FPX (flash pix)

Background

For years, the computer industry has come up with one imaging system after another, all focused on the best way to store images. Unfortunately, most systems don't provide a very good way to use images.

For consumers and Small Office/Home Office (SOHO) users, it's very difficult and time-consuming to add digital photographic images to documents. Systems require that the user select the needed resolution upon insertion, thus creating a need for information the user may not have or even understand.

In early 1995, Kodak and other key industry partners -- Microsoft Corporation, Hewlett-Packard Company and Live Picture, Inc. -- joined in a cooperative effort to design a new image format. The objective was a format that would enable the industry to deliver desktop computer solutions that make it easy, enjoyable, and commonplace to use digital color photographic images in offices and homes. The keystone of the format is the FPX file format. This file format was officially introduced in June 1996.

The FPX Image File

FPX is a multi-resolution image format in which the image is stored as a series of independent arrays, each representing the image at a different spatial resolution. In other words, there would be many different images at different distances/resolutions. Usually when a user zooms in on an image the image will loose quality. With FPX, the array of images all at different resolutions will allow the computer to create a clear representation of the zoomed picture on different output devices at different resolutions with minimal resizing of the image.

With an intelligent software layer on top of the format, this multi-resolution ability is achieved transparently to the user.

File Size

A FPX file requires about 33% more disk storage space -- if uncompressed -- than a TIFF file because of the extra resolutions contained in it, but:

- ?? It requires much less RAM for viewing; approximately 20% of the RAM required for a TIFF file
- ?? It takes much less time to modify an image and store the revision
- ?? Only the viewing parameters need to be modified, not the actual image
- ?? In most applications, FPX files reduce storage

In summary, a FPX file requires a less powerful computer. Less data is stored in RAM and less data is processed. FPX files offer a significant speed advantage to the computer user. Images burst upon the screen and are quickly modified regardless of their maximum resolution.

Capabilities

The FPX image file provides a common foundation upon which to build products that can be universally connected ... computers, applications software, capture products, sharing networks, printing, and services. In addition, it is more than a format. It requires products to use images differently.

In addition to specifying the organization of image data, FPX also defines a resolution-independent coordinate system for describing the locations of points in the image.

A structured storage format was chosen as the "wrapper" for FPX files. FPX structured storage format provides compatibility with Microsoft's structured storage format and other structured storage paradigms. Structured storage can be likened to a "file system in a file"; a structured storage file contains both storages (directories) and streams (files). Any application that understands the structured storage format can add additional storages and streams to any structured storage file at will, which will be "invisible" to the original application. A FPX file consists of a number of storages and streams, which can provide independent access to different parts of the file, such as a file system can provide access to multiple files at once.

The FPX file format provides an extensible color format that includes two unambiguous color space definitions, and optional support for the International Color Consortium (ICC) color management scheme.

The FPX file format provides a strong format for the encoding and storage of colors within an image. The format is intended to be extensible and to address many of the concerns of today and some of the concerns of tomorrow.

As with almost all existing image formats, the ability to compress image data is important, It is especially important in FPX, as the hierarchy of resolutions combined with the small disks often found on low-end machines can produce an unusable system if the image data in not sufficiently compressed.

The basic compression block in FPX is the tile. It is important that a reader be able to access individual tiles, so any compression must not preclude accessing only a single tile. FPX allows three compression methods:

- Uncompressed
- Single Color Compression
- JPEG Compression

Each tile is compressed individually from all other tiles, both in its present resolution and in all other resolutions. Each tile may be compressed using a different compression method, which allows an output device to determine the best method (for either size or reconstruction speed) depending on the data in that file.

The FPX format also provides for the storage of a large amount of non-image data. FPX draws upon many other formats (JFIF, TIFF, TIFF/EP, Photo CD Image Pac™, APS, etc.) for the types of information that should be stored. FPX groups non-image data into the following groups:

- File Source
- Intellectual Property
- Content Description
- Camera Information
- Per-picture Camera Settings
- Digital Camera Characterization
- Film Description
- Original Document Scan Description
- Scan Device

The FPX Image View provides a way to store a script of a few basic edits to be performed on a FPX image. It also provides a place to cache the result of performing the script. FPX supports the following operations in the Image View:

- Result Aspect Ratio
- Rectangle of Interest
- Filtering
- Spatial Orientation
- Colortwist Matrix
- Contrast Adjustment

Pros / Cons of File Type

While file format overhead and the size of the code required for reading and writing must be acknowledged as distinct disadvantages of the FPX file format (especially for people with low-end equipment), the number of technical features designed into the format coupled with support from Microsoft, Hewlett-Packard, Live Picture, Inc., and Kodak offer compelling advantages over any other system available.

