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

### Part 1: Core coding system specification

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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.

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](http://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](http://www.iso.org/patents)) or the IEC list of patent declarations received (see <http://patents.iec.ch>).

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

For an explanation of the voluntary nature of standards, 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 [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

This second edition cancels and replaces the first edition (ISO/IEC 18477-1:2015), which has been technically revised.

The main changes compared to the previous edition are as follows:

- Annex A.3 has been revised to adopt centred upsampling by default;
- minor editorial changes throughout.

A list of all parts in the ISO/IEC 18477 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

This document specifies a coded codestream format for storage of continuous-tone photographic content. JPEG XT is a scalable image coding system that builds on 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 document specifies the commonly deployed components of the JPEG coding system. Additional parts of the ISO/IEC 18477 series 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.

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

## Part 1: Core coding system specification

### 1 Scope

This document specifies a coding format, referred to as JPEG XT, which is designed primarily for continuous-tone photographic content. This document defines the core coding system, which forms the basis for the entire ISO/IEC 18477 series.

### 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.

Rec. ITU-T T.81 | ISO/IEC 10918-1:1994, *Information technology — Digital compression and coding of continuous-tone still images — Part 1: Requirements and guidelines*

Rec. ITU-T T.86 | ISO/IEC 10918-4, *Information technology — Digital compression and coding of continuous-tone still images — Part 4: Registration of JPEG profiles, SPIFF profiles, SPIFF tags, SPIFF colour spaces, APPn markers, SPIFF compression types and Registration Authorities (REGAUT)*

Rec. ITU-T T.871 | ISO/IEC 10918-5, *Information technology — Digital compression and coding of continuous-tone still images — Part 5: JPEG File Interchange Format (JFIF)*

### 3 Terms and definitions

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

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

— ISO Online browsing platform: available at <https://www.iso.org/obp>

— IEC Electropedia: available at <http://www.electropedia.org/>

#### 3.1

##### **bitstream**

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

**3.13  
marker segment**  
marker and associated set of parameters

**3.14  
precision**  
number of bits allocated to a particular sample or DCT coefficient

**3.15  
procedure**  
set of steps which accomplishes one of the tasks which comprise an encoding or decoding process

**3.16  
sample**  
one element in the two-dimensional array which comprises a component

**3.17  
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

**3.18  
scan**  
single pass through the data for one or more of the components in an image



**3.19****scan header**

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

**3.20****upsampling**

procedure by which the spatial resolution of a component is increased

**3.21****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
N <sub>f</sub>	number of components in an image
S <sub>i,x</sub>	subsampling factor of component i in horizontal direction
S <sub>i,y</sub>	subsampling factor of component i in vertical direction
H <sub>i</sub>	subsampling indicator of component i in the frame header
V <sub>i</sub>	subsampling indicator of component i in the frame header
v <sub>x,y</sub>	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
JPEG	joint photographic experts group

**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 document 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 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  $x < \text{min}$ , max if  $x > \text{max}$  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 document. 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.