33 Years JPEG:

Ubiquitous Presence and Still in its Infancy

This year, in January 2024, the Independent JPEG Group (IJG) released a new version 9f (9.6) of the JPEG reference software. This release proved to be quite stable so far, and it will be the last version of the 9 series. JPEG 10 is now in preparation and will be the next version, with a preview version scheduled for publication in the next year 2025 and release on the usual cycle in January 2026.

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The current version of the JPEG reference software added support for the Apple Mac platform with its Xcode IDE (Integrated Development Environment), as described in the previous article.
We are glad to welcome another reference application on macOS with full JPEG 9 support: GraphicConverter. GraphicConverter is one of the most used photo editing applications on the Mac with millions of users. Another major reference application on the Mac with full JPEG 9 support is PhotoLine.

One may be surprised to learn that "macOS is the most advanced desktop operating system in the world". Well, that's what Apple claims in their product description.
It can be confirmed at least regarding the level of JPEG support: macOS has built-in partial JPEG 8 support in the system and system apps: Finder, Preview app, web browser Safari. Kudos to Apple! Windows system and apps have only JPEG 6 support, which is the JPEG development status of year 1998. Major reference applications on Windows with full JPEG 9 support are cPicture and Directory Opus.

The system integrated JPEG support is generally still insufficient. The reason is general incompetence and lack of knowledge of system vendors about fundamental JPEG features.
Independent JPEG Group therefore recognizes that more effort will be needed to improve JPEG support for more applications and thus compensate for the incompetence of the system vendors.

JPEG 10 will be a groundbreaking new release which clarifies the bit depth issue in JPEG

As a universal image format JPEG is defined to represent images with various characteristics.
One basic parameter is image dimension (resolution), and JPEG can handle small and large image dimensions for practical applications well.
JPEG also supports various colour spaces, and Independent JPEG Group has clarified some issues regarding proper definition and robust detection of available standard colour spaces for file interchange in recent releases.

Another basic parameter is bit depth (data precision).
One of the most mentioned criticism about JPEG to date is the way in which it handles the bit depth characteristic, and the alleged limitation of choice in this regard.

The Independent JPEG Group reference implementation so far supports various bit depth settings, but the problem is that it is a compile time choice and not a runtime choice, and so different settings

are not compatible (interchangeable).
The default setting is 8 bits per sample, and other settings are not compatible (interchangeable).
Therefore one often finds the statement that JPEG would be limited to 8 bits per sample and would thus not support HDR (High Dynamic Range) applications which require 10 or more bits per sample.

JPEG 10 will introduce a basic new feature which allows to support sample values with up to 3 more bits than the nominal JPEG data precision parameter with up to lossless operation. The generated JPEG files are fully interchangeable for the same JPEG data precision parameter.
So particularly it will be possible to process 10 bit HDR sample data up to lossless with backward compatibility (nominal 8 bit JPEG data precision parameter) for file interchange.

How is that magic possible?

The magic is possible simply by adapted DCT processing, since the DCT coefficients are 3 bits larger than sample values with normal DCT processing.

DCT is the Discrete Cosine Transform, core component of the JPEG process. The historical development of the DCT was described in a previous article about the 30th anniversary of JPEG. Implementing fundamental DCT properties is the core of Independent JPEG Group's work, because it is the timeless substance of JPEG.
The new feature of JPEG 10 is just another cornerstone on this path.

While the basic principle of the new feature will be rather simple and obvious, the actual implementation will be quite extensive, because it requires a major overhaul of the whole DCT engine. There is a whopping number of 68 DCT functions which need to be adapted.
The overhauled DCT implementation will also reveal the abuse by the circulating fake JPEG Library distributions with wilful disregard and pitiful coding. This deliberate infringement of fundamental JPEG principles causes notable damage to the image processing ecosystem.

Notice that any circulating standard JPEG image with nominal 8 bit JPEG data precision parameter can potentially contain up to 11 bits per component data, also lossless in case of JPEG 8 or newer.
The Independent JPEG Group has introduced lossless transformation functions for JPEG a long time ago. These functions become even more important now, because they keep the original data range independent from the sample size. So they should always be used if possible to avoid degradation.

It can now be better understood why JPEG still is and will remain the dominant photographic image format: Even in its current standard form with nominal 8 bit JPEG data precision parameter, the potential data range is up to 11 bits per component, also lossless in case of JPEG 8 or newer.
This is necessary in order to support the current 10 bit HDR display standard.
An investigation published by the British Broadcasting Corporation (BBC) in September 2015 reveals that 10 bits can already cover the whole perceptible dynamic range, with appropriate gradation curves.
For example, Apple specifies "Support for 1 billion colours" for their displays, which corresponds to 30 bits per pixel or 10 bits per component.
JPEG 10 also provides an updated roadmap for higher sample size and data precision configurations.

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