Features	**Benefits**
Structured Storage	Standard access
Hierarchy of independent resolutions	Resolution-independent image handling
Tiled sub-images	Access viewable portion only

Support multiple color spaces	Flexibility
Optional JPEG compression	Fast network access
Viewing and composition parameters	Non-destructive editing
Descriptive information	Image databases
Distribution of sub-images	Optimize media costs, access speed

Likely Use of File Format

The following is a list of application categories for which the FPX file format will be well suited:

- Low-End Photo Editing/Entertainment
- Web Browsers
- On-line Information Services
- Office Suites
- Word Processing
- Presentation Graphics
- Low-End Desktop Publishing
- Draw/Illustration
- Miscellaneous Imaging Products

Application Examples

In order for the FPX format to become a standard, it is important that it enable the leading software programs currently on the market ... as well as innovative new applications already under development for both Macintosh and Windows platforms.

A Day in the Life of a FPX File User

Janice has heard about how FPX powered products and services have made using images as easy as text. Given her previous experience she is skeptical, but decides to give it a try. Janice decides to create a personalized business letter that includes several photos of a rental property in Key West, Florida. Janice's first step is deciding on the scenes that need to be captured. She selects four photos that show exterior and interior views of her rental property. Her selection is typical of business users who tend to use pictures of specific objects or places as opposed to images that communicate at a conceptual or emotional level.

Janice has three possible methods for creating a digital image and best of all they will all support these new FPX image files.

- Capture the scene using a digital camera
- Scan a slide, negative, or print of the original scene
- Pay a service provider to create a digital image

Janice selected the second choice because it was -- for her -- the easiest way to get FPX files and they are compatible with her word processing and other desktop software programs. She dropped her film at the local photo shop and picked it up the next day. The cost was affordable ... about ten dollars for a roll of film.

Janice inserts her CD with FPX files into her multimedia computer and uses desktop software to select the desired picture, quickly placing the image into her letter. The picture is automatically sized and cropped to fill the frame in her letter. The operation took less that five seconds.

Once the image is placed, Janice precedes to enter the text of her letter along with the other images. She experiences no perceivable performance delays and can enter the text as fast as she can type.

Upon further examination of her document, Janice realized that she would like to make some minor edits to her picture. She wants to crop the image, adjust the horizon so that it is horizontal with respect to the text in the letter, and adjust the color balance. To do this, Janice simply double clicks on the picture and is presented with editing tools.

First, she uses the horizon tool to adjust the horizon. The tool is easy to use. Processing takes a few seconds. The next step is to crop the picture. This is done using the zoom out tool so that the entire picture can be displayed on the screen. The screen is refreshed in three to five seconds. Janice then selects the area of interest by drawing a rectangular box around it and crops the picture. Processing time is again just a few seconds. She performs the last edit using the color correction tool and makes the image more blue so that the ocean view and skyline are enhanced. Processing takes another five to ten seconds. Once the edits are completed, Janice saves the file. It takes another three seconds to write the file to her hard drive. The file only consumes 2 KB of disk space.

Now that the image has been edited and saved, Janice returns to her document. The OLE feature of her desktop software automatically updates the picture in her document ... an operation completed in five seconds. Janice performs the process three more times for the remaining pictures. It has taken her significantly less than half an hour to add, edit and creatively place four pictures in her document. She is pleased with the improvements in her document. Her previous experience was much more difficult and took more than a half hour for just one picture.

Janice now prints the document on her color inkjet printer. The printing takes several minutes and is performed in background so she can continue using her computer. Janice is pleased with her print. The color is correct and the resolution is great.

Advanced Photo System (APS)

Background

The concept for a totally new photographic system had its beginnings in 1990, as Kodak began searching for ways to excite the photographic industry and better serve consumers.

