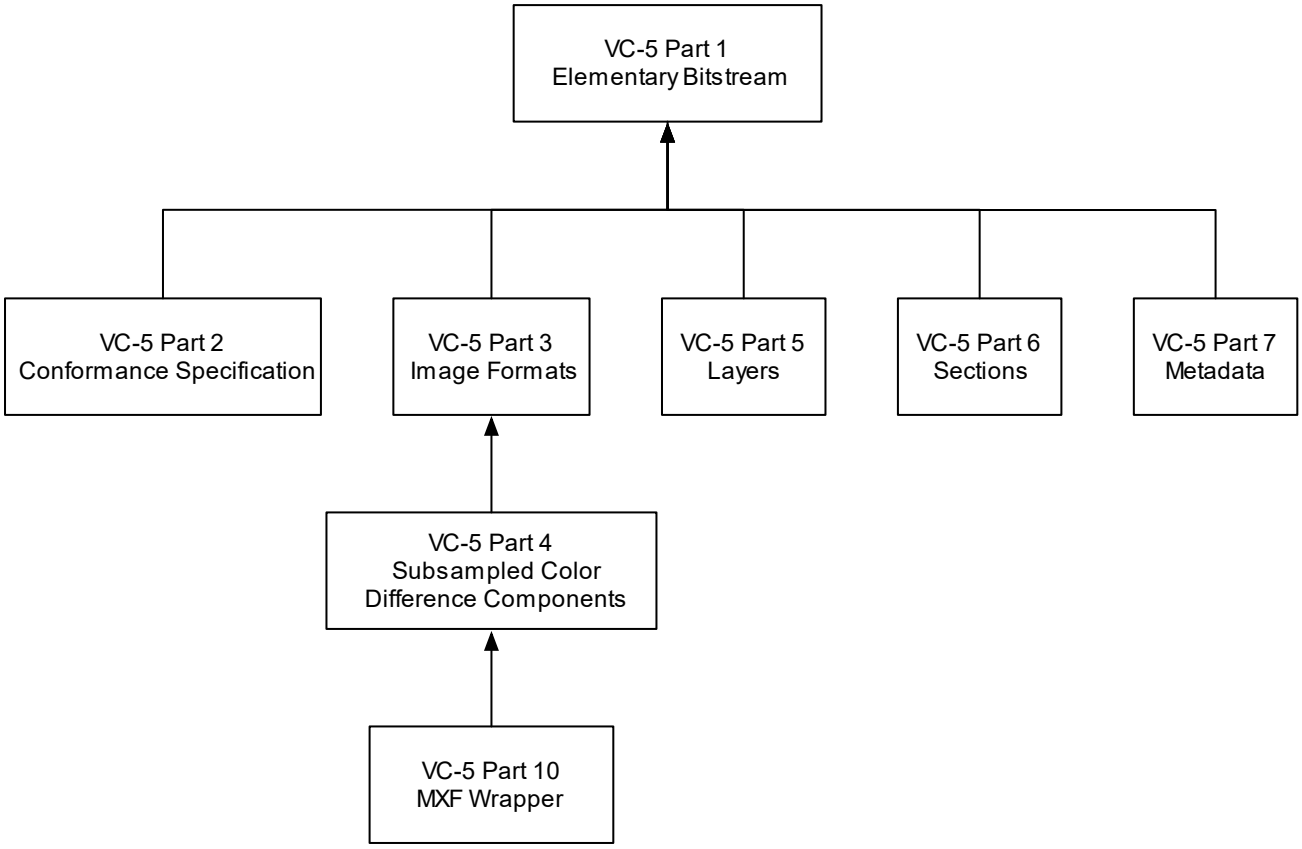

Figure 1 — Dependencies between documents in the SMPTE 2073 document suite.

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1 Scope

This overview describes the documents in the SMPTE 2073 document suite, which defines the syntax and semantics of the VC-5 video essence.

