Bitmap or Vector Image: Which Do You Choose?

Graphic images – such as photographs, illustrations, drawings, logos, and clip art – are a great addition to any printed piece. When combined with text, images measurably increase reader comprehension, retention, and interest when compared to text only.

In printing and publishing, graphic images are two-dimensional (2D), while on the World Wide Web, images can be two- or three-dimensional (3D) or multimedia.

How graphic images are formed

There are two ways to form graphic images: pixel by pixel in a grid (called a *bitmap* or *raster* image) or mathematically from geometric objects such as points, lines, curves and polygons (called *vector* images). Digital photographs and all images that have been scanned are bitmap images; vector images originate primarily from illustration or drawing software programs or from plotters used in technical drawing.

Examples of **bitmap file formats** are Tagged Image File Format (TIF); Joint Photographic Experts Group (JPG or JPEG); Graphics Interchange Format (GIF), Adobe Photoshop (PSD); bitmap (BPM); Windows Paint (PCX); and pixel image format for Macintosh (PICT). Photo editing or image editing software such as Adobe Photoshop, Corel Paint Shop Pro or Microsoft Paint all work on bitmap files.

Examples of **vector file formats** are Encapsulated Postscript (EPS); Adobe Illustrator (AI); and CorelDRAW (CDR). Popular vector drawing software includes Adobe Illustrator, CorelDRAW, and Macromedia Freehand.

A *metafile* is classified as a vector file format, though it contains both bitmap and vector information (an object – the vector – is filled with a bitmap pattern). Computer Graphics Metafile (CGM) and Windows Metafile (WMF) are both examples of this graphics file format.

Both screen displays and graphics on the World Wide Web use bitmap image files, and GIF and JPG are the most widely used file formats in this application. Print projects can use either bitmap or vector images; the preferred file formats are TIF (bitmap) or EPS (vector).

Characteristics of bitmap images

A bitmap image is a matrix of individual dots (called *picture elements* or *pixels*), each having its own color. Because pixels are so tiny, the human eye is unable to distinguish them individually, and so perceives the image as having smooth gradations. Only when a bitmap image is greatly enlarged are we able to see the individual pixels.

Although bitmaps images can be any color, there are four common categories describing how color is used:

- *Line art* images contain only two colors – black or white. The computer has to use only one bit to assign color to each pixel: on=black; off=white.

- *Grayscale* images contain various shades of gray as well as pure black and white.

- *Multitone* images contain shades of two or more colors. A well-know multitone is the duotone usually consisting of black and one other color.

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• *Full color* images use a color space such as RGB or CMYK to assign colors to each pixel.

A bitmap does not need to contain a bit of color-coded information for each pixel on every row; it only needs to contain information indicating a new color as the display scans along a row. Thus, an image with much solid color will tend to require a small bitmap (and smaller file size).

Bitmap images are *resolution dependent*. (Resolution is a measure of the number of pixels used to create the image and is usually stated as *dots per inch* or *pixels per inch*.) Computer screens and the World Wide Web require fewer dots per inch (dpi) to render an image than a printing device; hence an image that has sufficient resolution for a screen display or web application may have insufficient resolution for printing.

In addition, because bitmap images are resolution dependent, it is difficult to alter the size without changing image quality. To make an image smaller, it is *downsampled* by throwing out pixels. *Upsampling* is used to make an image larger by adding new pixels through a process called interpolation. *Interpolation* assigns a color to the new pixel based on the color values of surrounding pixels. Interpolation, particularly when many new pixels must be created, often results in a blurry image.

Characteristics of vector images

A vector image is created from many individual, scalable objects (lines, curves and shapes) that are defined by mathematical equations. Instead of using individual pixels, a vector image describes a series of points to be connected. There can be many points to be connected or just a few control points connected with *Bézier curves*. Bézier curves were widely publicized in 1962 by Pierre Bézier, a French engineer who used them to design automobile bodies.

The objects in a vector image may be assigned attributes (such as color, fill, or outline) without affecting the object itself. A vector image can be altered (enlarged, reduced, rotated, stretched, etc.) without losing resolution, and any object in the vector image can be altered independently of other objects in the image. Finally, an object can be modified by changing its attributes or by shaping and transforming it. A font is an example of a vector image.

All these characteristics mean that a vector image can be changed without affecting its resolution, making it *resolution independent*. This makes a vector image a good choice for logos which must be re-sized frequently. And because a vector image file consists of points rather than bits, it tends to be much smaller than a bitmap image file.

Despite its many advantages, a vector image has one disadvantage: it cannot create a photorealistic image. Compared to bitmap images, the objects and lines of vector images may look artificial.

Which image file format is best?

Given the many choices for image files, what is the best choice? The answer depends on your application. If you are using images for screen display or for your company's web site, you may want to optimize on file size. In this case, GIF or JPG is the best choice.

But when you are selecting images to include in a document you are providing to us to print, we ask that you use either TIFF or EPS. TIFF is the leading professional image file standard; is supported by Mac, Windows and Unix platforms; supports RGB, CMYK and other color spaces; stores data with bytes in either Mac or PC order; and offers several compression formats. EPS is a Postscript file that also satisfies some additional restrictions that are intended to make it easier for software to embed an EPS file within a Postscript document. EPS files may also include a preview picture of the content for screen display.

Checking the resolution of graphic images is one of the steps in *preflighting* any document you submit to us for printing.