In April 1991, a team was formed to take the concept to the marketplace. It included marketing, market research, film research and development, film manufacturing, camera design, photofinishing equipment design, photofinishing services, finance, system integration and industrial engineering.

Within months, the next major step was taken. Canon, Fuji, Minolta and Nikon signed a joint development agreement to work with Kodak to develop specifications for a new photo system. The tempo increased as representatives of the System Developing Companies traversed the globe to finalize a system feature set and standards for the Advanced Photo System™.

One key to success was the development and implementation of an effective information exchange technology, or means of transferring camera data (date, time, aperture, flash, etc.) to the photofinishing equipment using the film itself as the exchange vehicle. The entire back surface of the film base would be coated with a virtually transparent magnetic layer which can be used to store the camera data for later use by the photofinisher.

The Advanced Photo System was officially and jointly launched by the System Developing Companies in April 1996.

The APS File

APS is not a computer imaging file such as TIFF or PICT. The end-user (photographer) does not take unprocessed film out of a camera to use in a computer. Information is recorded initially on a magnetic layer as the consumer is taking pictures. In general, the magnetic tracks located adjacent to frames are used to record information which pertains to that frame.
For example, the date and time the picture is taken. Information recorded on the leader pertains to all of the exposures on the roll. An example of this information might be the serial number of the camera.

File Structure

The technology for information exchange is similar to VCRs, audio cassettes, and personal computer floppies. A magnetic layer is applied to film. Various areas or "tracks" on that layer are assigned to different functionalities:

- Camera data
- Photofinishing data

Additionally, the architecture is open, allowing for future expansion of magnetic use and enabling the delivery of richer functionality to the consumer.

Capabilities

As indicated, the magnetic coating on the film has tracks which are dedicated to camera use or photofinishing equipment use. The number of data items available for each of these tracks is dependent upon the make and model of camera as well as the make and model of photofinishing equipment. Also, since the product is so new, some of the data -- while potentially deliverable -- may only become available on downstream models.

Camera Data Items:

- Date and time
- Camera hand of load
- Aspect ratio
- Flash fire
- Brightness value
- Artificial illumination
- Flash return
- Sensed camera orientation
- Backlighting
- Exposure beyond range
- Series scene
- Subject location
- Print quantity
- Elapsed time
- User selectable frame title
- User input frame title
- Camera F-stop setting
- Camera shutter speed
- Camera ISO setting
- Camera exposure bias setting
- Camera metering mode
- Lens maximum f-stop
- Camera frame input priority list
- Language
- Fixed time printing mode
- Filmstrip sequence number
- User selectable filmstrip title
- Camera owner ID
- Camera serial number
- Reorder negative frame numbers to be printed

Photofinishing Data Items:

- Number of prints from this frame
- 1st through 4th order request
- Reorder frame paper size

?? Reorder frame paper surface
?? Reorder crop instructions
?? Reorder enlargement rotation instructions
?? Local product code
?? Customer exposure information
?? Customer exposure correction information

?? Vendor ID
?? Camera date format override
?? Camera time format override
?? Aspect ratio override
?? Illumination override
?? Series scene override
?? Print location
?? Camera orientation override
?? Subject location
?? Priority indicator
?? Number of prints, each frame
?? Print location
?? Fixed time printing mode override
?? Envelope number
?? Dealer coupons
?? Filmstrip paper size
?? Filmstrip paper surface
?? Language
?? Customer name or ID

There is a brief additional list of "internal" data that is specific to photofinishers, dealers and vendors.

Pros / Cons of File Format

From a positive perspective, the recordable "digital" data will enable consumers to get better pictures with less effort, but the introduction of APS technology should not be thought of as the introduction of a new computer imaging format.

Likely Uses of the File Format

Initially, the sole use of the APS file format will be to provide information exchange between APS cameras, film and photofinishing equipment.

Industry Involvement

While the development of the Advanced Photo System was driven by Kodak, it was important to gain cooperation from other major companies in the industry. Canon, Fuji, Minolta and Nikon were selected and chose to participate in APS development. Each manufacturer is marketing their own series of APS-compatible products. In addition, many other manufacturers have signed licensing agreements to develop hundreds of Advanced Photo System products and services.

Kodak envisions early interface with Photo CD technology, as well as the potential for image enhancement through such products as the KODAK Creation Station, Digital Enhancement Station and Copy Print Station.

