JPEG 2000

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JPEG 2000 (JP2) is an image compression standard and coding system. It was created by the Joint Photographic Experts Group committee in 2000 with the intention of superseding their original discrete cosine transform-based JPEG standard (created in 1992) with a newly designed, wavelet-based method. The standardized filename extension is **.jp2** for ISO/IEC 15444-1 conforming files and **.jpx** for the extended part-2 specifications, published as ISO/IEC 15444-2. The registered MIME types are defined in RFC 3745. For ISO/IEC 15444-1 it is **image/jp2**.

JPEG 2000 code streams are regions of interest that offer several mechanisms to support spatial random access or region of interest access at varying degrees of granularity. This way it is possible to store different parts of the same picture using different quality.

JPEG 2000

Filename extension	`.jp2, .j2k, .jpf, .jpx, .jpm, .mj2`
Internet media type	`image/jp2, image/jpx, image/jpm, video/mj2`
Uniform Type Identifier (UTI)	`public.jpeg-2000`
Developed by	Joint Photographic Experts Group
Type of format	graphics file format
Standard	ISO/IEC 15444

Contents

Aims of the standard

While there is a modest increase in compression performance of JPEG 2000 compared to JPEG, the main advantage offered by JPEG 2000 is the significant flexibility of the codestream. The codestream obtained after compression of an image with JPEG 2000 is scalable in nature, meaning that it can be decoded in a number of ways; for instance, by truncating the codestream at any point, one may obtain a representation of the image at a lower resolution, or signal-to-noise ratio – see scalable compression. By ordering the codestream in various ways, applications can achieve significant performance increases. However, as a consequence of this flexibility, JPEG 2000 requires encoders/decoders that are complex and computationally demanding. Another difference, in comparison with JPEG, is in terms of visual artifacts: JPEG 2000 produces ringing artifacts, manifested as blur and rings near edges in the image, while JPEG produces ringing artifacts and 'blocking' artifacts, due to its 8×8 blocks.

JPEG 2000 has been published as an ISO standard, ISO/IEC 15444. As of 2013, JPEG 2000 is not widely supported in web browsers, and hence is not generally used on the Internet.

Improvements over the 1992 JPEG standard

Superior compression performance

At high bit rates, artifacts become nearly imperceptible, JPEG 2000 has a small machine-measured fidelity advantage over JPEG. At lower bit rates (e.g., less than 0.25 bits/pixel for grayscale images), JPEG 2000 has a significant advantage over certain modes of JPEG: artifacts are less visible and there is almost no blocking. The compression gains over JPEG are attributed to the use of DWT and a more sophisticated entropy encoding scheme.

Multiple resolution representation

JPEG 2000 decomposes the image into a multiple resolution representation in the course of its compression process. This representation can be put to use for other image presentation purposes beyond compression as such.

Progressive transmission by pixel and resolution accuracy

These features are more commonly known as *progressive decoding* and *signal-to-noise ratio (SNR) scalability*. JPEG 2000 provides efficient code-stream organizations which are progressive by pixel accuracy and by image resolution (or by image size). This way, after a smaller part of the whole file has been received, the viewer can see a lower quality version of the final picture. The quality then improves progressively through downloading more data bits from the source.

Choice of lossless or lossy compression

Like the Lossless JPEG standard,[1] the JPEG 2000 standard provides both lossless and lossy compression in a single compression architecture. Lossless compression is provided by the use of a reversible integer wavelet transform in JPEG 2000.

Error resilience

Like JPEG 1992, JPEG 2000 is robust to bit errors introduced by noisy communication channels, due to the coding of data in relatively small independent blocks.

Flexible file format

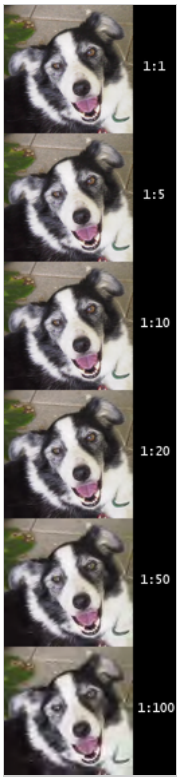
The JP2 and JPX file formats allow for handling of color-space information, metadata, and for interactivity in networked applications as developed in the JPEG Part 9 JPIP protocol.

