Appendix A:
How Format Conversions Actually Occur

Pixel Magician divides files into four categories: EPS/PS files, native NeXT TIFF files, PXM files and other files.

Opening Files

EPS/PS files

EPS/PS files are read directly into the NeXT using an *NXEPSImageRep.* Unfortunately, because of the generality of the PostScript syntax, little can be done with these files except scaling, rotating, flipping and rasterizing (*i.e.,* converting them to a raster format). With certain especially badly behaved PS files, even these operations might not be possible.

Pixel Magician does not automatically rasterize EPS/PS files for three reasons: (1) you may not want to rasterize your image, but simply want to use Pixel Magician to rotate, scale and flip your image; (2) if you do want to rasterize your image, best results are obtained by postponing rasterizing for as long as possible, *i.e.,* until after rotating, scaling and flipping; (3) we may support more vector operations and formats in the future.

To rasterize the EPS/PS file, simply save it to a raster format such as TIFF or PXM. This new file can be read back into Pixel Magician to perform further operations such as changing the bit depth.

Native NeXT TIFF Files

Native NeXT TIFF files are read directly into the NeXT using an *NXBit-mapImageRep.* TIFF is such a general format that there are many TIFF files which the NeXT is unable to read. As the TIFF 5.0 specification itself states:

It takes a fair amount of effort to handle all the options currently   defined in this specification (probably no application does a   complete job), and that is currently the only way you can be sure   that you will be able to import any TIFF image, since there are so   many image generating applications out there now.

Pixel Magician attempts to spot problem TIFF files and does not let the NeXT read these directly. These files are treated as generic format files (see below). Pixel Magician should read all 1, 2, 4 and 8 bits per sample class X compliant TIFF files correctly.

PXM Files

PXM files are read directly into the NeXT using a subclass of the *NXBit-mapImageRep* class, unless it is in a non-standard orientation. In this case, the file is filtered through an external filter to reorient the file before being read in. PXM is a fairly simple file format so that PXM files can often be

read and imaged more quickly than TIFF files. If size is an issue, these files can be compressed using the standard *compress* utility. A future release of Pixel Magician may be able to recognize and deal with compressed files directly.

Generic Files

Generic file formats are passed through an external filter program which converts them into the PXM format. From that point on, the files are treated as PXM files. Because reading other file formats is handled through external programs, adding new file formats for Pixel Magician to read is very simple. Contact BÙcchus, Inc., if you have additional filter programs and are interested in reading more file formats with Pixel Magician.

Transforming Images

Scaling, Rotating, Flipping and Changing the Resolution

Scaling, rotating, flipping and changing the image resolution are performed through standard PostScript operations. Using the NeXT's built in Display PostScript allows us to make these transformations very quickly, but at the same time it means that Pixel Magician is subject to PostScript's aliasing errors. Suffice it to say that other methods of scaling, rotating and resampling are possible, but they take considerably more time to perform. Flipping is not subject to aliasing problems.

Changing the Bit Depth

When choosing a palette for an image, the standard Heckbert algorithm is employed. For more information, see the paper ªColor Image Quantization for Frame Buffer Display,º *SIGGRAPH '82 Proceedings*, page 297.

If not choosing a palette, a uniform palette is generated. (Actually, the re-duction in this case is specially optimized and does not directly use a palette, but the process is equivalent.)

The user then has a choice of methods with which the bit depth change can be performed. Various error-diffusion algorithms are provided. For further infor- mation on error-diffusion, see the excellent book *Digital Halftoning* by Robert Ulichney. If error-diffusion is not employed, then the bit depth change is ac- complished through simple thresholding, *i.e.,* each color is simply mapped to the new color which is closest to the original color. One further optimization is employed when making a picture gray and reducing the bit depth. In this case, the image is made gray *before* the bit depth is reduced. This optimization increases the speed of the transformation but can cause an error from the optimal result when using error-diffusion. This error is less than one graylevel and, we are confident, will not be noticed by all but those with the keenest vision. For this reason, no error-diffusion is available for the 8-bit gray case.

Compositing

Pixel Magician allows the user to select any color for the image background

and a variety of compositing operators to use to combine the image with the background. The most useful composite operators are the Sover and Copy operators.