A Day in the Life of an APS User

Beth is excited. She's about to use her new Kodak Advantix camera for the first time at her grandson's birthday party. She knows the camera will record the Date and Time, the desired picture format, and a basic Picture Quality Improvement data set consisting of flash information (did it fire?) and the brightness of the scene. In addition, however, Beth has indicated through the camera's user interface that she wants a special notation (Happy Birthday) printed on the back of this picture.

The picture format and the notation are saved in the camera's memory before the picture is taken, in much the same way as a computer saves information in RAM. When the picture is taken, the camera collects the Date and Time, the brightness of the scene, and the flash information and saves it in the memory as well.

All the information is combined into a packet, and a numeric identifier which identifies the contents, is added. Moments later, when the camera advances the film strip to the next frame, the information packet is retrieved from the camera's memory and recorded on the filmstrip as it passes over a magnetic recording head in the camera's film path.

The above process is repeated for each exposed frame on the filmstrip, and then the cartridge is sent in for processing.

After developing, the photofinisher has a filmstrip which not only contains the negative images, but also includes magnetic information about each exposure; information that can be used to improve the print quality and deliver desired features. The information simply needs to be retrieved.

The photographic printer uses the aspect ratio data to determine cropping of the negative in order to automatically produce the desired print format. The flash information and the scene brightness information are used to make exposure adjustments for printing to provide the best quality color possible. And last, the Date and Time, and the words Happy Birthday are imprinted on the back of the photographs where they won't interfere with the image.

Image Pac

Background

Kodak announced the concept of the Photo CD System to the world in late September of 1990. It was originally introduced as a means whereby the consumer could store his or her pictures on a convenient, compact disc and view them easily on any television set.

By the time the Photo CD System was ready to go to market in the Summer of 1992, two facts had become very obvious.

First, the concept wasn't being embraced by U.S. consumers at the expected pace.

Second, people in the commercial and professional markets couldn't seem to learn enough about the technology.

Kodak responded quickly to determine what modifications had to be made to the system to meet the needs of these professionals.

Before 1992 had ended, Kodak had introduced new media formats targeted specifically at the professional and commercial imaging market ... and, had succeeded in convincing virtually every major manufacturer of digital equipment and software to endorse the KODAK Photo CD Image Pac file format as the digital image file standard.

The PCD Image File

As initially conceived, a PCD file -- or Image Pac -- could be created from any 35mm color or black and white negative or color slide. After conventional processing, the film is scanned and digitally written to a Photo CD disc. Each disc holds approximately 100 images. A thermal index print with a file access number for each image is intended to simplify image selection for viewing on a television set with a Photo CD player or on the monitor of a computer with a CD-ROM XA drive.

File Structure

Rather than attempt to adapt an existing file format -- such as TIFF, PICT, or EPS -- Kodak elected to develop a totally dedicated color encoding scheme called Photo YCC for its Image Pac file format. Several requirements were established:

- Support of Multiple Display Resolutions
- Fast Access to Video Resolution
- Practical Disc Capacity
- Device Independent Color Encoding

Since the initial concept called for viewing on television, the requirement for standard TV resolution was obvious.

To make the system "Future-Proof" a High-Definition TV resolution was included, along with a higher resolution for hard-copy output.

To meet the needs for fast viewing of low-resolution images or thumbnails of all the images on a disc, two additional resolutions were included.

And, at a later date, an additional resolution was incorporated on selected disc formats. This resolution is designed primarily for storage of larger format originals, such

as 2-1/4 and 4 X 5 images.

The six resolution levels and their respective sizes are:

- BASE / 16 128 X 192 Pixels
- BASE / 4 256 X 384 Pixels
- BASE 512 X 768 Pixels
- 4*BASE 1024 X 1536 Pixels
- 16*BASE 2048 X 3072 Pixels
- 64*BASE 6144 X 4096 Pixels

File Size

To maintain near-photographic quality for hard-copy output, it was necessary for the Photo CD system scanner to operate at a resolution of 2048 X 3072 pixels for each of three colors (red, green, and blue). The file for a single 35mm image would, therefore, require 18 MB of storage capacity.

Such file size complicates the requirements for fast access to television resolution and practical disc capacity.