High Dynamic Range support

JPEG 2000 supports any bit depths (like 16 and 32-bits floating point pixel image)and any color spaces.

Side channel spatial information

Full support for transparency and alpha planes.



Top-to-bottom demonstration of the artifacts of JPEG 2000 compression. The numbers indicate the compression ratio used.

JPEG 2000 image coding system - Parts

The JPEG 2000 image coding system (ISO/IEC 15444) consists of following parts:

JPEG 2000 image coding system - Parts[2][3]

Part	Number	First public release date (First edition)	Latest public release date (edition)	Latest amendment	Identical ITU-T standard	Title	Description
Part 1	ISO/IEC 15444-1 (http://www.iso.org/iso/iso_catalogue/catalogue_ics/catalogue_detail_ics.htm?csnumber=27687)	2000	2004	2006[4]	T.800 (http://www.itu.int/rec/T-REC-T.800)	Core coding system	the basic characteristi of JPEG 20 compressio (*.jp2*)
Part 2	ISO/IEC 15444-2 (http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=33160)	2004	2004	2006[5]	T.801 (http://www.itu.int/rec/T-REC-T.801)	Extensions	(*.jpx*, *.jpf*, *floating points*)
Part 3	ISO/IEC 15444-3 (http://www.iso.org/iso/iso_catalogue/catalogue_ics/catalogue_detail_ics.htm?csnumber=33875)	2002	2007[6]		T.802 (http://www.itu.int/rec/T-REC-T.802)	Motion JPEG 2000	(*.mj2*)
Part 4	ISO/IEC 15444-4 (http://www.iso.org/iso/iso_catalogue/catalogue_ics/catalogue_detail_ics.htm?csnumber=33876)	2002	2004[7]		T.803 (http://www.itu.int/rec/T-REC-T.803)	Conformance testing	
Part 5	ISO/IEC 15444-5 (http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=33877)	2003	2003	2003[8]	T.804 (http://www.itu.int/rec/T-REC-T.804)	Reference software	Java and C implementat
Part 6	ISO/IEC 15444-6 (http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=35458)	2003	2003	2007[9]	T.805 (http://www.itu.int/rec/T-REC-T.805)	Compound image file format	(*.jpm*) e.g. document imaging, for pre-press a fax-like applications
Part 7	abandoned[2]					Guideline of minimum support function of ISO/IEC 15444-1[10]	(Technical Report on Minimum Support Functions[11]
Part 8	ISO/IEC 15444-8 (http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=37382)	2007	2007	2008[12]	T.807 (http://www.itu.int/rec/T-REC-T.807)	Secure JPEG 2000	JPSEC (security aspects)
Part 9	ISO/IEC 15444-9 (http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=39413)	2005	2005	2008[13]	T.808 (http://www.itu.int/rec/T-REC-T.808)	Interactivity tools, APIs and protocols	JPIP (interactive protocols a API)
Part 10	ISO/IEC 15444-10 (http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=40024)	2008	2008	2008[14]	T.809 (http://www.itu.int/rec/T-REC-T.809)	Extensions for three-dimensional data	JP3D (volumetric imaging)
Part 11	ISO/IEC 15444-11 (http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=40025)	2007	2007[15]		T.810 (http://www.itu.int/rec/T-REC-T.810)	Wireless	JPWL (wire applications
Part 12	ISO/IEC 15444-12 (http://www.iso.org/iso/iso_catalogue/catalogue_ics/catalogue_detail_ics.htm?csnumber=38612)	2004	2008[16]			ISO base media file format	
Part 13	ISO/IEC 15444-13 (http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=42271)	2008	2008[17]		T.812 (http://www.itu.int/rec/T-REC-T.812)	An entry level JPEG 2000 encoder	
Part 14	ISO/IEC 15444-14[18][19]	2013			T.813 (http://www.itu.int/rec/T-REC-T.813)	XML structural representation and reference	JPXML[20]

Technical discussion

The aim of JPEG 2000 is not only improving compression performance over JPEG but also adding (or improving) features such as scalability and editability. JPEG 2000's improvement in compression performance relative to the original JPEG standard is actually rather modest and should not ordinarily be the primary consideration for evaluating the design. Very low and very high compression rates are supported in JPEG 2000. The ability of the design to handle a very large range of effective bit rates is one of the strengths of JPEG 2000. For example, to reduce the number of bits for a picture below a certain amount, the advisable thing to do with the first JPEG standard is to reduce the resolution of the input image before encoding it. That is unnecessary when using JPEG 2000, because JPEG 2000 already does this automatically through its multiresolution decomposition structure. The following sections describe the algorithm of JPEG 2000.

