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Information technology — JPEG XR image coding system —

Part 5: Reference software

Technologies de l'information — Système de codage d'image JPEG XR —

Partie 5: Logiciel de référence

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 29199-5 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*, in collaboration with ITU-T.

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This part of ISO/IEC 29199 is technically aligned with ITU-T Rec. T.835 but is not published as identical text.

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ISO/IEC 29199 consists of the following parts, under the general title *Information technology — JPEG XR image coding system*:

— *Part 2: Image coding specification*

— *Part 3: Motion JPEG XR*

— *Part 4: Conformance testing*

— *Part 5: Reference software*

The following part is under preparation:

— *Part 1: System architecture* [Technical Report]

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0 Introduction

This part of ISO/IEC 29199 has been developed by ITU-T and ISO/IEC in a collaborative team that is referred to as the Joint Photographic Experts Group (JPEG). It is published as technically-aligned twin text by both organizations (ITU-T and ISO/IEC).

This part of ISO/IEC 29199 provides reference software for ITU-T Rec. T.832 | ISO/IEC 29199-2 (*Information technology – JPEG XR image coding system – Image coding specification*) as an electronic attachment. The reference software is an integral part of this part of ISO/IEC 29199.

Reference software is useful in aiding users of an image coding standard to establish and test conformance and interoperability, and to educate users and demonstrate the capabilities of the associated standard. For these purposes, the accompanying software is provided as an aid for the study and implementation of ITU-T Rec. T.832 | ISO/IEC 29199-2 technology. The reference software includes both encoder and decoder functionality.

0.1 Purpose

The purpose of this part of ISO/IEC 29199 is to provide the following.

- Reference decoder software capable of decoding codestreams (or files) that conform to ITU-T Rec. T.832 | ISO/IEC 29199-2 in a manner that conforms to the decoding process specified in ITU-T Rec. T.832 | ISO/IEC 29199-2.
- Sample encoder software capable of producing codestreams (or files) that conform to ITU-T Rec. T.832 | ISO/IEC 29199-2.

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The use of this reference software is not required for making an implementation of an encoder or decoder in conformance to ITU-T Rec. T.832 | ISO/IEC 29199-2. Requirements established in ITU-T Rec. T.832 | ISO/IEC 29199-2 take precedence over the behaviour of the reference software.

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0.2 Examples of use

Some examples of uses for the reference decoder software are as follows:

- As an illustration of how to perform the decoding process specified in ITU-T Rec. T.832 | ISO/IEC 29199-2.
- As the starting basis for the implementation of a decoder that conforms to ITU-T Rec. T.832 | ISO/IEC 29199-2.
- For testing the conformance of a decoder implementation with the decoding process specified in ITU-T Rec. T.832 | ISO/IEC 29199-2 (as the values of the samples in all decoded pictures will be identical from all conforming decoder implementations that support the profile and level used in a codestream that conforms to ITU-T Rec. T.832 | ISO/IEC 29199-2, with limited allowances for color sampling format conversions as specified in ITU-T Rec. T.832 | ISO/IEC 29199-2).
- For (non-exhaustive) testing of the conformance of a codestream (or file) to the constraints specified for codestream (or file) conformance in ITU-T Rec. T.832 | ISO/IEC 29199-2, as the software can detect and report many codestream conformance violations.

  NOTE 1 – However, the lack of the detection of any conformance violation by the reference decoder software should not be considered as definitive proof that the codestream (or file) conforms to all constraints specified for conformance in ITU-T Rec. T.832 | ISO/IEC 29199-2.

Some examples of uses for the sample encoder software are as follows:

- As an illustration of how to perform an encoding process that produces codestreams (or files) that conform to the constraints specified for codestream (or file) conformance in ITU-T Rec. T.832 | ISO/IEC 29199-2.
- As the starting basis for the implementation of an encoder that conforms to ITU-T Rec. T.832 | ISO/IEC 29199-2.
- As a means of generating codestreams (or files) for testing the conformance of a decoder implementation with the decoding process specified in ITU-T Rec. T.832 | ISO/IEC 29199-2.