At the time the system was launched, CD-ROM players accessed and transferred data at a rate of 150 KB/sec (1X). At this rate, it would take two minutes to display one image.

And, with a Photo CD disc capacity of about 540 MB, only 30 images could be stored on a disc.

To reduce the access time and increase the number of images that fit on a disc, the Photo CD System compresses Photo CD images.

In simplistic terms, data required for each level of resolution is recorded only once, so if a user selects the highest resolution, the system calls up the BASE resolution and only adds the residual values needed to produce the higher resolution image.

As a result, the final Image Pac file size ranges between 4.5 and 6.5 MB, which allows storage of up to 100 images on a single Photo CD disc.

Capabilities

The Image Pac -- or PCD -- file is a multi-resolution image format developed by Kodak as part of the Photo CD System.

Part of the initial strategy for the development and market positioning of the Photo CD

System was to establish the PCD file format as the industry standard for digital image storage.

Once an imaging professional has a library of images on one or more Photo CDs, a broad range of opportunities becomes available:

- ?? A user can quickly view all the images on a Photo CD in thumbnail format using the BASE / 16 Resolution
- ?? Individual images can be quickly viewed full-screen using the BASE / 4 Resolution
- ?? BASE resolution, which is standard video resolution, enables the viewer to see his or her images at the highest resolution attainable on a television set. This resolution is also useful for on-screen multimedia presentations
- ?? 4*BASE resolution is being used for desktop thermal "proof prints", and in those parts of the world where High Definition TV is already in use, viewers can take advantage of this Image Pac component
- ?? For desktop publishing and commercial printing applications where the film original was 35mm and the ultimate image size is, in general, not going to exceed 5 X 7 inches, the 16*BASE resolution can be utilized
- ?? For applications where the film original is large format and the ultimate image size will exceed 5 X 7 inches, the 64*BASE resolution is available (only on a Pro Photo CD Master disc)

Pros / Cons of File Type

The PCD file format was designed to reliably perform a specific function. However, the equipment and software required to scan an image from film and write it to a PCD file is expensive.

As a result, unless a company has sufficient continuing work of this nature to justify the cost, the process is more logically performed by a service bureau. This, of course, means dependence on the service bureau production schedule and pricing structure. And, if a user edits or manipulates an image, the altered image cannot be easily stored back on a Photo CD disc.

Likely Uses of the File Format

The Image Pac is a proprietary file format designed specifically for storing photographic quality images on CD. It is now used in numerous pre-press, scientific and commercial applications.

Industry Involvement

Most major hardware and software manufacturers have endorsed the Kodak format as an industry standard and have upgraded their products to be fully compatible.

Application Examples

The list of applications for the PCD file format is presently limited to one ... the storage of high-quality digital color images on a proprietary optical disc. The potential applications for the Photo CD System, on the other hand, are numerous and exciting.

Archiving - Museums, libraries, universities and major corporations all have needs for archiving images. Photo CD is considered the affordable, quality archiving solution.

Catalogs - Everything from crystal and china to clothes and stock photography.

Prepress - Affordable alternative to drum scanning ... allowing "re-purposing" and reuse of images.

Multimedia - Images, graphics and audio ... to inform, to teach, to sell, and to entertain.

A Day in The Life of a PCD User

For a small manufacturing company, hiring a professional photographer to shoot its whole product line -- along with images of its facilities and its top executives -- is a major investment; one from which management wants to get its money's worth.

Kassi, the company's communications manager, put plans in place to make that happen, even before any photography began. She discussed the options with the photographer while they planned the shoot.

- Most of the facilities images would be shot on 35 mm film
- The products would be shot on 4 X 5 film
- The management team portraits -- along with a few key facilities images -- would be shot on 2 1/4 film.

After all of the photography had been shot and edited, the photographer arranged to have selected images scanned onto a Pro Photo CD Master disc. Kassi decided to order ten copies. It was a wise decision.

The ad agency got one disc and immediately set to work laying out the company's new product literature. The layout and text were created in Quark Xpress. The images were opened in Photoshop, sized and cropped, then exported as TIFF files and positioned in the Quark document.

Meanwhile, Jason, in the public relations department, reviewed his copy of the disc and selected portraits of several corporate officers for use in electronic press releases scheduled to be mailed out by the end of the week. He also contacted the photographer to order framed 8 X 10 prints for the families of each of the executives.

