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

Part 1: Scalable compression and coding of continuous-tone still images

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

Partie 1: Codage des images à gamme dynamique élevée

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Contents

Page

Foreword

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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).

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, SC 29, *Coding of audio, picture, multimedia and hypermedia information.*

ISO/IEC 18477 consists of the following parts, under the general title: *JPEG HDR image coding system:*

— *Part 1: Coding of high dynamic range images*

— *Part 2: Extensions for high dynamic range images*

— *Part 3: Box file format*

— *Part 6: IDR Integer Coding*

— *Part 7: HDR Floating-Point Coding*

The following parts are under preparation:

— *Part 4: Conformance testing*

— *Part 5: Reference software*

— *Part 8: Coding of high dynamic range images*

— *Part 9: Encoding of alpha channels*

Introduction

This part of ISO/IEC 18477 specifies a coded codestream format for storage of continuous-tone photographic content. JPEG XT is a scalable image coding system that builds on top of the legacy Rec. ITU-T T.81 | ISO/IEC 10918-1 coding system, also known as JPEG, but extends it in a backwards compatible way. This part of ISO/IEC 18477 specifies the commonly deployed components of the JPEG coding system. Additional parts of ISO/IEC 18477 will extend on this baseline.

JPEG XT has been designed to be backwards compatible to legacy applications while at the same time having a small coding complexity; JPEG XT uses, whenever possible, functional blocks of Rec. ITU-T T.81 | ISO/IEC 10918-1, Rec. ITU-T T.86 | ISO/IEC 10918-4 and Rec. ITU-T T.871 | ISO/IEC 10918-5 to extend the functionality of the legacy JPEG Coding System. It is optimized for good image quality and compression efficiency while also enabling low-complexity encoding and decoding implementations.

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

Part 1:
Scalable compression and coding of continuous-tone still images

1 Scope

This part of ISO/IEC 18477 specifies a coding format, referred to as JPEG XT, which is designed primarily for continuous-tone photographic content.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 10918-1, *Information technology — Digital compression and coding of continuous-tone still images — Requirements and guidelines*

ISO/IEC 10918-4, *Information technology — Digital compression and coding of continuous-tone still images: Registration of JPEG profiles, SPIFF profiles, SPIFF tags, SPIFF colour spaces, APPn markers, SPIFF compression types, and Registration Authorities (REGAUT)*

ISO/IEC 10918-5, *Information technology — Digital compression and coding of continuous-tone still images: JPEG File Interchange Format (JFIF)*

3 Terms and definitions

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

3.1
bit stream
partially encoded or decoded sequence of bits comprising an entropy-coded segment

3.2
block
8 × 8 array of samples or an 8 × 8 array of DCT coefficient values of one component

3.3
byte
group of 8 bits

3.4
coder
embodiment of a coding process

3.5
coding
encoding or decoding

3.6
compression
reduction in the number of bits used to represent source image data

3.7
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.

3.8
continuous-tone image
image whose components have more than one bit per sample

3.9
discrete cosine transform
DCT
either the forward discrete cosine transform or the inverse discrete cosine transform

3.10
downsampling
procedure by which the spatial resolution of a component is reduced

3.11
entropy-coded (data) segment
independently decodable sequence of entropy encoded bytes of compressed image data

3.12
entropy decoder
embodiment of an entropy decoding procedure

3.13
entropy decoding
lossless procedure which recovers the sequence of symbols from the sequence of bits produced by the entropy encoder

3.14
entropy encoder
embodiment of an entropy encoding procedure

3.15
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

3.16
grayscale image
continuous-tone image that has only one component

3.17
joint photographic experts group
JPEG
informal name of the committee which created this International Standard

Note 1 to entry: The “joint” comes from the ITU-T and ISO/IEC collaboration.

3.18
legacy decoder
embodiment of a decoding process conforming to Rec. ITU-T T.81 | ISO/IEC 10918-1 operating in baseline, sequential or progressive mode with a sample resolution of eight bits

3.19
marker
two-byte code in which the first byte is hexadecimal FF and the second byte is a value between 1 and hexadecimal FE

3.20
marker segment
marker and associated set of parameters

3.21
pixel
collection of sample values in the spatial image domain having all the same sample coordinates

Note 1 to entry: A pixel may consist of three samples describing its red, green and blue value.