Color components transformation

Initially images have to be transformed from the RGB color space to another color space, leading to three *components* that are handled separately. There are two possible choices:

1. Irreversible Color Transform (ICT) uses the well known YC_BC_R color space. It is called "irreversible" because it has to be implemented in floating or fix-point and causes round-off errors.
2. Reversible Color Transform (RCT) uses a modified YUV color space that does not introduce quantization errors, so it is fully reversible. Proper implementation of the RCT requires that numbers are rounded as specified that cannot be expressed exactly in matrix form. The transformation is:

$$Y = \left\lfloor \frac{R + 2G + B}{4} \right\rfloor; C_B = B - G; C_R = R - G;$$

and $G = Y - \left\lfloor \frac{C_b + C_r}{4} \right\rfloor; R = C_R + G; B = C_B + G.$

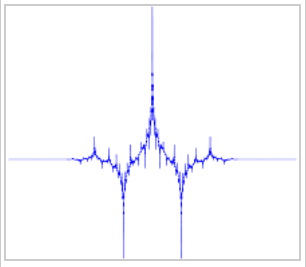
The chrominance components can be, but do not necessarily have to be, down-scaled in resolution; in fact, since the wavelet transformation already separates images into scales, downsampling is more effectively handled by dropping the finest wavelet scale. This step is called *multiple component transformation* in the JPEG 2000 language since its usage is not restricted to the RGB color model.

Tiling

After color transformation, the image is split into so-called *tiles*, rectangular regions of the image that are transformed and encoded separately. Tiles can be any size, and it is also possible to consider the whole image as one single tile. Once the size is chosen, all the tiles will have the same size (except optionally those on the right and bottom borders). Dividing the image into tiles is advantageous in that the decoder will need less memory to decode the image and it can opt to decode only selected tiles to achieve a partial decoding of the image. The disadvantage of this approach is that the quality of the picture decreases due to a lower peak signal-to-noise ratio. Using many tiles can create a blocking effect similar to the older JPEG 1992 standard.

Wavelet transform

These tiles are then wavelet transformed to an arbitrary depth, in contrast to JPEG 1992 which uses an 8×8 block-size discrete cosine transform. JPEG 2000 uses two different wavelet transforms:



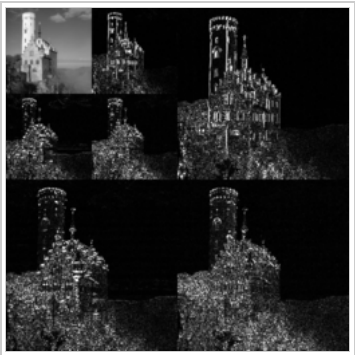
CDF 5/3 wavelet used for lossless compression.

1. *irreversible*: the CDF 9/7 wavelet transform. It is said to be "irreversible" because it introduces quantization noise that depends on the precision of the decoder.
2. *reversible*: a rounded version of the biorthogonal CDF 5/3 wavelet transform. It uses only integer coefficients, so the output does not require rounding (quantization) and so it does not introduce any quantization noise. It is used in lossless coding.

The wavelet transforms are implemented by the lifting scheme or by convolution.

Quantization

After the wavelet transform, the coefficients are scalar-quantized to reduce the number of bits to represent them, at the expense of quality. The output is a set of integer numbers which have to be encoded bit-by-bit. The parameter that can be changed to set the final quality is the quantization step: the greater the step, the greater is the compression and the loss of quality. With a quantization step that equals 1, no quantization is performed (it is used in lossless compression).



An example of the wavelet transform that is used in JPEG 2000. This is a 2nd-level CDF 9/7 wavelet transform.

Coding

The result of the previous process is a collection of *sub-bands* which represent several approximation scales. A sub-band is a set of *coefficients*—real numbers which represent aspects of the image associated with a certain frequency range as well as a spatial area of the image.

The quantized sub-bands are split further into *precincts*, rectangular regions in the wavelet domain. They are typically selected in a way that the coefficients within them across the sub-bands form approximately spatial blocks in the (reconstructed) image domain, though this is not a requirement.

