

Generating and using Enif graphics in reports



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Enif is software used to access EMME/2 data banks with a modern interface. This presentation includes tips on generating output from Enif and discusses alternative graphic formats for the preparation and distribution of reports.

The graphics included in this presentation are designed to be presented directly from OpenOffice Impress or to be printed in color directly from OpenOffice Impress for distribution. Conversion of this presentation into PDF format may introduce distortion due to lossy compression. Conversion of this presentation into web format necessitates that the graphics be saved in JPEG or GIF format, which also introduces distortion.

Graphics were generated in various graphic file formats using an Intel PC with Windows XP and the most recent official release of Enif, version 1.0. This presentation itself serves as an example of how Enif images in various formats can be incorporated into a presentation.

Online references:

- Graphic file formats at a glance
acompan.stanford.edu/acpubs/Docs/graphic_file_formats/
- PostScript vs. PDF
www.adobe.com/print/features/psvspdf/main.html
- How to Create Adobe PDF Files for Print and Press
www.adobe.com/products/postscript/pdfs/pdfforprint.pdf
- The Official Free PDF Support Site
www28.brinkster.com/freepdfsupport/index.html

Contents of presentation

- Types of reports
- Raster graphics
- Vector graphics
- Graphics format recommendations
- Tips for Enif output

These notes included below the slides serve the purpose of

- documenting the oral content to the presentation,
- providing additional technical content, and
- supplying details so that the audience may replicate the graphics presented.

The definition and description of the various graphic formats are limited to those aspects which are relevant to producing reports with Enif graphics.

Demonstrations cover the following activities

- generation of graphics of Enif plots,
- manipulating those graphics,
- inserting the graphics into report-creation software, and
- saving the reports for distribution.

Types of reports

- How will the audience be reached?
 - Print the report
 - Post an HTML report
 - Distribute the report in electronic PDF format
 - Present the report live
- Understand the limitations of the software, hardware, and materials used to generate reports.

Understand the limitations of the software, hardware, and materials used to generate reports. How will the reader access the report?

Printed report

- Identify the image-handling capabilities of the software used to create the report.
- Test that the colors are distinguishable if printed in black & white.
- Choose the paper size, e.g. A4, letter, or large format.
- Choose a paper type that works with your printer and its ink.

Browse an HTML report

- Which browser? Different browsers support only certain image formats and may render HTML or process scripts with differences that effect the appearance and functionality of your page. Pole your audience.
- Design the layout to fit the resolution of the monitor/projector.
- Should the report be printable? Browsers do not print HTML consistently. See electronic distribution below.

Electronic distribution in PDF* format

- * PDF files are viewable with Adobe Acrobat Reader, available at no charge. Other formats that require the purchase of software to view the file is discouraged.
- Consider the same issues as a printed report, plus...
- Generate the report in PDF format. (FreePDF-generation software is discussed later.)

Presentations

- Identify the image-handling capabilities of the software used to create/present.
- If presented with printed slides, choose a slide compatible with your printer and ink.
- If presented with a projector, note the limitations of projector resolutions

Raster images

- A raster graphic is a graphic drawn as an array of colored dots.
- Advantages
 - fast screen rendering
 - compact for photos
- Disadvantages
 - not scalable
 - loss due to compression depending on format
 - potentially very large files

Raster image formats

| <u>Format name</u> | <u>.ext</u> | <u>Color</u> | <u>Compression</u> | <u>Transparency</u> |
|----------------------------------|-------------|------------------|--------------------|---------------------|
| bitmap | BMP | max 24-bit RGB | | |
| joint photographic experts group | JPEG | 24-bit RGB | lossy* | |
| portable network graphics | PNG | max 48-bit* | lossless* | yes |
| portable bitmap | PBM | 1-bit monochrome | | |
| portable graymap | PGM | 8-bit grayscale | | |
| portable pixmap | PPM | 24-bit RGB | | |
| X bitmap | XBM | 1-bit monochrome | | |
| X pixmap | XPM | 24-bit RGB | lossless | |
| graphic interchange format | GIF* | max 8-bit | lossless | yes |
| tagged image file format | TIFF* | 24-bit RGB | lossy & lossless | yes |

