
**Information technology — JPEG 2000
image coding system —**

**Part 1:
Core coding system**

*Technologies de l'information — Système de codage d'image
JPEG 2000 —
Partie 1: Système de codage de noyau*

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. 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 part of ISO/IEC 15444 may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 15444-1 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, but is not published as common text at this time.

ISO/IEC 15444 consists of the following parts, under the general title *Information technology — JPEG 2000 image coding system*:

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- *Part 2: Extensions*
- *Part 3: Motion JPEG 2000*
- *Part 4: Conformance testing*
- *Part 5: Reference software*
- *Part 6: Compound image file format*

Annexes A to I form a normative part of this part of ISO/IEC 15444. Annexes J, K and L are for information only.

INFORMATION TECHNOLOGY – JPEG 2000 IMAGE CODING SYSTEM – PART 1: CORE CODING SYSTEM

1 Scope

This Recommendation | International Standard defines a set of lossless (bit-preserving) and lossy compression methods for coding bi-level, continuous-tone grey-scale, palletized color, or continuous-tone colour digital still images.

This Recommendation | International Standard

- specifies decoding processes for converting compressed image data to reconstructed image data
- specifies a codestream syntax containing information for interpreting the compressed image data
- specifies a file format
- provides guidance on encoding processes for converting source image data to compressed image data
- provides guidance on how to implement these processes in practice

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2 References

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision and parties to agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

- ITU-T Recommendation T.81 | ISO/IEC 10918-1:1994, *Information technology — Digital compression and coding of continuous-tone still images: Requirements and guidelines.*
- ITU-T Recommendation T.88 | ISO/IEC 14492, *Information technology — Lossy/lossless coding of bi-level images.*
- ISO/IEC 646:1991, *Information technology — ISO 7-bit coded character set for information interchange.*
- ISO/IEC 8859-15:1999, *Information technology — 8-bit single-byte coded graphic character sets — Part 15: Latin alphabet No. 9.*
- ITU-T Recommendation T.84 | ISO/IEC 10918-3:1997, *Information technology — Digital compression and coding of continuous-tone still images: Extensions.*
- ITU-T Recommendation T.84 | ISO/IEC 10918-3:1997/Amd.1:1999, *Information technology — Digital compression and coding of continuous-tone still images: Extensions — Amendment 1: Provisions to allow registration of new compression types and versions in the SPIFF header.*
- ITU-T Recommendation T.86 | 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).*

- ITU-T Recommendation T.87 | ISO/IEC 14495-1, *Information technology — Lossless and near-lossless compression of continuous-tone still images: Baseline*.
- International Color Consortium, ICC profile format specification. ICC.1:1998–09.
- IEC 61966-2-1:1999, *Multimedia systems and equipment — Colour measurement and management — Part 2-1: Colour management — Default RGB colour space — sRGB*.
- W3C, Extensible Markup Language (XML 1.0), REC-xml-19980210.
- IETF RFC 2279, UTF–8, A transformation format of ISO 10646. January 1998.
- ISO/IEC 11578:1996, *Information technology — Open Systems Interconnection — Remote Procedure Call (RPC)*.

3 Definitions

For the purposes of this Recommendation | International Standard, the following definitions apply.