Jennifer, in the AV department, started pulling images of the corporate facilities from her copy of the disc to add some polish to the multimedia CD-ROM she's creating to promote the company's capabilities.

Barb, in Human Resources, asked for a copy of the disc. She found a shot of the company's president talking with workers on the shop floor that's a natural for the upcoming issue of the employee newsletter. She'll acquire it in Photoshop, crop it, screen it in grayscale (since the newsletter is reproduced in

one color) and export it to her Pagemaker document.

Kassi sent copies of the disc to each of the company's four Regional Sales Managers along with suggestions for using them when customers visit the regional offices. She suggested that the disc could be used like a tray of slides ... with random access, so only selected images would be viewed. Or, some of the product images on the disc could be imported directly into a PowerPoint presentation on a laptop computer for use during a series of sales calls.

And the last two copies of the disc? Well, one was put aside for a trade journal that has indicated an interest in doing a feature article on the company ... and Kassi proudly put a label on the tenth copy that reads "Corporate Image Archives: Volume I".

Digital Camera System

Background

The promise of electronic still cameras was met with mixed emotions during the 1980s when analog cameras were first introduced. There was concern about the quality on the image; there was concern about the cost of the equipment; and there was concern that electronic image capture was a threat to traditional photography.

Since then, a number of digital cameras have reached the marketplace. Images are captured using a solid-state image sensor, such as a CCD (charge coupled device), instead of film. Kodak has developed a family of digital cameras for the professional and non-professional photo enthusiast

The output of the CCD is stored in digital memory, typically using solid-state memory ICs or a magnetic hard drive. The storage medium may be fixed inside the camera and/or contained on a removable card.

To view or edit images, they are downloaded to a computer. To do this, the camera is connected by cable to a computer, or the removable card is inserted into the PCMCIA slot in a computer. Some types of digital cameras include an LCD display to view images, or a video output connection to a television set.

The Digital Camera File

There are a number of file formats used in the current generation of digital cameras. They include TIFF and Exif (Exchangeable Image Format), which is used in Fuji digital cameras. Most Kodak cameras use a version of TIFF called TIFF/EP (Tag Image File Format for Electronic Photography). TIFF/EP allows many different types of image data to be stored in the image file, along with non-image data such as the date and time, lens aperture setting, subject distance, etc.

In order to maximize the number and quality of the images stored in memory, current Kodak digital cameras store an intermediate image representation. This

intermediate image data in the TIFF/EP file is further processed by special Kodak image processing on the host computer to create the final, full color image.

The host software then stores the final color image in one of many different formats specified by the user, such as a PICT file, a BMP file, or a JPEG compressed file. Eventually, To support the FPX™ image format, the host software applications and TWAIN drivers can be revised in order to include a "Save as" FPX file output option. In this case, the final, full color image will be expanded into the full FPX resolution hierarchy, just as if the image was from a Kodak FPX formatted CD.

All of the non-image data supplied by the camera can be stored in the appropriate FPX storages, since the FPX non-image data storage capability was designed to accommodate all of the non-image data in the TIFF/EP and Exif formats.

A Day in the Life of a Digital Camera File User

Michelle works as a marketing communications specialist for a major corporation. Several months ago, her department invested in six KODAK digital cameras. The primary intent was to use the digital cameras to capture images of the company's products in the field for use in PowerPoint presentations and to add some polish to the department's internal newsletter ... which always seems to find its way into an external environment.

Michelle took one of the cameras with her on a site inspection for the company's sales meeting in Scottsdale. When she brought back the images, she and Alex -- her supervisor -- were commenting on the excellent image quality, when it struck Michelle that the Kodak digital camera presented a fast and cost-effective means of producing a "Happy Faces" show for the closing session of the sales meeting.

With all six cameras shooting throughout the first three days of the meeting, Joe -- the department's computer whiz -- was fed a continuous supply of removable memory cards. He simply imported the images into a PowerPoint presentation template he'd produced beforehand, after completing some basic crops and saving them as TIFF files.

It was a great success. Everyone got to see themselves at work and at play. For Michelle, it was just one more feather in her cap.