Precincts are split further into *code blocks*. Code blocks are located in a single sub-band and have equal sizes—except those located at the edges of the image. The encoder has to encode the bits of all quantized coefficients of a code block, starting with the most significant bits and progressing to less significant bits by a process called the *EBCOT* scheme. *EBCOT* here stands for *Embedded Block Coding with Optimal Truncation*. In this encoding process, each bit plane of the code block gets encoded in three so-called *coding passes*, first encoding bits (and signs) of insignificant coefficients with significant neighbors (i.e., with 1-bits in higher bit planes), then refinement bits of significant coefficients and finally coefficients without significant neighbors. The three passes are called *Significance Propagation*, *Magnitude Refinement* and *Cleanup* pass, respectively.

Clearly, in lossless mode all bit planes have to be encoded by the EBCOT, and no bit planes can be dropped.

The bits selected by these coding passes then get encoded by a context-driven binary arithmetic coder, namely the binary MQ-coder. The context of a coefficient is formed by the state of its nine neighbors in the code block.

The result is a bit-stream that is split into *packets* where a *packet* groups selected passes of all code blocks from a precinct into one indivisible unit. Packets are the key to quality scalability (i.e., packets containing less significant bits can be discarded to achieve lower bit rates and higher distortion).

Packets from all sub-bands are then collected in so-called *layers*. The way the packets are built up from the code-block coding passes, and thus which packets a layer will contain, is not defined by the JPEG 2000 standard, but in general a codec will try to build layers in such a way that the image quality will increase monotonically with each layer, and the image distortion will shrink from layer to layer. Thus, layers define the progression by image quality within the code stream.

The problem is now to find the optimal packet length for all code blocks which minimizes the overall distortion in a way that the generated target bitrate equals the demanded bit rate.

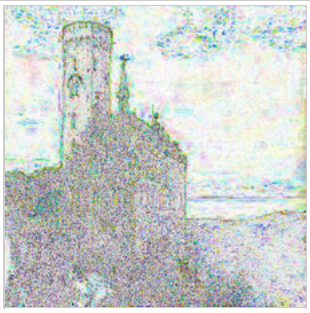
While the standard does not define a procedure as to how to perform this form of rate–distortion optimization, the general outline is given in one of its many appendices: For each bit encoded by the EBCOT coder, the improvement in image quality, defined as mean square error, gets measured; this can be implemented by an easy table-lookup algorithm. Furthermore, the length of the resulting code stream gets measured. This forms for each code block a graph in the rate–distortion plane, giving image quality over bitstream length. The optimal selection for the truncation points, thus for the packet-build-up points is then given by defining critical *slopes* of these curves, and picking all those coding passes whose curve in the rate–distortion graph is steeper than the given critical slope. This method can be seen as a special application of the method of *Lagrange multiplier* which is used for optimization problems under constraints. The Lagrange multiplier, typically denoted by λ, turns out to be the critical slope, the constraint is the demanded target bitrate, and the value to optimize is the overall distortion.

Packets can be reordered almost arbitrarily in the JPEG 2000 bit-stream; this gives the encoder as well as image servers a high degree of freedom.

Already encoded images can be sent over networks with arbitrary bit rates by using a layer-progressive encoding order. On the other hand, color components can be moved back in the bit-stream; lower resolutions (corresponding to low-frequency sub-bands) could be sent first for image previewing. Finally, spatial browsing of large images is possible through appropriate tile and/or partition selection. All these operations do not require any re-encoding but only byte-wise copy operations.

Performance

Compared to the previous JPEG standard, JPEG 2000 delivers a typical compression gain in the range of 20%, depending on the image characteristics. Higher-resolution images tend to benefit more, where JPEG-2000's spatial-redundancy prediction can contribute more to the compression process. In very low-bitrate applications, studies have shown JPEG 2000 to be outperformed[21] by the intra-frame coding mode of H.264. Good applications for JPEG 2000 are large images, images with low-contrast edges — e.g., medical images.



This image shows the (accentuated) difference between an image saved as JPEG 2000 (quality 50%) and the original.