3.22
precision
number of bits allocated to a particular sample or DCT coefficient

3.23
procedure
set of steps which accomplishes one of the tasks which comprise an encoding or decoding process

3.24
quantization value
integer value used in the quantization procedure

3.25
quantize
act of performing the quantization procedure for a DCT coefficient

3.26
sample
one element in the two-dimensional array which comprises a component

3.27
sample grid
common coordinate system for all samples of an image with the samples at the top left edge of the image having the coordinates (0, 0), the first coordinate increases towards the right, the second to the bottom

3.28
scan
single pass through the data for one or more of the components in an image

3.29
scan header
marker segment that contains a start-of-scan marker and associated scan parameters that are coded at the beginning of a scan

3.30
upsampling
procedure by which the spatial resolution of a component is increased

3.31
vertical sampling factor
relative number of vertical data units of a particular component with respect to the number of vertical data units in the other components in the frame

4 Symbols and abbreviated terms

4.1 Symbols

X	width of the sample grid in positions
Y	height of the sample grid in positions
Nf	number of components in an image
$s_{i,x}$	subsampling factor of component i in horizontal direction
$s_{i,y}$	subsampling factor of component i in vertical direction
H_i	subsampling indicator of component i in the frame header
V_i	subsampling indicator of component i in the frame header
$v_{x,y}$	sample value at the sample grid position x, y

4.2 Abbreviated terms

ASCII	American Standard Code for Information Interchange
DC	Lowpass
AC	Highpass
LSB	Least Significant Bit
MSB	Most Significant Bit
DCT	Discrete Cosine Transformation

5 Conventions

5.1 Conformance language

The keyword “reserved” indicates a provision that is not specified at this time, shall not be used, and may be specified in the future. The keyword “forbidden” indicates “reserved” and in addition indicates that the provision will never be specified in the future.

5.2 Operators

NOTE Many of the operators used in this part of ISO/IEC 18477 are similar to those used in the C programming language.

5.2.1 Arithmetic operators

+	Addition
–	Subtraction (as a binary operator) or negation (as a unary prefix operator)
×	Multiplication
/	Division without truncation or rounding

5.2.2 Assignment operators

= Assignment operator

5.2.3 Precedence order of operators

Operators are listed below in descending order of precedence. If several operators appear in the same line, they have equal precedence. When several operators of equal precedence appear at the same level in an expression, evaluation proceeds according to the associativity of the operator either from right to left or from left to right.

Operators	Type of operation	Associativity
(), [ ], .	Expression	Left to Right
–	Unary negation	
×, /	Multiplication	Left to Right
+, –	Addition and Subtraction	Left to Right
< , >, <=, >=	Relational	Left to Right

5.2.4 Mathematical functions

$\lceil x \rceil$ Ceiling of x. Returns the smallest integer that is greater than or equal to x.

$\lfloor x \rfloor$ Floor of x. Returns the largest integer that is lesser than or equal to x.

|x| Absolute value, is –x for x < 0, otherwise x.

sign(x) Sign of x, zero if x is zero, +1 if x is positive, –1 if x is negative.

clamp(x, min, max) Clamps x to the range [min, max]: returns min if x < min, max if x > max or otherwise x.

6 General

6.1 General definitions

The purpose of this clause is to give an informative overview of the elements specified in this part of ISO/IEC 18477. Another purpose is to introduce many of the terms which are defined in Clause 3. These terms are printed in *italics* upon first usage in this clause.

There are three elements specified in this part of ISO/IEC 18477:

a) An *encoder* is an embodiment of an *encoding process*. An encoder takes as input *digital source image data* and *encoder specifications*, and by means of a specified set of *procedures* generates as output *a codestream*.

b) A *decoder* is an embodiment of a *decoding process*. A decoder takes as input a codestream, and by means of a specified set of procedures generates as output *digital reconstructed image data*.

c) The *codestream* is a compressed image data representation which includes all necessary data to allow a (full or approximate) reconstruction of the sample values of a digital image. Additional data might be required that define the interpretation of the sample data, such as the spatial dimensions of the samples.