2 The VC-5 Document Suite

2.1 Scope – ST 2073-1:2017 Elementary Bitstream

SMPTE ST 2073-1 defines the compressed representation and decoding process for the VC-5 elementary bitstream. Any image or array of data that can be unpacked into component arrays can be represented by a VC-5 elementary bitstream.

2.2 Scope – RP 2073-2:2022 Conformance Specification

SMPTE RP 2073-2 specifies the criteria and procedures for testing the conformance of encoder and decoder implementations to the VC-5 standard and describes the test materials used for conformance testing. The test materials comprise a reference decoder to test bitstreams for compliance with the VC-5 standard and reference bitstreams to test implementations of a VC-5 decoder for compliance with the VC-5 standard.

The conformance specification and test materials were updated to include conformance testing for VC-5 bitstreams with metadata as specified in SMPTE ST 2073-7 bitstreams.

2.3 Scope – ST 2073-3:2015 Image Formats

The VC-5 elementary bitstream defined in SMPTE ST 2073-1 does not specify the type of components that are represented in the bitstream.

SMPTE ST 2073-3 extends the elementary bitstream syntax with new elements for representing R′G′B′(A) images, Y′C′$_1$C′$_2$(A) images, without color difference component sub-sampling, and Color Filter Array (CFA) images including Bayer image formats.

2.4 Scope – ST 2073-4:2015 Subsampled Color Difference Components

SMPTE ST 2073-4 extends the Y'C'$_1$C'$_2$(A) image format defined in SMPTE ST 2073-3 to include subsampled color difference components, including 4:2:2, 4:2:0, 4:1:1, and 4:1:0 subsampling. An alpha channel is optional and can have the same resolution as the Y′ channel or the same resolution as the C'$_1$ and C'$_2$ channels.

2.5 Scope – ST 2073-5:2015 Layers

SMPTE ST 2073-5 extends the elementary bitstream syntax with new elements to support the representation of multiple images in a single VC-5 bitstream. Each of the individual images is called a layer. All layers present in the bitstream have the same width, height, number of channels, and image format. For example, a stereo pair can be represented as a single image in the bitstream with a layer for the left image and a layer for right image.

2.6 Scope – ST 2073-6:2015 Sections

SMPTE ST 2073-6 extends the elementary bitstream syntax with new elements to support sections that delineate contiguous portions of the bitstream. Sections subdivide the bitstream to enable advanced decoder features such as fast seeking within the bitstream, error detection and correction, multi-resolution decoding, and concurrent decoding.

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2.7 Scope – ST 2073-7:2022 Metadata

SMPTE ST 2073-7 extends the VC-5 standard to specify a method for representing metadata in VC-5 essence as the payload of one or more VC-5 chunk elements. Metadata as defined in this standard can include intrinsic metadata that is specific to the VC-5 standard, extrinsic metadata that is defined in other standards, and dark metadata in a non-standard format. This standard also defines a method for representing streaming (time series) data in a VC-5 bitstream.

Intrinsic metadata defined in this standard includes parameters that describe the image represented by VC-5 essence, including the pixel format, color space, and co-siting of subsampled color difference components.

This document specifies how to represent, in the VC-5 bitstream, extrinsic metadata in the following formats: XMP, DPX, SMPTE ST 377-1 MXF Annex F and G essence descriptors, ACES attributes, ALE, and dynamic metadata color volume transforms.

Dark metadata is represented in the VC-5 bitstream as an opaque block of binary data.

Streaming data is represented using a hierarchical structure of device, stream within device, and data within stream, allowing streaming data to include samples from multiple devices and each device can output one or more streams.

The streaming data representation defined in this standard can be adapted to applications beyond the VC-5 standards suite.

2.8 Scope – ST 2073-10:2017 MXF – Mapping VC-5 Video Essence into the MXF Generic Container

SMPTE ST 2073-10 specifies the mapping of VC-5 image essence as a picture essence track of the MXF generic container in frame-wrapped, clip-wrapped, or custom-wrapped form. The standard includes the KLV coding, essence container label values, and compression label values, and defines the subdescriptors for CDCI and Bayer images.

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