File format and code stream

Similar to JPEG-1, JPEG 2000 defines both a file format and a code stream. Whereas the latter entirely describes the image samples, the former includes additional meta-information such as the resolution of the image or the color space that has been used to encode the image. JPEG 2000 images should — if stored as files — be boxed in the JPEG 2000 file format, where they get the **.jp2** extension. The part-2 extension to JPEG 2000, i.e., ISO/IEC 15444-2, also enriches this file format by including mechanisms for animation or composition of several code streams into one single image. Images in this extended file-format use the **.jpx** extension.

There is no standardized extension for code-stream data because code-stream data is not to be considered to be stored in files in the first place, though when done for testing purposes, the extension **.jpc** or **.j2k** appear frequently.

Metadata

For traditional JPEG, additional metadata, e.g. lighting and exposure conditions, is kept in an application marker in the Exif format specified by the JEITA. JPEG 2000 chooses a different route, encoding the same metadata in XML form. The reference between the Exif tags and the XML elements is standardized by the ISO TC42 committee in the standard 12234-1.4.

Extensible Metadata Platform can also be embedded in JPEG 2000.

Comparison between JPEG 2000, JPEG XR, and JPEG.

Applications of JPEG 2000

Some markets and applications intended to be served by this standard are listed below:

- Consumer applications such as multimedia devices (e.g., digital cameras, personal digital assistants, 3G mobile phones, color facsimile, printers, scanners, etc.)
- Client/server communication (e.g., the Internet, Image database, Video streaming, video server, etc.)
- Military/surveillance (e.g., HD satellite images, Motion detection, network distribution and storage, etc.)
- Medical imagery, esp. the DICOM specifications for medical data interchange.
- Biometrics.
- Remote sensing
- High-quality frame-based video recording, editing and storage.
- Live HDTV feed contribution (I-frame only video compression with low transmission latency), such as live HDTV feed of a sport event linked to the TV station studio
- Digital cinema
- JPEG 2000 has many design commonalities with the ICER image compression format that is used to send images back from the Mars rovers.
- Digitized Audio-visual contents and Images for Long term digital preservation
- World Meteorological Organization has built JPEG 2000 Compression into the new GRIB2 file format. The GRIB file structure is designed for global distribution of meteorological data. The implementation of JPEG 2000 compression in GRIB2 has reduced file sizes up to 80%.[22]

Comparison with PNG

Although JPEG 2000 format supports lossless encoding, it is not intended to completely supersede today's dominant lossless image file formats.

The PNG (Portable Network Graphics) format is still more space-efficient in the case of images with many pixels of the same color, such as diagrams, and supports special compression features that JPEG 2000 does not.

Legal status

JPEG 2000 is covered by patents, but the contributing companies and organizations agreed that licenses for its first part—the core coding system—can be obtained free of charge from all contributors.

The JPEG committee has stated:

> It has always been a strong goal of the JPEG committee that its standards should be implementable in their baseline form without payment of royalty and license fees... The up and coming JPEG 2000 standard has been prepared along these lines, and agreement reached with over 20 large organizations holding many patents in this area to allow use of their intellectual property in connection with the standard without payment of license fees or royalties.[23]

However, the JPEG committee has acknowledged that undeclared submarine patents may still present a hazard:

> It is of course still possible that other organizations or individuals may claim intellectual property rights that affect implementation of the standard, and any implementers are urged to carry out their own searches and investigations in this area.[24]

Related standards

Several additional parts of the JPEG 2000 standard exist; Amongst them are ISO/IEC 15444-2:2000, JPEG 2000 extensions defining the **.jpx** file format, featuring for example Trellis quantization, an extended file format and additional color spaces,[25] ISO/IEC 15444-4:2000, the reference testing and ISO/IEC 15444-6:2000, the compound image file format (**.jpm**), allowing compression of compound text/image graphics.[26]

Extensions for secure image transfer, *JPSEC* (ISO/IEC 15444-8), enhanced error-correction schemes for wireless applications, *JPWL* (ISO/IEC 15444-11) and extensions for encoding of volumetric images, *JP3D* (ISO/IEC 15444-10) are also already available from the ISO.

JPIP protocol for streaming JPEG 2000 images

In 2005, a JPEG 2000 based image browsing protocol, called JPIP has been published as ISO/IEC 15444-9.[27] Within this framework, only selected regions of potentially huge images have to be transmitted from an image server on the request of a client, thus reducing the required bandwidth.

