What's the difference between Bitmap and Vector?

Introduction

What is the difference between Bitmap and Vector? This is a very common question and one which can lead to major problems with printed output when misunderstood, especially in our industry of wide format printing.

Many documents on this subject you might read are explained as Bitmap vs. Vector, but it should be explained that Bitmap and Vector graphics/images both have their place in the world of graphics, but need to be used in the right place.

It is also worth mentioning that file extensions/ file formats don't always indicate whether a file contains Bitmap or Vector information. For example a TIFF or JPEG will always be Bitmap, but EPS, PS or PDF may contain Bitmap, Vector or both together.

Bitmap

Bitmap (AKA Raster) graphics/images are made up of pixels and normally captured from a digital camera or scanner. Pixels are small squares with a numerical value which depicts the colour of each pixel. These pixels are mapped into a grid and the different colour shades of the pixels together form the overall image. If the right ratio of size of image and the number of pixels which it contains are set correctly, then the image should be perceived as continuous tone, meaning that the square pixels cannot be seen with the naked eye.

Fig.1 is a bitmap image, which when magnified, clearly shows the coloured pixels.

(Figure 1)
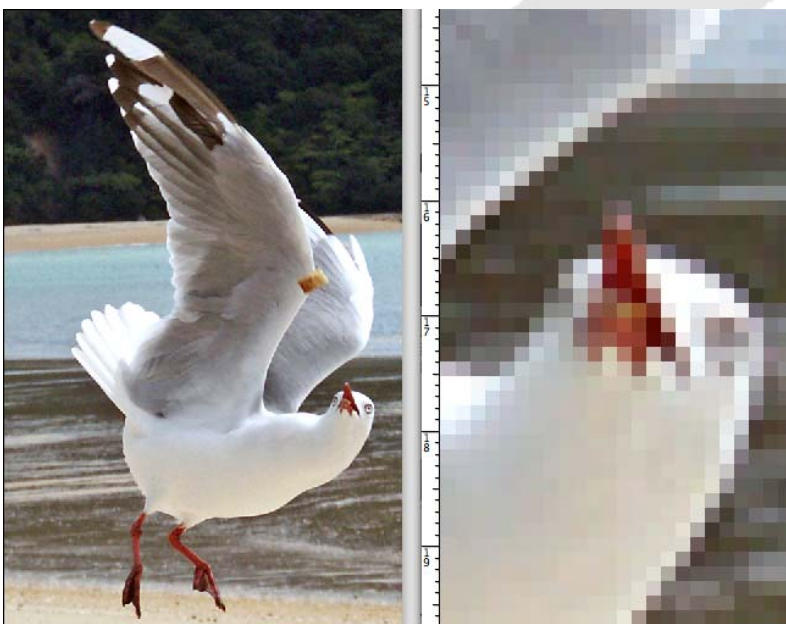
Bitmap cont.

The resolution of a bitmap image is measured in the number of pixels per inch (PPI) and this will affect the size the image can be printed whilst maintaining the impression of continuous tone and therefore not being able to see the pixels.

The higher the PPI value, the better quality print you will get, but only to a certain point, as the human eye is not capable of seeing a difference above a certain value.

Generally, 300ppi is considered the maximum required number required for photographic quality output and 200ppi the minimum. Remember that it needs to be 300ppi at the size of output, because if an image is scaled up in size, the number of pixels per inch goes down and so the pixels get bigger. For large format posters viewed from a distance this value can come down to around 150ppi, but this is very subjective.

