
**Information technology — Scalable
compression and coding of
continuous-tone still images —**

**Part 9:
Alpha channel coding**

*Technologies de l'information — Compression échelonnée et codage
d'images plates en ton continu*

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/IEC JTC 1, *Information technology, SC29, Coding of audio, picture, multimedia and hypermedia information*.

A list of all parts in the ISO 18477- series, published under the general title *Information technology — Scalable compression and coding of continuous-tone still images*, can be found on the ISO website.

Introduction

This document specifies an extension for ISO/IEC 18477-3 compliant files that adds capabilities for lossy or lossless storage of continuous or binary opacity information associated to the image; such additional channels are commonly known as alpha channels. These channels are used for compositing the image content with other content on the same physical media. An alpha value of 0 encodes maximal transparency (and no opacity), while the maximal sample value represents maximal opacity (and no transparency). Additionally, the image content itself may be *premultiplied* with the alpha value or *premultiplied and shaded with a background colour M*, a process by which the original image A is replaced by the image A' defined as

$$A' = \alpha * A \quad \text{for pre-multiplication}$$

$$A' = \alpha * A + (1 - \alpha) * M \quad \text{for pre-multiplication and shading}$$

And A' is encoded instead of A in the JPEG XT codestream. Reconstruction is then performed as follows: If A denotes the sample value of the image contained in the ISO/IEC 18477-3 file at a specific spatial location, B is the sample value of the background on which the image should be rendered, M is the matte colour and α is the decoded value of the alpha channel, then the sample value of the image C composed from A and B on the same position is given by:

$$C = \alpha * A + (1 - \alpha) * B \quad \text{for non-premultiplied content;}$$

$$C = A + (1 - \alpha) * B \quad \text{for premultiplied content;}$$

$$C = A + (1 - \alpha) * (B - M) \quad \text{for premultiplied content with shade removal.}$$

Encoding a *premultiplied* and shaded version of A' with colour M enables legacy decoders that lack alpha channel support to still decode and display the image with the appearance that it is composited on a background with colour M. At the same time, new JPEG XT compliant decoders can composite the image on any background by calculating image C from A, B and M.

This document provides facilities to encode the value of α for each spatial location, with or without loss, either as a binary decision, i.e. $\alpha = 0$ or $\alpha = 1$, on a continuous scale of integers with a resolution between 8 and 16 bits, or as floating point number between 0 and 1 with 16-bit precision. It uses coding technology from other parts of the ISO/IEC 18477 family of standards for its encoding, and no new technology besides that already defined in other parts is required for the reconstruction of the opacity information.

This document can be freely combined with other parts of the ISO/IEC 18477 family, i.e. the sample values A in the above formulae might be either 8-bit unsigned integers, i.e. represented by ISO/IEC 18477-1, up to 16-bit integers using the encoding of ISO/IEC 18477-6 or floating point values encoded by ISO/IEC 18477-7. The image content A may also be encoded without loss, using ISO/IEC 18477-8. However, the compositing step itself to create the final output image C from the input images A and B is not standardized.

The syntax of the codestream defined in this document is fully backward compatible to Rec. ITU-T T.81 | ISO/IEC 10918-1 and the ISO/IEC 18477 family of standards. Decoders unaware of the extensions defined here will reconstruct a fully opaque version of the image and discard the alpha channel content.

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Information technology — Scalable compression and coding of continuous-tone still images —

Part 9: Alpha channel coding

1 Scope

This document specifies a coding format, referred to as JPEG XT, which is designed primarily for continuous-tone photographic content.

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.

ISO/IEC 18477-1, *Information technology — Scalable compression and coding of continuous-tone still images — Part 1: Scalable compression and coding of continuous-tone still images*

ISO/IEC 18477-3:2015, *Information technology — Scalable compression and coding of continuous-tone still images — Part 3: Box file format*

ISO/IEC 18477-6:2016, *Information technology — Scalable compression and coding of continuous-tone still images — Part 6: IDR Integer Coding*

ISO/IEC 18477-7:2016, *Information technology — Scalable compression and coding of continuous-tone still images — Part 7: HDR Floating-Point Coding*

ISO/IEC 18477-8:2016, *Information Technology: Scalable compression and coding of continuous-tone still images — Lossless and near-lossless coding*

ITU-T T.81 | ISO/IEC 10918-1, *Information technology – Digital compression and coding of continuous-tone still images: Requirements and guidelines*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1.1

ASCII encoding

encoding of text characters and text strings according to ISO/IEC 10646

3.1.2

base decoding path

process of decoding legacy codestream and refinement data to the base image, jointly with all further steps until residual data is added to the values obtained from the residual codestream

3.1.3

base image

collection of sample values obtained by entropy decoding the DCT coefficients of the legacy codestream and the refinement codestream, and inversely DCT transforming them jointly

3.1.4

alpha channel

additional scalar image channel that encodes the opacity of each sample in the main image

3.1.5

alpha component

synonym for alpha channel

3.1.6

binary decision

choice between two alternatives

3.1.7

block

8×8 array of samples or an 8×8 array of DCT coefficient values of one component

3.1.8

box

structured collection of data describing the image or the image decoding process embedded into one or multiple APP₁₁ marker segments

Note 1 to entry: See ISO/IEC 18477-3:2015, Annex B for the definition of boxes.

3.1.9

byte

group of 8 bits

3.1.10

coder

embodiment of a coding process

3.1.11

coding

encoding or decoding

3.1.12

coding process

general reference to an encoding process, a decoding process, or both

3.1.13

compression

reduction in the number of bits used to represent source image data

3.1.14

component

two-dimensional array of samples having the same designation in the output or display device

Note 1 to entry: An image typically consists of several components, e.g. red, green and blue.

3.1.15**composition**

process of merging the decoded image data with background image data using opacity information and generating one single final output image

3.1.16**continuous-tone image**

image whose components have more than one bit per sample

3.1.17**decoder**

embodiment of a decoding process

3.1.18**decoding process**

process which takes as its input compressed image data and outputs a continuous-tone image

3.1.19**encoder**

embodiment of an encoding process

3.1.20**encoding process**

process which takes as its input a continuous-tone image and outputs compressed image data

3.1.21**entropy decoder**

embodiment of an entropy decoding procedure

3.1.22**entropy decoding**

lossless procedure which recovers the sequence of symbols from the sequence of bits produced by the entropy encoder

3.1.23**entropy encoder**

embodiment of an entropy encoding procedure

3.1.24**entropy encoding**

lossless procedure which converts a sequence of input symbols into a sequence of bits such that the average number of bits per symbol approaches the entropy of the input symbols

3.1.25**fixed point discrete cosine transformation****fixed point DCT**

implementation of the discrete cosine transformation based on fixed point arithmetic following the specifications in ISO/IEC 18477-8:2016, Annex E

3.1.26**high dynamic range****HDR**

image or image data comprised of more than eight bits per sample

3.1.27**integer based discrete cosine transformation****integer point DCT**

transformation of an 8×8 sample block from the spatial domain to the frequency domain using the integer approximation of the discrete cosine transformation as specified in ISO/IEC 18477-8:2016, Annex E