JPEG 2000 data may also be streamed using the ECWP and ECWPS protocols found within the ERDAS ECW/JP2 SDK.

Motion JPEG 2000

Motion JPEG 2000, (MJ2), originally defined in Part 3 of the ISO Standard for JPEG2000 (ISO/IEC 15444-3:2002,) as a standalone document, has now been expressed by ISO/IEC 15444-3:2002/Amd 2:2003 in terms of the ISO Base format, ISO/IEC 15444-12 and in ITU-T Recommendation T.802.[28] It specifies the use of the JPEG 2000 format for timed sequences of images (motion sequences), possibly combined with audio, and composed into an overall presentation.[29][30] It also defines a file format,[31] based on ISO base media file format (ISO 15444-12). Filename extensions for Motion JPEG 2000 video files are **.mj2** and **.mjp2** according to RFC 3745.

It is an open ISO standard and an advanced update to MJPEG (or MJ), which was based on the legacy JPEG format. Unlike common video formats, such as MPEG-4 Part 2, WMV, and H.264, MJ2 does not employ temporal or inter-frame compression. Instead, each frame is an independent entity encoded by either a lossy or lossless variant of JPEG 2000. Its physical structure does not depend on time ordering, but it does employ a separate profile to complement the data. For audio, it supports LPCM encoding, as well as various MPEG-4 variants, as "raw" or complement data.[32]

Motion JPEG 2000 (often referenced as MJ2 or MJP2) was considered as a digital archival format[33] by the Library of Congress. In June 2013, in an interview with Bertram Lyons from the Library of Congress for *The New York Times Magazine*, about "Tips on Archiving Family History", codecs like FFV1, H264 or Apple ProRes are mentioned, but JPEG 2000 is not.[34]

ISO base media file format

ISO/IEC 15444-12 is identical with ISO/IEC 14496-12 (MPEG-4 Part 12) and it defines ISO base media file format. For example, Motion JPEG 2000 file format, MP4 file format or 3GP file format are also based on this ISO base media file format.[35][36][37][38][39]

GML JP2 georeferencing

The Open Geospatial Consortium (OGC) has defined a metadata standard for georeferencing JPEG 2000 images with embedded XML using the Geography Markup Language (GML) format: *GML in JPEG 2000 for Geographic Imagery Encoding (GMLJP2)*, version 1.0.0, dated 2006-01-18.[40]

JP2 and JPX files containing GMLJP2 markup can be located and displayed in the correct position on the Earth's surface by a suitable Geographic Information System (GIS), in a similar way to GeoTIFF images.

Application support

Applications

Application support for JPEG 2000

Program	Basic [Note 1]		Advanced [Note 1]		License
	Read	Write	Read	Write	
ACDSee	Yes	Yes	?	?	Proprietary
Adobe Photoshop [Note 2]	Yes	Yes	Yes	Yes	Proprietary
Apple iPhoto	Yes	No	Yes	No	Proprietary
Apple Preview	Yes	Yes	Yes	*?*	Proprietary
Autodesk AutoCAD	Yes	Yes	Yes	*?*	Proprietary
BAE Systems CoMPASS	Yes	No	Yes	No	Proprietary
Blender[41]	Yes	Yes	*?*	*?*	GPL
Chasys Draw IES	Yes	Yes	Yes	Yes	Freeware
CineAsset	Yes	Yes	Yes	Yes	Proprietary
CompuPic Pro	Yes	Yes	*?*	*?*	Proprietary
Corel Photo-Paint	Yes	Yes	Yes	Yes	Proprietary
Daminion[42]	Yes	No	Yes	No	Proprietary
darktable[43]	*?*	Yes	*?*	*?*	GPL
DBGallery	Yes	No	Yes	No	Proprietary
digiKam[44][45] **(KDE**[46]**)**	Yes	Yes	*?*	*?*	GPL
ENVI	Yes	Yes	*?*	*?*	Proprietary
ERDAS IMAGINE	Yes	Yes	*?*	*?*	Proprietary
FastStone Image Viewer	Yes	Yes	Yes	Yes	Freeware
FastStone MaxView	Yes	No	Yes	No	Proprietary
FotoGrafix 2.0	No	No	No	No	Proprietary
FotoSketcher 2.70	No	No	No	No	Proprietary
GIMP 2.8	Yes[47]	No	*?*	No	GPL
GraphicConverter	Yes	Yes	Yes	*?*	Shareware
Gwenview (KDE[46]**)**	Yes	Yes	*?*	*?*	GPL
IDL	Yes	Yes	*?*	*?*	Proprietary
ImageMagick	Yes	Yes	No	No	ImageMagick License (http://www.imagemagick.org/script/license.php)
IrfanView	Yes [Note 3]	Partial [Note 3]	No	No	Proprietary
KolourPaint (KDE[46]**)**	Yes	Yes	*?*	*?*	2-clause BSD
Mathematica	Yes	Yes	*?*	*?*	Proprietary
Matlab	via toolbox	via toolbox	via toolbox	via toolbox	Proprietary
Mozilla Firefox	via extension [Note 4]	-	*?*	-	MPL
Opera	via QuickTime	-	*?*	-	Proprietary
Paint Shop Pro	Yes	Yes	Yes	Yes	Proprietary
PhotoFiltre 7.1	No	No	No	No	Proprietary
PhotoLine	Yes	Yes	*?*	*?*	Proprietary
Pixel image editor	Yes	Yes	*?*	*?*	Proprietary
Safari	Yes	-	*?*	-	Proprietary
SilverFast	Yes	Yes	Yes	Yes	Proprietary
XnView	Yes	Yes	Yes	Yes	Proprietary
Ziproxy	Yes	Yes	No	No	GPL