As an example, Fig.2 shows the image size info within Photoshop. This image is 3000 x 3000 pixels and set at 300ppi, so the output size will be 10 inches by 10 inches, which will give photographic quality.
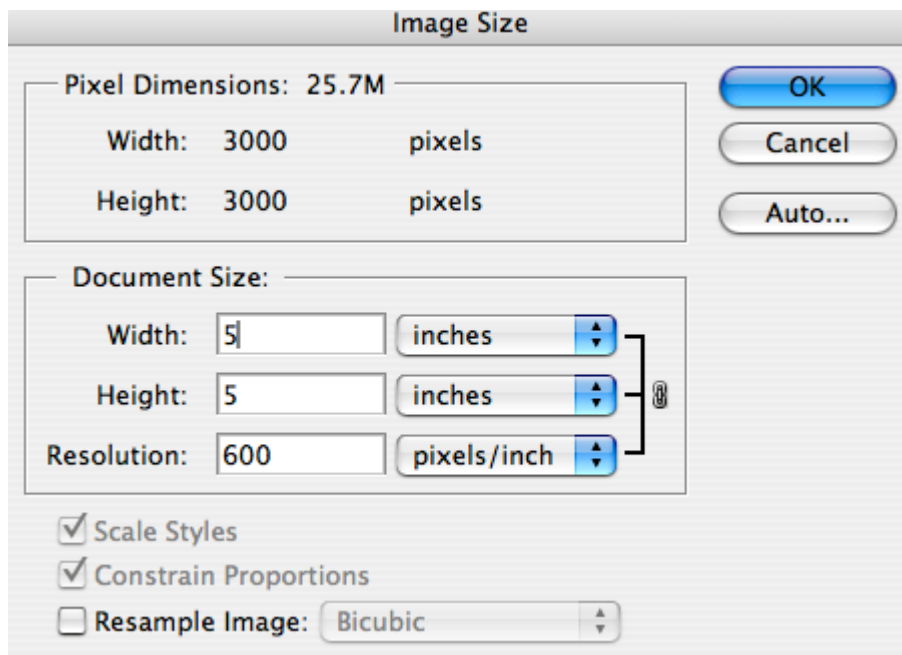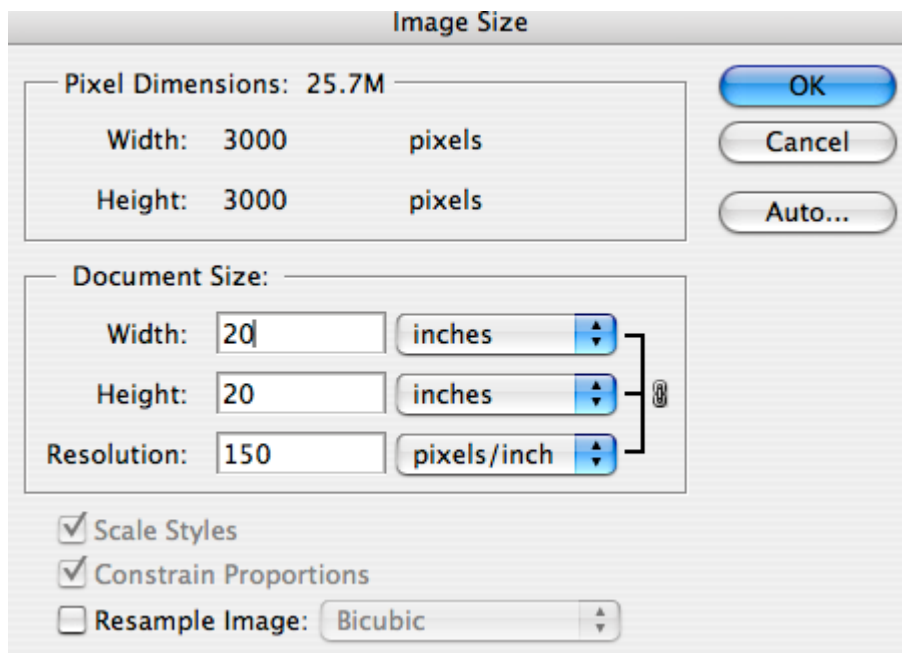
(Figure 2)
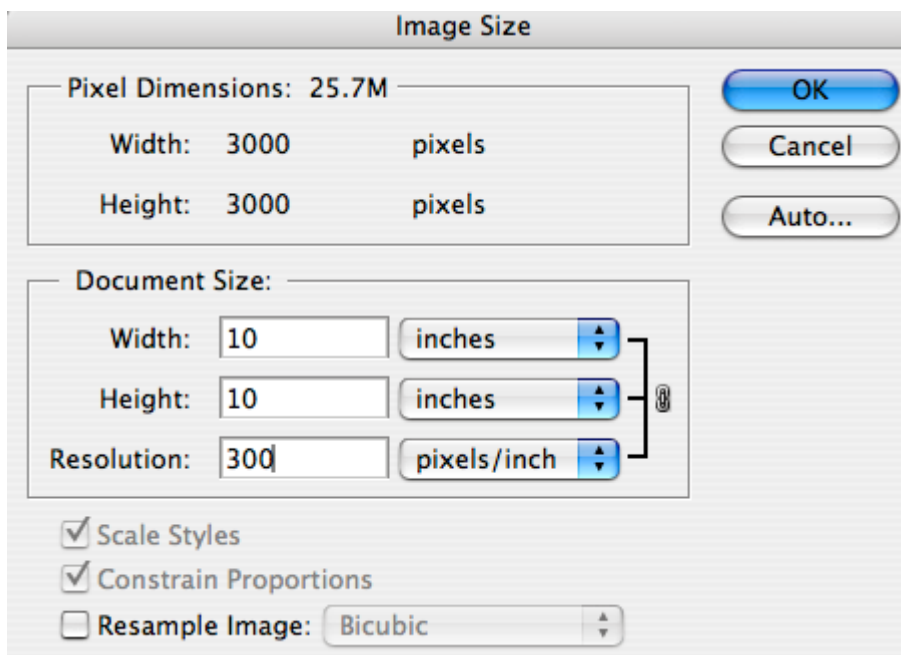
Note that the option "Resample Image" has not been enabled. With this unchecked, if the size of the image is changed, the total number of pixels remains the same, but the PPI either goes up if the image size is increased, or down if the image size is decreased.
See Fig.3 and 4 below.

