Get the picture?

Gordon Laing show us around the gallery of graphics file formats. Exhibits include TIFF, GIFF, JPEG and PCX and our critic gives the low-down on the pros and cons of each.

This month I ask the question: "Why are there so many different graphics file formats?" but I'll make it interesting… honest! There's more than one way to describe and store a picture, and some formats are better than others for different applications. Maybe you want the highest quality, the greatest compatibility, the most flexibility, or perhaps the tightest compression. Whatever, there are lots of graphics file formats out there and it can be a real maze finding your way around and deciding which is the best for you. Hopefully, by the end of this month's column you'll have a much better idea, and be able to make the right choice from that currently imposing Save As dialog box.

Computers are happiest handling digital information, which is either on or off, with no mucking about with maybe, perhaps or sort of. The easiest way for a computer to handle images is with a bitmap description, which is nothing more than a rectangular grid of coloured dots. The grid can be of any size, and the dots or pixels any number of possible colours. The quality of a bitmapped image is down to its number of dots (the resolution) and colours: the higher the resolution, the greater the detail; the more colours, the greater the smoothness of shades and perceived realism.

The number of possible colours is dependent on the number of bits allocated to each dot or pixel. The simplest number of colours is monochrome (black and white) which can be described with a single bit of information per dot or pixel. Eight bits per pixel offers a choice of 256 colours (calculated by 2^8), 16 bits per pixel can supply 65536 colours (2^{16}) while 24 bits per pixel boasts a whopping 16,777,216 colours (2^{24}). Clearly, a bitmap file in 24-bit colour is going to be three times bigger than the same size bitmap in 8-bit colour, or 24 times bigger than the same bitmap in black and white. Full-colour photographic images look best in 24-bit colour, but some images like logos or screenshots can get away with 16- or 8-bit colour, saving storage space and processing time.

The higher the resolution, the greater the detail captured, but bear in mind that more dots or pixels mean a physically larger file occupying more storage space and taking longer to process. That's why high resolution, full-colour images are so large.

Bitmaps are everywhere. Your on-screen Windows or Mac desktop is a bitmap image, typically at a resolution of either 640 x 480, 800 x 600 or 1,024 x 768 pixels. Common screen colour settings are eight or 16 bits per pixel. The space to store these screen images is in your video card's memory which defines the maximum resolution or number of colours in which you can work. Dropping one allows you to increase the other, but if you want more colours and higher resolutions you're going to need more video memory. Two megabytes of video memory is common and capable of displaying a 1,024 x 768 pixel resolution in 16-bit colour, or 800 x 600 resolution in 24-bit colour. If you want 1,024 x 768 in 24-bit, you'll need another 1Mb or 2Mb of video memory.

After all the cunning page descriptions employed to drive printers, the final result is a bitmap image on paper. Printers typically work at much higher resolutions than on-screen, with most models offering 300 to 600 dots per inch (dpi): for a 10 x 8in sheet of paper at 600dpi this means a bitmap measuring 6,000 x 4,800 dots; and if that seems huge, just consider that most laser printers are black-and-white devices, therefore operating at one bit per pixel. The bitmap described would only measure 3.6Mb in mono, but in full 24-bit colour it would be a massive 86.4Mb.

Fortunately, most colour printing can get away with much lower resolutions due to the involving nature of colour to our eyes. Consider your TV set, which looks great with its 24 bits of full colour but is, in fact, only operating at a low resolution of 640 x 480 pixels. The full colour and moving images distract our brain to perceive reality.

Scanners and digital cameras also convert real-life objects into bitmap images. Digital cameras usually offer one or two fixed resolutions, with the typical entry-level models offering 640 x 480 pixels in 24-bit colour. Flatbed scanners, mostly used to digitise photographs or sheets of paper, usually operate at between 300 and 600dpi, and in anything from 1- to 24-bit (or higher) colour. Like the laser printers, a 10 x 8in scan at 600dpi will produce a 6,000 x 4,800 pixel image, amounting to 3.6Mb in mono, or 86.4Mb in 24-bit full-colour.

The question of what resolution to scan at is a subject in its own right, but briefly you should use the highest optical resolution for monochrome images, but select considerably less for colour reproduction. Remember that if you're going to reproduce the image larger than real life, you should scan at a higher resolution, while if you're going to reproduce smaller than life size, then you should use a lower resolution. If you've got your own printer, it's worth scanning the same image at a variety of resolutions and printing them out to compare the differences. You'll be surprised at how small a resolution you can get away with, which is certainly worth knowing to save memory and processing time.

