

# Joint Photographic Expert Group (JPEG) Image Coding Standard

## Background

Digital photos have advanced e-commerce significantly, where digital images of products have become an essential part of merchandizing opportunities. And sharing digital photos has become one of the most popular modes of online social interaction, with millions of images shared every day via e-mail and on enormously successful social networking sites. The technology that enables digital photography is the industry adoption of the joint photographic expert group (JPEG) image coding standard, a hugely successful joint effort between the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and the International Telecommunication Union-Technology Standardization Sector (ITU-T).

In the early 1980s, the only mode of transmission of images was via facsimile. As demand for more advanced technology grew, technical experts from ISO, IEC, and ITU began work on a joint international standard for the compression of continuous tone, grayscale, and color still images. The result was the publication of ISO/IEC 10918-1, *Information Technology - Digital Compression and Coding of Continuous-tone Still Images: Requirements and Guidelines*, in 1992 which provided the baseline for the JPEG image coding standard.

## Problem

The goal of the JPEG standard was to develop a general method for image compression that would meet a wide range of requirements and applications. The standard needed to be state of the art in image compression and allow users or applications to tradeoff easily between desired compression and image quality. But at the same time, it needed to be of modest computational complexity, and allow for sequential coding, progressive coding, lossy coding, lossless coding, and feasibility of hardware implementation.

## Approach

The development of JPEG followed the operating directives governed by ISO and ITU, based on a consensus approach in the selection of technology and methods. An important part of the standard includes a set of conformance rules with published test data and procedures – helping to ensure that any implementation of the standard conforms to the standard as published.

The JPEG baseline technology adopted at the time of its development was based on a simple, efficient, eight by eight discrete cosine transform (DCT) compression algorithm that used Huffman coding, operated in sequential mode, and restricted to eight bits/pixel input. Aside from its technical merits, the success enjoyed by JPEG can be attributed to the availability of free and efficient software developed by consortia. Part of the success of JPEG is also due to the introduction of the ISO/IEC 10918-5, *Information Technology - Digital Compression and Coding of Continuous-tone Still Images: JPEG File Interchange Format (JFIF)*, a file format that makes the popular file extension ‘.jpg’ synonymous with JPEG compressed images.

## Outcome

After the publication of the JPEG standard, the development committee has continued to work diligently in delivering innovative imaging standards that can serve new requirements in imaging applications, using the most advanced technology from research in the imaging field. For example ISO/IEC 15444, *Information Technology - JPEG 2000 Image Coding System: Core Coding System*, a comprehensive imaging coding system addressing new requirements not included in the original JPEG standard; ISO/IEC TR 24800, *Information Technology - JPSearch*, addressing the need for image search and retrieval; ISO/IEC CD TR 29199, *Information Technology - JPEG XR Image Coding System*, covering extended range technology; ISO/IEC NP 29170, *Information Technology - Advanced Image Coding (AIC)*, covering coding of audio, picture, and multi- and hyper-media information; and, most recently the new work item ISO/IEC DIS 18477-1, *Information Technology - JPEG Extensions HDR Image Coding System*, addressing the needs of high-dynamic range imagery, currently under development.

The adoption of JPEG 2000 in a wide variety of imaging applications such as digital cinema, remote sensing, image surveillance, digital culture imaging, and archiving illustrates its success. The work of JPSearch will benefit the image search and retrieval system greatly. And JPEG Extensions will address the need for high-dynamic imagery to come.

The JPEG committee has enjoyed the success of the imaging standards it has developed through adoption by industry and users for over 20 years. The exceptionally successful JPEG standard is utilized every day by millions of users worldwide to share and print digital photos and images.