## Bitmap cont.

(Figure 3)

(Figure 4)

Bitmap cont.

If an image needs to be increased or decreased, maintaining the PPI, then the option "Resample Image" will need to be checked and a method of interpolation will need to be selected.

Interpolation in the context of resampling a bitmap image, are intelligent algorithms which decide which pixels to discard when decreasing the size of an image, or deciding the colour and positioning of a new pixel when increasing the size of an image.

As a general rule it is recommended to use "Bilinear" when decreasing the size of an image and "Bicubic" when increasing the size of an image, but just remember that this is just clever guess work and has real limitations when increasing the total number of pixels. Where possible it is best to work with the original captured number of pixels, but if resampling is required, then experiment in small increments.

Fig.4 and 5 show examples of how increasing and decreasing the size of an image with the resampling enabled, changes the total number of pixels.

(Figure 4)

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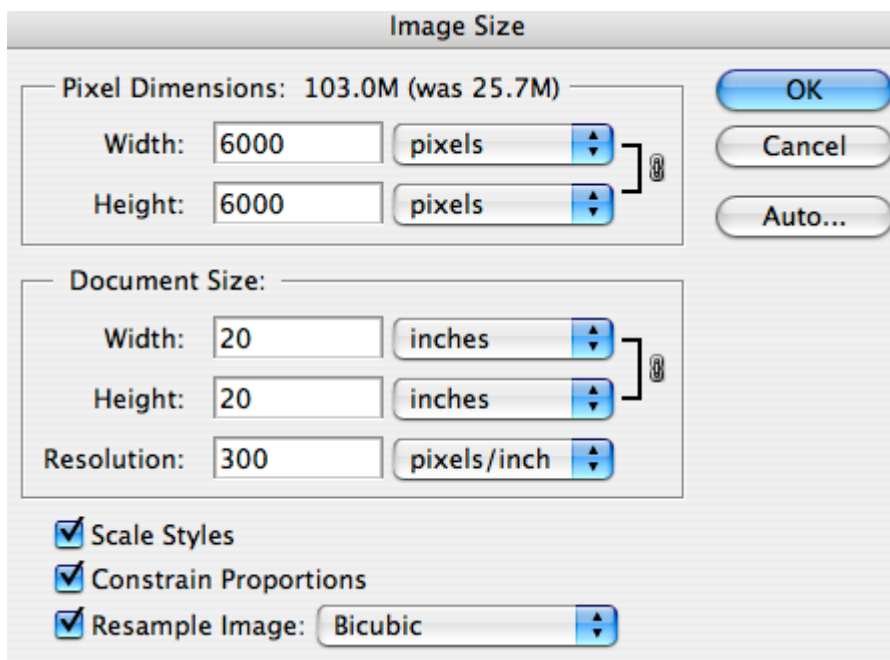
(Figure 5)
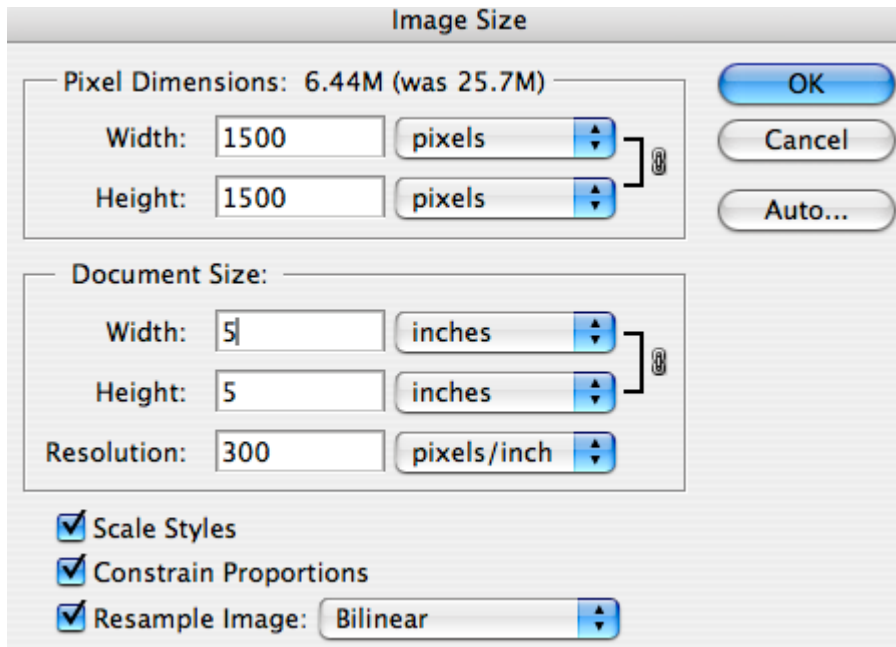
This concludes the basics of bitmap and this document will now move onto the more simple graphical form, vector.
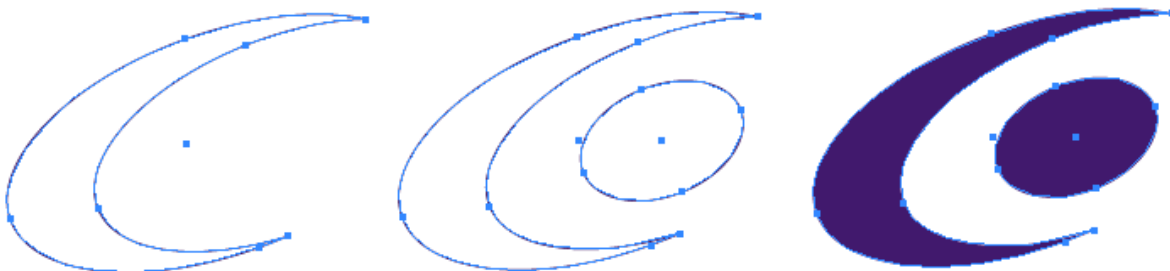
Vector