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- As a means of demonstrating and evaluating examples of the quality that can be achieved by an encoding process that conforms to ITU-T Rec. T.832 | ISO/IEC 29199-2.

  NOTE 2 – However, no guarantee of the quality that will be achieved by an encoder is provided by its conformance to ITU-T Rec. T.832 | ISO/IEC 29199-2, as the conformance of an encoder to ITU-T Rec. T.832 | ISO/IEC 29199-2 is defined only in terms of specified constraints imposed on the syntax of the output of the encoder. In particular, while the sample encoder software may suffice to provide some illustrative examples of what quality can be achieved in conformance to ITU-T Rec. T.832 | ISO/IEC 29199-2, it provides neither an assurance of minimum guaranteed image encoding quality nor maximum achievable image encoding quality.

  NOTE 3 – Similarly, the computational resource characteristics (in terms of program or data memory usage, processing speed, types and characteristics of computational operations, etc.) of the sample software encoder or decoder should not be construed as representative of the typical, minimum or maximum computational resource characteristics to be exhibited by implementations of ITU-T Rec. T.832 | ISO/IEC 29199-2.

0.3 Warranty disclaimer

Regardless of any and all statements made herein or elsewhere regarding the possible uses of the reference software, the following disclaimers of warranty apply to the provided reference software.

- ITU, ISO, and IEC disclaim any and all warranties, whether express, implied, or statutory, including any implied warranties of merchantability or of fitness for a particular purpose.
- In no event shall the contributor(s) or ITU, ISO, or IEC be liable for any incidental, punitive, or consequential damages of any kind whatsoever arising from the use of these programs.
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Information technology — JPEG XR image coding system —

Part 5: Reference software

1 Scope

This part of ISO/IEC 29199 provides reference software for ITU-T Rec. T.832 | ISO/IEC 29199-2 (*Information technology – JPEG XR image coding system – Image coding specification*) as an electronic attachment. The reference software is an integral part of this part of ISO/IEC 29199.

The purpose of this part of ISO/IEC 29199 is to provide the following.

— Reference decoder software capable of decoding codestreams (or files) that conform to ITU-T Rec. T.832 | ISO/IEC 29199-2 in a manner that conforms to the decoding process specified in ITU-T Rec. T.832 | ISO/IEC 29199-2.

— Sample encoder software capable of producing codestreams (or files) that conform to ITU-T Rec. T.832 | ISO/IEC 29199-2.

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The use of this reference software is not required for making an implementation of an encoder or decoder in conformance to ITU-T Rec. T.832 | ISO/IEC 29199-2, and conforming implementations of ITU-T Rec. T.832 | ISO/IEC 29199-2 are not expected to follow the algorithms or programming techniques used therein. Conformance requirements established in ITU-T Rec. T.832 | ISO/IEC 29199-2 take precedence over the behaviour of the reference software.

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2 Normative references

The following referenced documents are indispensable for the application 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.

ITU-T Rec. T.832 | ISO/IEC 29199-2, *Information technology — JPEG XR image coding system — Image coding specification*

3 Terms and definitions

For the purposes of this document, the terms, definitions and symbols given in ITU-T Rec. T.832 | ISO/IEC 29199-2 and the following apply.

3.1
codestream
sequence of bits contained in a sequence of bytes that conforms to the codestream requirements specified by ITU-T Rec. T.832 | ISO/IEC 29199-2 or is to be tested to determine whether it conforms to the codestream requirements specified by ITU-T Rec. T.832 | ISO/IEC 29199-2

3.2
decoder
embodiment of the decoding process specified by ITU-T Rec. T.832 | ISO/IEC 29199-2 or a process embodiment that is to be tested to determine whether it conforms to the decoding process specified by ITU-T Rec. T.832 | ISO/IEC 29199

NOTE The decoder does not include the display process, which is outside the scope of this part of ISO/IEC 29199.