The Sover operator places the image *over* the background. Thus, where the image is transparent or partially transparent, the background will show through. The background is also seen if the image is rotated. Similarly, the Dover operator places the image *under* the background. If the background is transparent, the image will be seen underneath it.

The Copy operator cuts a piece the shape and size of the image out of the background and replaces it with the image. Thus, the background is not present where the image is, and the background can only be seen if the image is rotated. Using Copy is faster than Sover (the default) since Copy just copies pixels whereas Sover requires per pixel multiplication and addition.

Another useful compositing operator is Clear. Clear simply replaces the image with a patch of clear (totally transparent) paint the same size as the original image. Together with the Scale panel, Clear can be used to generate clear templates for use in painting programs.

Experiment with the operators to find out what they do. The *NeXTstep Concepts* manual may also be useful. Note that some of the compositing operators may add or remove an alpha channel to the image. It is extremely difficult to determine whether or not the final image has an alpha channel without actually saving the result. Therefore, Pixel Magician resorts to simple heuristics to guess whether or not an image might have an alpha channel when the user attempts to save to a format allowing an alpha channel. These heu- ristics may not always be correct. Note also that some

of the compositing operators are not fully implemented under NeXTstep 2.1. In particular, some of the images may not look the same on the screen as when they are printed. NeXTstep 3.0 has promised fuller PostScript Level 2 compliance so this problem may solve itself automatically.

Order of Transformations

If the user performs multiple transformations, the order of transformations may become important. The exact order follows:

1. The image file is read. See **Opening Files** above for more information.

2. The image is composited with the background color and compositing operator chosen by the user.

3. Display PostScript is used to rotate, scale, flip and change the resolution of the image. See Appendix B, ªNotes on Scaling, Rotating and Dots Per Inchº for more details.

4. If the user wants to change one of the image attributes in the Attributes panel (make a color image non-color, a gray image non-gray, a paletted file non-paletted or change the bit depth of the file), the image is filtered through one or more external programs which perform the appropriate transform- ations, and read back into Pixel Magician. This step only applies to non- EPS/PS files.

5. If the image is being opened or inspected, the results are displayed on the screen. If the image is being converted, the results are saved to a file on disk.

Saving Files

EPS/PS files

EPS files are generated by taking the Display PostScript which would be sent to the screen to show the picture, and instead, saving it to a file on disk. Since EPS is a subclass of PostScript, proper EPS files are also valid PS files. Display PostScript *is* slightly different from the standard PostScript used for printing, but these differences are currently ignored.

Native NeXT TIFF Files

If the image has alpha channel data and Retain Alpha Channel is not checked, the *NXBitmapImageRep* is manually stripped of the alpha channel data. If the NeXT Compatible TIFF option is selected, the result is saved to a file on disk using the standard *writeTIFF:usingCompression:andFactor:* method. Other- wise, Pixel Magician attempts to determine if the selected TIFF options will result in a standard NeXT TIFF file. If so, the *writeTIFF:usingCompression:andFactor:* method is employed, as above. If not, the image is treated as a generic format file (see **Generic Files** below).

PXM Files

PXM files are created by using a custom method implemented in a subclass of *NXBitmapImageRep.* Again, if the image has alpha channel data and Retain Alpha Channel is not checked, the *NXBitmapImageRep* subclass is manually stripped of the alpha channel data before saving the result to disk.

Generic Files

Saving to other file formats is accomplished via a three step process:

1. If the image has alpha channel data, and either the destination file format   does not support an alpha channel or Retain Alpha Channel is not checked,   the image representation is manually stripped of the alpha channel data.

2. The image representation is saved to disk as a PXM file using a custom method. If the image is not in a paletted format and the destination file format requires a palette, the image is passed through an external PXM paletting filter as it is being saved.

3. The PXM file is converted to the destination file format using an external file format conversion program, applying any other format specific options.

Like reading, writing generic file formats is handled mostly through external filters, which makes adding additional destination file types fairly simple. However, if the format supports an alpha channel, requires a palette or has format specific options like the TARGA and BMP formats, a custom version of Pixel Magician will need to be written. Again, contact BÙcchus, Inc., if

you have additional filter programs and are interested in writing more file formats with Pixel Magician.