Unlike bitmap images, vector images/ graphics are not constructed with pixels, (although it is worth noting that when a vector image is viewed on a monitor, it is displayed using the monitors pixels).

Vector graphics are defined by mathematical descriptions and instructions and consist of straight and or curves lines, which are then connected from one point to another to form simple shapes, with coloured fills and gradients, or more complex and intricate graphics.

Fig.6 and 7 show the stages of the creation of a logo, which is a typical use of vector graphics.

(Figure 6)

Vector cont.

(Figure 7)

The greatest advantage of vectors over bitmaps is that they can be scaled up or down to any size without loss of quality. Rather than using interpolation, the computer program just uses basic addition, multiplication and other such mathematical formulae.

Fig.8 shows the difference between a logo created as a vector and as a 300ppi bitmap. Both have then been output with a 200% scale increase.

(Figure 8)

COLOURGEN

Vector cont.

In Fig.8 the image on the left is the vector and the one on the right the bitmap, which clearly shows signs of pixilation due to the size increase, yet the vector is still perfectly smooth in the printed output.

Vector graphics can be easily converted into bitmap, but it is not so easy to convert bitmap into vector. There are software packages available which will do this, but they are only really designed to convert simple bitmap images, like scanned line drawings, or bitmap logo's, not photographic images.

Conclusion

Each type of graphic has instances where it makes sense to create it in bitmap or vector form, but in the world of printing it is common practice to use both. There are DTP (desktop publishing) programs available which cater for both types of image creation, like Adobe Photoshop for bitmap images and Adobe Illustrator for vector graphics. Both types of graphics can then be collated into one program like Adobe InDesign or QuarkXPress to form a complete project which can then be printed.

Common bitmap creation/ editing programs include:

Adobe Photoshop
Adobe Photoshop Elements
Corel Paintshop Pro
Microsoft Paint

Common vector creation/ editing programs include:

Adobe Illustrator
CorelDraw
Vectorworks
AutoCAD