Other File Formats

Background

During the early years of computer graphics development and the race for dominance by both hardware and software manufacturers, many proprietary formats were designed. Every graphics program saved files in its proprietary -- or native -- format, and therefore, any file saved from a specific application and used exclusively by that application was -- and still is -- known as a native file.

Unfortunately, these native files weren't always readable by other applications ... especially when the native file was originated in a Mac-based application and the target application was PC-based or vice versa.

With greater demands for inter-application compatibility and cross-platform compatibility, many developers and manufacturers realized that survival was closely linked to meeting those demands.

Today, most major graphics applications can save and open both in their native formats and in a number of other formats that can be used to transfer images from one application to another or from one platform to another.

The TIFF File

TIFF -- or Tag Image File Format -- was developed by Aldus Corporation in 1986, specifically for saving images from scanners, frame grabbers, and paint/photo-retouching programs.

Today, it is probably the most versatile, reliable, and widely supported bit-mapped format. It is capable of describing bilevel, grayscale, palette-color, and full-color image data in several color spaces.

It includes a number of compression schemes and is not tied to specific scanners, printers, or computer display hardware.

The TIFF format does have several variations, however, which means that occasionally an application may have trouble opening a TIFF file created by another application or on a different platform.

The PICT File

The PICT format -- which is not an acronym -- is native to the Macintosh. It first appeared in 1984 with the introduction of MacDraw software. Since then, it has been used by many applications, especially when images are designed for screen previews. It is great for presentations, screen displays, and video work.

The PICT format can contain both bit-mapped and object-oriented graphics. It is a standard format for graphics that are cut or copied to the Clipboard and for drawings that will be output on raster printers.

The EPS File

EPS -- or Encapsulated PostScript -- files are the standard format for storing high-resolution PostScript illustrations. The EPS format -- which was introduced in the mid-'80s allows both Mac and Windows users to save bit-mapped screen representations of screen images. These previews, however, don't travel well across platforms.

An EPS file generally has two parts: a PostScript (text) description that tells a PostScript printer how to output the resolution-independent image, and

(optionally) a bit-mapped PICT image for on-screen previews.

A drawing saved in EPS format can be imported into other documents and scaled and cropped, but its contents are often no longer editable, even by the program that created it (Adobe Illustrator files are the exception).

The GIF File

GIF -- or Graphics Interchange Format -- files define a protocol intended for the on-line transmission and interchange of raster graphic data in a way that is independent of the hardware used in their creation or display.

The GIF format was developed in 1987 by CompuServe -- one of the world's most successful bulletin board services -- for compressing eight-bit images that could be telecommunicated through their service and exchanged among users.

The GIF file is defined in terms of blocks and sub-blocks which contain relevant parameters and data used in the reproduction of a graphic. A GIF data stream is a sequence of protocol blocks and sub-blocks representing a collection of graphics.

The JPEG File

JPEG is a standardized image compression mechanism. The name derives from the Joint Photographic Experts Group, the original name of the committee that wrote the standard. In reality, JPEG is not a file format, but rather a method of data encoding used to reduce the size of a data file. It is most commonly used within file formats such as JFIF and TIFF.

JPEG File Interchange Format (JFIF) is a minimal file format which enables JPEG bitstreams to be exchanged between a wide variety of platforms and applications. This minimal format does not include any of the advanced features found in the TIFF JPEG specification or any application specific file format.

JPEG is designed for compressing either full-color or grayscale images of natural, real-world scenes. It works well on photographs, naturalistic artwork, and similar material, but not so well on lettering or simple line art. It is also commonly used for on-line display/transmission; such as on web sites. A 24-bit image saved in JPEG format can be reduced to about one-twentieth of its original size.

The Photoshop File

A Photoshop file is the native file format for Adobe Photoshop. A file saved in this manner can only be opened and edited in Photoshop. However, the user has the option to save the file in a variety of other formats that are readable in both the Macintosh and PC environment.

The major advantage of the Photoshop format becomes apparent when working on documents with layers. For example, a background can be created on one layer, then graphics can be added on a second layer, a drop-shadow on a third layer and text on yet another layer. Each layer is independent of the others and can be edited separately without affecting the contents of the other layers.

Photoshop supports the preservation of layer information, so that the layers can be preserved for additional editing.

The IVUE File

The IVUE file is a format developed by Live Picture, Inc. to work with its FITS (Functional Interpolating Transformation System) technology.

