

SMPTE RECOMMENDED PRACTICE

VC-5 Video Essence —
Part 2: Conformance Specification



Table of Contents	Page
Foreword	3
Intellectual Property	3
Introduction.....	3
1 Scope	4
2 Conformance Notation	4
3 Normative References	5
4 Glossary	5
5 Overview (Informative).....	5
6 Description of Materials.....	6
6.1 Source Code.....	6
6.2 Reference Decoder	6
6.3 Sample Encoder	7
6.4 Image Converter	8
6.5 Image Comparer.....	8
6.6 Test Images.....	9
7 File Formats	10
7.1 Image File Formats.....	10
7.2 Unformatted Image Files	12
7.3 Component Array Files.....	12
7.4 DPX Image Files.....	12
7.5 Other Image File Formats	12
8 Conformance Testing (Informative)	12
9 Conformance Specification	14
9.1 Test Materials	14
9.2 Bitstream Conformance.....	15
9.3 Decoder Conformance	15
10 Installing the Test Materials	15
Annex A Reference Bitstreams and Images	17
A.1 Reference Bitstreams	17
A.2 Reference Images.....	17
Annex B Bibliography (Informative)	19

Figures

Figure 1 – Sample array 11

Tables

Table 1 – Reference decoder command-line options..... 6

Table 2 – Sample encoder command-line options. 7

Table 3 – Image converter command-line options. 8

Table 4 – Image comparer command-line options. 9

Table 5 – File formats used by the test materials..... 11

Table 6 – Tcl test script command-line options. 14

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 RP 2073-2 was prepared by Technology Committee 10E.

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.

Introduction

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

VC-5 is a wavelet-based intra-frame codec intended for applications that require fast decoding and encoding with high visual quality. The VC-5 codec is suitable for image capture and post production.

The VC-5 standard consists of SMPTE ST 2073-1 for elementary bitstreams and this document for conformance.

This document describes the test materials and procedures for verifying that a bitstream produced by an implementation of a VC-5 encoder is compliant with SMPTE ST 2073-1 and for verifying that an implementation of a VC-5 decoder is compliant with SMPTE ST 2073-1.

1 Scope

This recommended practice specifies the procedures for testing the conformance of VC-5 encoder and decoder implementations to SMPTE ST 2073-1 and the test materials used for conformance testing.

The test materials used for conformance testing comprise:

1. Reference decoder for testing bitstreams created by implementations of a VC-5 encoder for compliance with SMPTE ST 2073-1 (see Section 6.2);
2. Bitstreams and reference images for testing implementations of a VC-5 decoder for compliance with SMPTE ST 2073-1 (Annex A).

Although not required for conformance testing, the test materials include a sample encoder (Section 6.3), the images used by the sample encoder to create the bitstreams used for conformance testing (Section 6.6), a program for converting between image formats (Section 6.4), and a program for comparing image files (Section 6.5).

The image file formats used by the sample encoder, reference decoder, and utility programs are described in Section 7. Procedures and scripts that can be used for conformance testing are described in Section 8. The criteria for conformance to SMPTE ST 2073-1 are specified in Section 9.

The test materials are described in Section 6. Instructions for installing and building the programs and contact information for submitting bug reports are provided in a separate document included in the test materials distribution.

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

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 2073-1:2014, VC-5 Video Essence — Part 1: Elementary Bitstream

SMPTE VC-5 Test Materials

ISO/IEC 9899:2011, Programming Language — C (C11)

4 Glossary

little-endian

order of bytes that comprise a number with less significant bytes before more significant bytes

5 Overview (Informative)

Section 6 describes the source code and test streams provided as part of this conformance specification, including:

1. Source code for a reference decoder;
2. Source code for a sample encoder;
3. Source code for a program used to convert common image formats into the file format used by the sample encoder and reference decoder;
4. Utility programs and scripts useful for testing VC-5 decoder and encoder implementations.

The bitstream defined in SMPTE ST 2073-1 consists of an ordered set of component arrays. In typical practice, each component array corresponds to an image plane containing color values of the same type. An image unpacking process unpacks an input image into component arrays for input to the encoding process. The image unpacking process is not defined by the SMPTE ST 2073-1 standard. Likewise, a decoding process outputs an ordered set of component arrays that can be packed into an image by an image repacking process that is not defined by the SMPTE ST 2073-1 standard.

The encoding and decoding software provided with the test materials includes image unpacking and repacking code to allow the codec to be tested with common image formats.

A VC-5 bitstream can represent common image formats as well as Color Filter Array (CFA) images such as Bayer, but the specific image formats are out of scope for SMPTE ST 2073-1. The component values represented in a VC-5 bitstream can have up to 24 bits of precision. To accommodate the variety of images that can be encoded into a bitstream that is compliant with SMPTE ST 2073-1, the software provided as part of this conformance specification can use images stored as unformatted binary files (Section 7.2) or an ordered set of component arrays stored as one array per file with the channel number encoded into the pathname (Section 7.3). For convenience, the software also supports the DPX file format (Section 7.4).

The test materials provided for testing the conformance of implementations of SMPTE ST 2073-1 are described in Section 6. The file formats used by the sample encoder and reference decoder are described in Section 7. The mechanism for performing the conformance testing procedures are described in Section 8. Criteria for evaluating the conformance of a VC-5 decoder implementation are specified in Section 9.

6 Description of Materials

6.1 Source Code

The source code for the reference decoder and sample encoder is written in the C programming language.

6.2 Reference Decoder

The reference decoder reads a bitstream that is compliant with SMPTE ST 2073-1 and outputs a single image that is either an unformatted file (Section 7.2), an ordered set of component array files (Section 7.3), or a DPX file with 10-bit packed RGB color values (Section 7.4). The reference decoder includes an implementation of an image repacking process that packs the component arrays output by the decoder into an output image.

To invoke the reference decoder from the command line:

```
decoder [options] bitstream_file image_file
```

Command-line options for the reference decoder are listed in Table 1.

The reference decoder provided with the test materials includes an implementation of an image repacking process to allow the decoder to output packed images. The packed image file formats that are supported by the reference decoder are listed in Table 5. The code for the image repacking process can be modified to support other image formats.

Table 1 – Reference decoder command-line options

Option (Short or Long Format)	Description
-p FileFormat --pixel FileFormat	File format of the image input to the sample encoder to enable the decoder to output an image in the same format as input to the sample encoder (default is the file format of the output image)
-o FileFormat --output FileFormat	File format of the output image (default is the file format corresponding to the filename extension of the output image file)
-w ImageWidth --width ImageWidth	Width of the input image in samples (default is the width obtained from the bitstream)
-h ImageHeight --height ImageHeight	Height of the input image in sample rows (default is the height obtained from the bitstream)
-v --verbose	Enable verbose output during decoding (default is no verbose output)
-h --help	Print the program usage and command-line options (default is not to print the program usage text)