*proprietary formats not supported by Enif

*file size is affected by Enif's Quality setting

*Enif output is 24-bit RGB

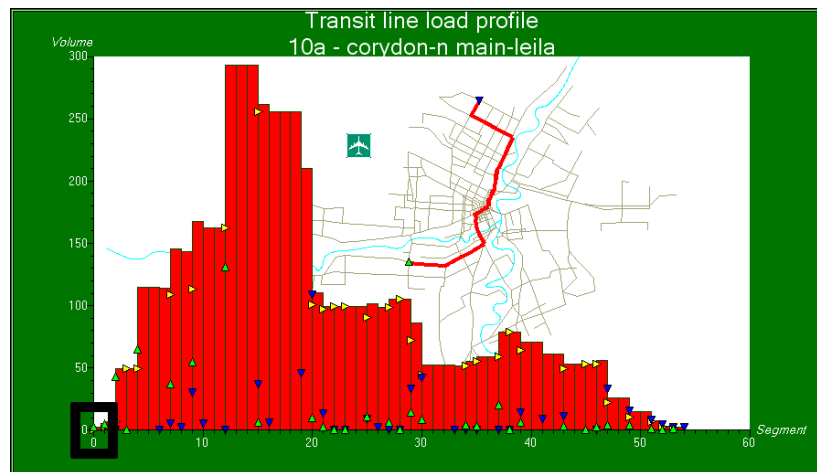
8-bits is adequate for 256 colors or shades of gray. RGB color capability requires 24-bits: 256 shades of red, green and blue to yield 16.7 million colors. If a limited color palette is used, then 8-bits is adequate and 24-bits is wasted memory.

Lossy compression reduces the file size at the expense of image quality. JPEG lossy compression (optionally supported in TIFF) distorts sharply contrasting boundaries.

Lossless compression reduces the file size at the expense of rendering speed. The image quality is not affected. Lossless compression is efficient for images with areas of homogeneous color, such as drawings.

Transparency is useful for annotations in Enif. For example, highway number symbols are not square shaped.

Sample plot



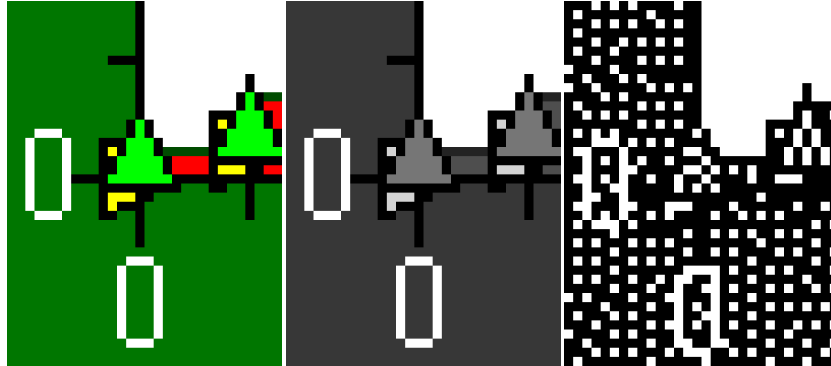
This sample image was used to demonstrate the qualitative and quantitative comparison of various image formats. The small black rectangle was enlarged to make the differences visible.

This image is the Enif plot configuration

Winnipeg plot configuration > Transit network and results > Transit line load profile with the following settings

- predefined view: Whole network
- removed wallpaper background
- generated a file for each graphic format with commands "Print current view" or "Export print view to image file" from the File menu

Image formats with lossless/no compression



| | | | | | |
|-------------|--------|------------|----|-------------|----|
| BMP (Win) | 100 | PGM (Unix) | 33 | PBM (Unix) | 4 |
| PNG (All) | 100..1 | | | XBM (X Win) | 22 |
| PPM (Unix) | 100 | | | | |
| XPM (X Win) | 67 | | | | |

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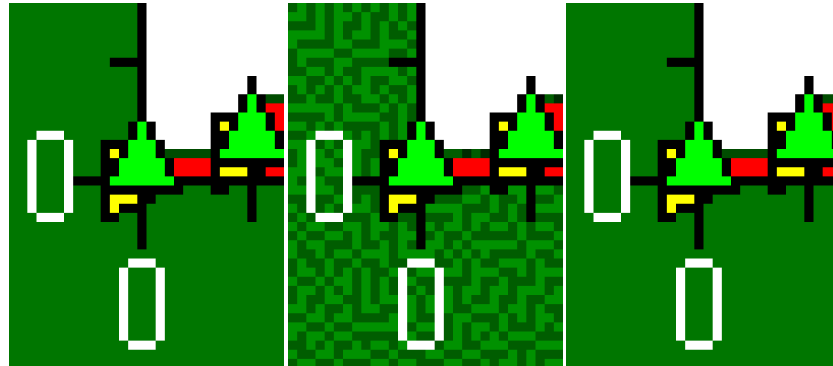
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The numbers are the relative file sizes, where the whole image has size 100 = 1 978 818 bytes.

The PNG image format has lossless compression which reduces the file size at the expense of rendering speed. The file size of this image was reduced by 99%.

PNG is the preferred format for raster images as long as the software being used to display the report with Enif plot images supports the PNG format. For example, Internet Explorer 4 and Netscape 4 do not support PNG at all. IE 6 renders PNG images, but does not handle PNG transparency.