By now you've realised the importance of bitmap files and how large they are in terms of resolution and number of colours. But what about bitmap file formats? You've scanned your picture, or manipulated an image in something like Photoshop, only to find this huge array of options in the Save As box. Essentially, a bitmap file has only to start with a header describing the size of the bitmap and the number of colours it uses before a huge wad of bits follows, describing each individual pixel or dot from top to bottom, one row at a time. So what are the differences between the formats?

We started with a 300dpi greyscale image of 686Kb. Left to right: Saved firstly as a TIFF with LZW compression measuring 450Kb; secondly, saved as a JPEG with high compression measuring 47Kb; thirdly, saved as a GIF measuring 592Kb; and finally, an LZW compressed TIFF again, but this time reduced to 50dpi to measure 20.8Kb. Greyscale images are in 8-bit anyway, hence there is no loss in quality when saved as a GIF

Bit of a TIFF

Probably the most common bitmap file format is the Tagged Image File Format, or TIFF. Originally developed by Aldus, it is one of the most compatible and widespread formats in use today. It's a fairly basic description but in certain instances can handle up to 32-bit CMYK colour for printing or 48 bits for ultra-precise RGB work. Normally eight bits is considered sufficient for numbers of grey levels but the 48-bit format allows 16 bits for extra smoothness and high dynamic range.

TIFFs can also support various types of compression, the most common being run length encoding (RLE), which looks out for portions of the image using the same colours. An uncompressed raw file would describe the colour of each dot individually, but if you've got, say, 50 identically coloured dots in a row, then a compression routine could save space by assuming that the next 50 dots were all the same shade of red. RLE routines perform this task (very effective for certain images) and, better still, do not degrade the quality of the image. This is known as "lossless compression", as opposed to "lossy compression" where there is a variable loss of quality.

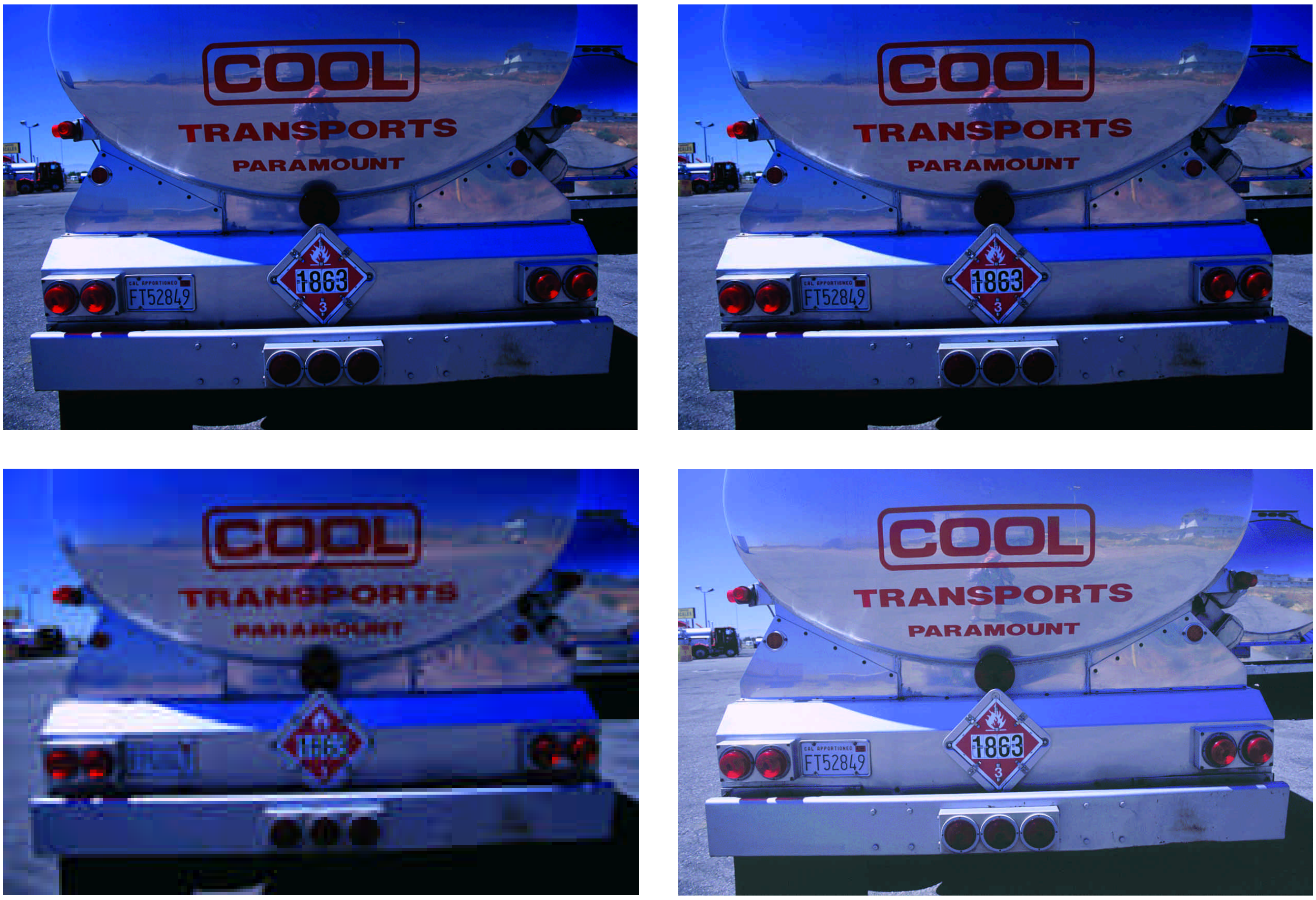
TIFF also supports other compression formats which, along with the higher colour options, can sometimes cause incompatibility with lower-end graphics packages. Some can only recognise and display TIFFs up to 24-bit colour or those compressed using LZW (as used in the popular ZIP compression format).