1. ^ *a b* **basic** and **advanced** support refer to conformance with, respectively, **Part1** and **Part2** of the JPEG 2000 Standard.
2. ^ Adobe Photoshop CS2 and CS3's official JPEG 2000 plug-in package is not installed by default and must be manually copied from the install disk/folder to the Plug-Ins > File Formats folder.
3. ^ *a b* IrfanView's official plug-in package supports reading of .jp2 files but writing is quite limited until plug-in is purchased separately.
4. ^ Mozilla support for JPEG 2000 was requested in April 2000, but the report was closed as WONTFIX in August 2009.[1] (https://bugzilla.mozilla.org/show_bug.cgi?id=36351) There is an extension that adds support to older versions of Firefox.[2] (http://eschew.org/test/jp2/xpi/)

Libraries

Library support for JPEG 2000

Program	Basic		Advanced		Language	License
	Read	Write	Read	Write		
Comprimato	Yes	Yes	*?*	*?*	C, C++, CUDA	Proprietary
ERDAS ECW JPEG2000 SDK	Yes	Yes	*?*	*?*	C, C++	Proprietary
FFmpeg	Yes [Note 1]	Yes [Note 1]	*?*	*?*	C	LGPL
GTK+ (from 2.14)	Yes	No	*?*	No	C/GTK	LGPL
J2K-Codec	Yes	No	Yes	No	C++	Proprietary
JasPer	Yes [Note 2]	Yes	No	No	C	MIT License-style
Kakadu	Yes	Yes	Yes	Yes	C++	Proprietary
LEADTOOLS	Yes	Yes	Yes	Yes	C++, .NET	Proprietary
OpenJPEG	Yes	Yes	Yes	Yes	C	BSD
BOI codec	Yes	Yes	No	No	Java	BOI License

1. ^ *a b* Both the decoder and the encoder in FFmpeg are still marked experimental.
2. ^ Jasper does not handle 16bits properly See for example [3] (http://bugs.debian.org/681234#17).

See also

- Digital cinema
- Comparison of graphics file formats
- Video compression picture types
- DjVu – a compression format that also uses wavelets and that is designed for use on the web.
- ECW – a wavelet compression format that compares well to JPEG 2000.
- High bit rate media transport
- QuickTime – a multimedia framework, application and web browser plugin developed by Apple, capable of encoding, decoding and playing various multimedia files (including JPEG 2000 images by default).
- MrSID – a wavelet compression format that compares well to JPEG 2000
- PGF – a fast wavelet compression format that compares well to JPEG 2000
- JPIP – JPEG 2000 Interactive Protocol
- Wavelet
- WebP – an image format related to WebM, supporting lossy and lossless compression
- The High Efficiency Video Coding's Main Still Picture profile, which has been shown to give superior compression compared to JPEG 2000.

Notes

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External links

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JPEG 2000 comparisons

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JPEG 2000 adoption (and barriers to)

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