Image editing actions are stored mathematically in a FITS file, while the original pixel data is saved in the IVUE format. A new output file is created from the original IVUE image based on the FITS file in a single, final RIP process that avoids cumulative processing error.

The major advantage of the format is its ability to deal only with that portion of an image being edited, thereby greatly speeding screen display between edits.

A Day in the Life of a Common Image File User

While the number of computers in homes and small businesses has skyrocketed in recent years, the percentage of those computers used for digital imaging is extremely low.

If computer users were to be categorized with regard to their use of digital imaging, they would fall into three broad groups:

The Power Users could be defined as a small minority of imaging professionals and other highly-proficient computer users who have the knowledge, the high-powered hardware and the software required to deal with current imaging technology.

The Unsold Masses are that vast majority of computer users who haven’t even tried to use pictures. They think of computers as tool for word processing and spreadsheets.

In between those two very disparate groups is a third which could be called the Frazzled Few. These are average users who have tried digital imaging only to be frustrated by a complex array of image formats, resolutions, slow performance, inconsistent color output and inadequate storage. A fraction of these people invest the time and money to become "Power Users," but most of them simply give up on digital imaging for the time being.

John is one of these people. He works at a small manufacturing company and does desktop publishing for a variety of departments, including sales, human resources, engineering and manufacturing. With their collective demands and short deadlines, he puts in a full day ... and then some.

Recently, the sales department asked if he could add some color images to a sell sheet he was preparing for them. The idea appealed to John, even though he knew it would mean more hours because he’d never explored digital imaging.

The first shock was the array of technical terms and buzz words such as aspect ratio, lines per inch, pixels per inch, dots per inch, color balance, saturation ... and on and on.

John decided to "wing" it. He bought a film scanner, hooked it up to his computer and started acquiring images for the sell sheet. First he had to decide what resolution to use. The sell sheet was going to be printed on a high-quality stock, so he opted for the highest resolution.

That was the first problem. He found himself with an 18 megabyte file, and his system choked on it. He rebooted and reduced the resolution. Now he had a 4 MB file. That seemed more reasonable, so he proceeded to crop it and do a little enhancement in Photoshop.

Everytime the screen refreshed itself, it seemed to take forever. Of course, for imaging professionals with their high-powered graphics workstations this kind of work is no problem, but for John -- with his Pentium 100 and 16 MB of RAM -- it becomes a real challenge. He called his computer supplier and asked what it would cost to upgrade to a system that could handle this kind of work. The answer he received was the second shock.

Then, to top it all off, one of the images he needed came from the Mac-based ad agency as a TIFF file. Now he had to figure out how to import the image at the right resolution and at the right size. For John, time was ticking away ... and total frustration was setting in.

The final shock came when John received an estimate from a local service bureau to outsource the job.

The bottom line? He'd blown the budget on the sell sheet project; he'd spent so much time on it that he'd missed deadlines for other departmental clients ... and he wasn't anxious to get involved in digital imaging again soon.

John had become one of the Frazzled Few.

Further Information on Graphic File Formats

More information on graphics file formats and closely related topics can be found in a variety of resources such as:

Encyclopedia of Graphics File Formats, James D. Murray and William vanRyper (O'Reilly & Associates Inc. 1994)

File formats for Popular PC Software: A Programmer's Reference, Jeff Walden (John Wiley & Sons, Inc. 1986)

File Format Handbook, Allen G. Taylor (Microtrend Books 1992)

The File Format Handbook, Guenter Born (International Thomson Computer Press 1995)

Graphics File Formats, David C. Kay and John R. Levine(Windcrest Books/McGraw-Hill 1995)

Graphics File Formats: Reference and Guide, C. Wayne Brown and Barry J. Shepherd (Manning Publications 1994)

The Graphic File Toolkit: Converting and Using Graphic Files, Steve Rimmer (Addison-Wesley 1994)

High Resolution Graphics Display Systems, Jon Peddie (Windcrest Books/McGraw-Hill 1994)

Inside Windows File Formats, Tom Swan (Sams Publishing 1993)

Internet File Formats, Tim Kientzle (The Coriolis Group 1995)
PC File Formats & Conversions, Ralf Kussmann (Abacus 1990)