Got DIBs on it

Perhaps the most obviously named bitmap format is BMP which can support up to 24-bit colour and sometimes optional RLE compression. BMPs (also known as DIBs) are, incidentally, used by Windows 3.x and 95 for its backdrops. To create a new backdrop, take your image and save it as a BMP format in the Windows folder. Next time you go to change your backdrop, this image will be available.

Like BMP, PCX (also known as the PC Paintbrush file format) can support colours up to 24-bit and compression using RLE. By now the question of compatibility will have cropped up in the back of your mind. Launch your favourite graphics application and see which formats it supports. Paintbrush, which comes with every version of Windows, supports BMP and PCX files. The very reasonably priced

p276 ➢



We started with a 300dpi CMYK colour image measuring 3.81Mb. Clockwise from top left: The image saved as a TIFF with LZW compression measuring 2.59Mb; secondly, saved as a JPEG with high compression measuring 99Kb; thirdly, saved as a GIF measuring 430Kb; and finally, an LZW compressed TIFF again, but reduced to 50dpi to measure 74Kb. Notice how the GIF image loses subtle shades when downgraded to 8-bit

PaintShop Pro can handle almost anything you throw at it although, in my view, Adobe Photoshop is the king of file formats, capable of opening the most obscure colour spaces and compressions.

GIF it to me

The ubiquitous Graphics Interchange Format (GIF) was developed by CompuServe as a compressed format for quick exchange while online. Compression and getting the information transferred as quickly as possible is clearly very important in all online applications and the GIF was the first popular format of this kind. It employs compulsory LZW compression but sadly does not support anything above 8-bit colour. However, the recent GIF89a export filter, available for some applications, will support 24-bit RGB images and transparent areas for use in HTML web documents.

The JPEG line

Equally, if not more popular than the GIF on the web, is the Joint Photographic Experts Group (JPEG) format. To confuse matters a little, JPEG is in fact a compression system which can be applied to any file format but typically finds itself used on images. However, there is a JPEG bitmapped file format in wide circulation, supporting 24-bit colour and using the same compression system as its name.

Prior to JPEG compression, we had the choice of RLE and LZW algorithms which worked well on simple images but not continuous-tone colour photographic pictures. JPEG was designed to better handle real-world full-colour images. It is a lossy system, which throws away pieces of information the human eye can't easily see.

When saving an image with JPEG compression, the user is given several choices of quality from low but highly compressed, to high but only compressed a little. At the highest compression, file sizes can shrink to tiny sizes, but the quality is noticeably poor. On the other hand, JPEG offers excellent quality at more modest levels of compression.

It is up to the user to experiment to see what levels of compression they find acceptable, although bear in mind that once lossy compression has been performed, there is no going back; the discarded information is lost forever. For this reason, make sure you have a safe copy of your original image stored in a lossless format such as a TIFF, and experiment with duplicates.

We have merely scraped the surface of bitmapped graphics file formats here, but you now have an idea of what is involved. Which format you choose will depend on your particular requirements, but please bear compatibility in mind, particularly when crossing platforms or going to a very basic system. After that, consider compression in terms of storage or bandwidth — no-one wants to wait around all day downloading an image, and bear in mind that if it is only ever going to appear on-screen, you can get away with resolutions of around 75dpi.

Best of luck!

PCW Contact

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