

SMPTE RECOMMENDED PRACTICE

VC-2 Conformance Specification



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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. This SMPTE Engineering Document was prepared by Technology Committee 10E Essence.

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

This revision uses a new suite of conformance testing materials.

Introduction

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

VC-2 is a wavelet-based, intra-frame video compression system aimed at professional applications requiring "mezzanine" compression, i.e. low-complexity, low-latency, visually lossless compression of about 4:1. VC-2 has adopted an open technology approach and, to assist implementors, a conformance test suite has been developed.

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 recommended practice describes how to verify conformance of SMPTE VC-2 bitstreams, decoders and encoders.

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

SMPTE ST 2042-1 VC-2 Video Compression

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply:

3.1. peak signal-to-noise ratio

PSNR

ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation.

Note to entry: "signal" refers specifically to decoded video signal values and not to display linear light levels.

4 Conformance Tools

4.1. List of tools

The conformance tools shall include the items listed in Table 1.

Table 1 — Required conformance tools.

Name	Tool #	Function
bitstream validator	1	verify whether a bitstream is in conformance with SMPTE ST 2042-1
test case generator	2	generate pictures, compliant bitstreams and reference decodings to be used to test VC-2 encoders and decoders
reference decoder	3	decode a bitstream to picture data and metadata using the decoding specification in SMPTE ST 2042-1
picture comparison tool	4	compare pictures (and their metadata)
bitstream viewer	5	decode the syntax of a VC-2 bitstream to a human-readable format

The conformance tools may also include the item listed in Table 2.

Table 2 — Optional conformance tools.

Name	Tool #	Function
picture explanation tool	6	provide an informative explanation of the format of a picture file

4.2. Picture file format

The picture file format used by the conformance tools shall be described in the documentation which accompanies the tools. The format shall include all metadata that can be carried in a VC-2 bitstream, as specified in SMPTE ST 2042-1.

4.3. Verification of the conformance code (informative)

The bitstream validator [tool #1] can be built from the pseudocode functions defined in SMPTE ST 2042-1, augmented with additional checks which enforce conformance. For example, tests can be added to ensure that values read from the bitstream are within permitted ranges and do not conflict. By using the pseudocode in this way, much of the bitstream validator [tool #1] behavior will be correct by definition.

The bitstream validator [tool #1] source code and the ST 2042-1 pseudocode can be compared as part of the conformance software's own automated test suite. This process can use the Abstract Syntax Tree (AST) representations of the two codebases. The AST representation omits insignificant details, such as comments and spacing, but retains semantic structure. The only differences between the ASTs will be the addition of (explicitly annotated) validity checks.

4.4. Example implementation (informative)

Example implementations of the conformance tools listed in Table 1 and Table 2 and associated documentation are available at:

https://github.com/bbc/vc2_conformance

In this implementation, the bitstream validator [tool #1] also functions as the reference decoder [tool #3].

5 Test Procedures

5.1. Bitstream

SMPTE ST 2042-1 fully specifies a VC-2 bitstream. No further conformance provisions are added by this Recommended Practice.

A VC-2 bitstream shall be tested as follows:

- Use the bitstream validator [tool #1] on a file containing the bitstream

The bitstream shall be declared conformant if:

- The bitstream validator [tool #1] detects no errors

5.2. Decoder

SMPTE ST 2042-1 specifies the decoding of a valid VC-2 bitstream. It is only possible to verify conformance of a decoder for specific bitstreams. However, conformance with a variety of test bitstreams (within the stated operational parameters of the decoder) is an indication of likely conformance in general.

A VC-2 decoder shall be tested as follows:

- Use the test case generator [tool #2] to generate compliant bitstreams and reference decodings for the required picture format and coding options
- Decode the bitstreams with the decoder-under-test
- Compare corresponding decoded pictures from the decoder-under-test and from the reference decodings using the picture comparison tool [tool #4]

The decoder shall be declared conformant for these bitstreams if:

- The decoded pictures (and their metadata) from the decoder-under-test and from the reference decoder [tool #3] are identical

The test should be repeated for a variety of picture formats and coding options within the stated operational parameters of the decoder.

5.3. Encoder

SMPTE ST 2042-1 does not specify the operation of an encoder. This Recommended Practice specifies a procedure for testing an encoder but some of the provisions are necessarily subjective. It is only possible to test an encoder for specific input pictures and coding parameters. However, testing under a variety of conditions (within the stated operational parameters of the encoder) can give an indication of likely performance in general.

A VC-2 encoder shall be tested as follows:

- Use the test case generator [tool #2] to produce a set of test pictures for the video formats and encoder options under test
- Use the encoder-under-test to encode the pictures using the indicated coding parameters
- Use the bitstream validator [tool #1] on the resulting bitstream to verify bitstream conformance and produce a reference decoding
- Use the bitstream viewer [tool #5] on the resulting bitstream
- View the decoded picture
- Compare the decoded picture to the input picture using the picture comparison tool [tool #4]

The following conditions should be met:

- No errors are reported during the encoding process
- Bitstream validator [tool #1] reports no errors
- Bitstream viewer [tool #5] indicates that the required coding parameters have been implemented
- Decoded pictures have no unexpected visual artifacts when compared with the input pictures
- Picture comparison tool [tool #4] reports no differences in metadata

Note: If the picture comparison tool [tool #4] reports the difference between input and decoded pictures as PSNR, an implementor can use this for parameter tuning.