- 3.1** $\lfloor x \rfloor$, **floor function**: This indicates the largest integer not exceeding x .
- 3.2** $\lceil x \rceil$, **ceiling function**: This indicates the smallest integer not exceeded by x .
- 3.3** **5-3 reversible filter**: A particular filter pair used in the wavelet transformation. This reversible filter pair has 5 taps in the low-pass and 3 taps in the high-pass.
- 3.4** **9-7 irreversible filter**: A particular filter pair used in the wavelet transformation. This irreversible filter pair has 9 taps in the low-pass and 7 taps in the high-pass.
- 3.5** **AND**: Bit wise AND logical operator.
- 3.6** **arithmetic coder**: An entropy coder that converts variable length strings to variable length codes (encoding) and visa versa (decoding).
- 3.7** **auxiliary channel**: A channel that is used by the application outside the scope of colourspace conversion. For example, an opacity channel or a depth channel would be an auxiliary channel.
- 3.8** **bit**: A contraction of the term “binary digit”; a unit of information represented by a zero or a one.
- 3.9** **bit-plane**: A two dimensional array of bits. In this Recommendation | International Standard a bit-plane refers to all the bits of the same magnitude in all coefficients or samples. This could refer to a bit-plane in a component, tile-component, code-block, region of interest, or other.
- 3.10** **bit stream**: The actual sequence of bits resulting from the coding of a sequence of symbols. It does not include the markers or marker segments in the main and tile-part headers or the EOC marker. It does include any packet headers and in stream markers and marker segments not found within the main or tile-part headers.
- 3.11** **big endian**: The bits of a value representation occur in order from most significant to least significant.
- 3.12** **box**: A portion of the file format defined by a length and unique box type. Boxes of some types may contain other boxes.
- 3.13** **box contents**: Refers to the data wrapped within the box structure. The contents of a particular box are stored within the DBox field within the Box data structure.
- 3.14** **box type**: Specifies the kind of information that shall be stored with the box. The type of a particular box is stored within the TBox field within the Box data structure.
- 3.15** **byte**: Eight bits.
- 3.16** **channel**: One logical component of the image. A channel may be a direct representation of one component from the codestream, or may be generated by the application of a palette to a component from the codestream.
- 3.17** **cleanup pass**: A coding pass performed on a single bit-plane of a code-block of coefficients. The first pass and only coding pass for the first significant bit-plane is a cleanup pass; the third and the last pass of every remaining bit-plane is a cleanup pass.

- 3.18 codestream:** A collection of one or more bit streams and the main header, tile-part headers, and the EOC required for their decoding and expansion into image data. This is the image data in a compressed form with all of the signalling needed to decode.
- 3.19 code-block:** A rectangular grouping of coefficients from the same subband of a tile-component.
- 3.20 code-block scan:** The order in which the coefficients within a code-block are visited during a coding pass. The code-block is processed in stripes, each consisting of four rows (or all remain rows if less than four) and spanning the width of the code-block. Each stripe is processed column by column from top to bottom and from left to right.
- 3.21 coder:** An embodiment of either an encoding or decoding process.
- 3.22 coding pass:** A complete pass through a code-block where the appropriate coefficient values and context are applied. There are three types of coding passes: significance propagation pass, magnitude refinement pass and cleanup pass. The result of each pass (after arithmetic coding, if selective arithmetic coding bypass is not used) is a stream of compressed image data.
- 3.23 coefficient:** The values that are result of a transformation.
- 3.24 colour channel:** A channel that functions as an input to a colour transformation system. For example, a red channel or a greyscale channel would be a colour channel.
- 3.25 component:** A two-dimensional array of samples. A image typically consists of several components, for instance representing red, green, and blue.
- 3.26 compressed image data:** Part or all of a bit stream. Can also refer to a collection of bit streams in part or all of a codestream.
- 3.27 conforming reader:** An application that reads and interprets a JP2 file correctly.
- 3.28 context:** Function of coefficients previously decoded and used to condition the decoding of the present coefficient.
- 3.29 context label:** The arbitrary index used to distinguish different context values. The labels are used as a convenience of notation rather than being normative.
- 3.30 context vector:** The binary vector consisting of the significance states of the coefficients included in a context.
- 3.31 decoder:** An embodiment of a decoding process, and optionally a colour transformation process.
- 3.32 decoding process:** A process which takes as its input all or part of a codestream and outputs all or part of a reconstructed image.
- 3.33 decomposition level:** A collection of wavelet subbands where each coefficient has the same spatial impact or span with respect to the source component samples. These include the HL, LH, and HH subbands of the same two dimensional subband decomposition. For the last decomposition level the LL subband is also included.
- 3.34 delimiting markers and marker segments:** Markers and marker segments that give information about beginning and ending points of structures in the codestream.
- 3.35 discrete wavelet transformation (DWT):** A transformation that iteratively transforms one signal into two or more filtered and decimated signals corresponding to different frequency bands. This transformation operates on spatially discrete samples.
- 3.36 encoder:** An embodiment of an encoding process.
- 3.37 encoding process:** A process, that takes as its input all or part of a source image data and outputs a codestream.
- 3.38 file format:** A codestream and additional support data and information not explicitly required for the decoding of codestream. Examples of such support data include text fields providing titling, security and historical information, data to support placement of multiple codestreams within a given data file, and data to support exchange between platforms or conversion to other file formats.
- 3.39 fixed information markers and fixed information marker segments:** Markers and marker segments that offer information about the original image.