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3.3
encoder
process that produces **codestreams** or **files** that conform to ITU-T Rec. T.832 | ISO/IEC 29199-2 or are to be tested to determine whether these **codestreams** or **files** conform to ITU-T Rec. T.832 | ISO/IEC 29199-2

3.4
file
⟨ITU-T Rec. T.832 | ISO/IEC 29199-2:2009, Annex A⟩ finite-length sequence of bytes produced by an **encoder** that conforms to ITU-T Rec. T.832 | ISO/IEC 29199-2:2009, Annex A or is to be tested to determine whether it conforms to ITU-T Rec. T.832 | ISO/IEC 29199-2:2009, Annex A

3.5
output formatting
⟨ITU-T Rec. T.832 | ISO/IEC 29199-2:2009, 9.10⟩ processes of formatting the output of the sample reconstruction process of the **decoder**

3.6
raw file
file used to store the resulting image buffers after the **output formatting** process

NOTE The raw file is described in detail in 6.2.4.

3.7
reference software decoder
decoder software provided as an electronic attachment to this part of ISO/IEC 29199

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3.8
sample software encoder
encoder software provided as an electronic attachment to this part of ISO/IEC 29199

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4 Abbreviations

For the purposes of this document, the abbreviations given in ITU-T Rec. T.832 | ISO/IEC 29199-2 apply.

5 Conventions

For the purposes of this document, the conventions given in ITU-T Rec. T.832 | ISO/IEC 29199-2 apply.

6 Reference software

6.1 General

The reference software for ITU-T Rec. T.832 | ISO/IEC 29199-2 is provided as an electronic attachment to this part of ISO/IEC 29199, and is an integral part thereof.

6.2 Structure and use of the software

This subclause is not an integral part of this part of ISO/IEC 29199.

The reference software is written in the C programming language.

The "jpegxr" program is an example program that performs encoding or decoding, and uses data structures defined in the "jxr_priv.h" header file.

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6.2.1 Use of the reference decoder

USAGE

jpegxr <flags> <input-file>

SUPPORTED OPTIONS

-o <path>

When this flag is present, it specifies an output file destination pathname. This is the pathname of the output decoded image data file.

Default: out.raw

-w

When this flag is present, the program will test the conditions that necessitate the syntax element LONG_WORD_FLAG to be equal to TRUE, and the decoding function will return an error message if the encoded value of LONG_WORD_FLAG is equal to FALSE and the associated constraints are violated. The input file will still be decoded regardless of the actual encoded value of the LONG_WORD_FLAG.

-P [44 | 55 | 66 | 111]

When this flag is present, the program will only decode codestreams conforming to the specified profile value.

Default: 111

NOTE 1 – The profile value and its interpretation are defined in ITU-T Rec. T.832 | ISO/IEC 29199-2 Annex B.

-L [4 | 8 | 16 | 32 | 64 | 128 | 255]

When this flag is present, the program will only decode codestreams conforming to the specified level value.

Default: 255

NOTE 2 – The level value and its interpretation are defined in ITU-T Rec. T.832 | ISO/IEC 29199-2 Annex B.

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6.2.2 Use of the sample encoder

USAGE

jpegxr -c <flags> <input-file>

SUPPORTED OPTIONS

-c

When this flag is present, the program performs encoding. This flag is necessary to enable encoding.

-o <path>

When this flag is present, it specifies an output file destination pathname. When encoding (-c) this is the pathname of the encoded output file; otherwise, this is the pathname of the output decoded image data file.

Default: out.jxr

-b [ALL | NOFLEXBITS | NOHIGHPASS | DCONLY]

When this flag is present, it selects the subbands to encode (using terminology specified in ITU-T Rec. T.832 | ISO/IEC 29199-2).

Default: ALL

-a [0 | 1| 2]

When this flag is present, it selects the alpha encoder mode. The value 0 corresponds to no alpha image plane being encoded. The value 1 corresponds to encoding with an interleaved alpha image plane. The value 2 corresponds to encoding with a separate alpha plane.

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