Converted raster graphics



BMP format
relative file size 100

GIF format
relative file size 3

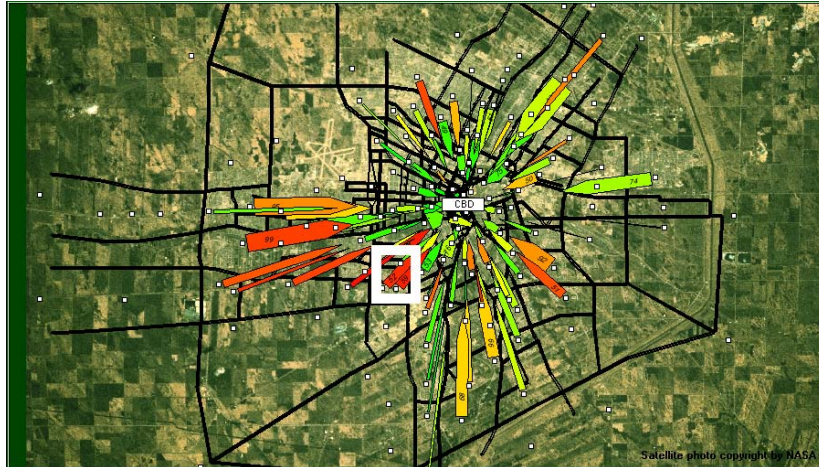
TIFF format
relative file size 5

Enif does not support the GIF or TIFF formats. The BMP file was resaved as a GIF file and a TIFF file.

The GIF format supports only 8-bit = 256 colors. Note the approximated green color. If the Enif plot uses only the standard web colors, then converting the image to GIF will yield no loss of quality.

TIFF supports lossless compression. Note that there is no distortion in the converted TIFF image. Support of the TIFF format by various software is better than for PNG now, so converting Enif PNG images to TIFF is a good alternative.

Sample plot with a background image



The satellite photo is a JPEG image used as a background image in this Enif plot configuration.

This image is the Enif plot configuration

Winnipeg plot configuration > Demand > Desire lines between zones
with the following settings

- Full view
- files generated with File > Print full view or Export print view to image file

JPEG lossy compression



BMP format
relative file size 100

JPEG format
Quality 100
relative file size 12

JPEG format
Quality 75 (default)
relative file size 4

The BMP format serves as a consistent benchmark because it does not support compression.

The JPEG lossy compression was designed for images with continuously varying gradation, such as photos. The distortion of photographic images is acceptable when weighed against the savings in file size. Note the distorted background image. The distortion of text and shapes with high contrast makes JPEG a poor choice as an export format for most Enif plots.

Demonstration: Enif raster graphics

- export an image in Enif
 - adjust the Enif window size
 - select "Export..." from the File menu
 - specify the graphic format with a file name extension
 - set the Enlargement
 - set the Quality (affects only JPG and PNG)
- add the image to a web page
- do not resize the image

To save an image (raster format) in Enif:

- Fix the proportions of the view port by adjusting the size of the Enif window. Check the dimensions of the view port with the tool tip of the pan panel.
- Select "Export screen view to image file" or "Export print view to image file" from the File menu.
- Set the Enlargement factor (up to 8) to control the image resolution. The processor time and the file size increase with the square of this factor, so do not use bigger enlargement factors to be on the sure side!)
- Set the Quality from 0 for maximum compression to 100 for no compression. The Quality setting affects only the JPEG and PNG formats. The quality and the file size decrease for a JPEG file, where the default Quality is 75. Only the file size decreases for a PNG file; the quality remains the same. The default Quality has a value of 30 for a PNG file.
- Enter the file name with the correct extension.

Post-processing a raster graphic:

- Adjust the Enif window and set the Enlargement factor appropriately to avoid post-processing.
- A raster graphic can be easily cropped with any image manipulation software.
- Resizing a raster graphic will distort the image. Resizing is accomplished by resampling (throwing away pixels) or interpolation (estimating the color of added pixels).
- Rescale/resample a graphic to increase the resolution for printing. Rescaling can be done with Jasc Paint Shop Pro, Adobe Photoshop, and other image manipulation software, but not Microsoft Paint.

Vector graphics

- A vector graphic is a graphic drawn as lines, polygons and text.
- Advantages
 - scalable
 - compact for images composed of geometric shapes
- Disadvantages
 - generating vector graphics requires additional software with careful configuration (on Windows)
 - displaying vector graphics requires specific software and can be computationally expensive

To generate a PostScript graphic in Windows install Adobe Acrobat (US\$249+) or follow these instructions to install the Adobe PostScript Printer Driver free of charge:

- Download (at no cost) the "Adobe Universal PostScript Windows Driver Installer 1.0.6" and "PPD Files: Adobe" from www.adobe.com. Extract the "PPD Files: Adobe" archive to the hard drive.

- The recommended system requirements refer to an installed PostScript printer, which proved unnecessary in our tests.

- Install the Adobe PostScript Printer Driver locally on LPT1. Browse to "Acrobat Distiller" in the unzipped archive to select the printer model. Name this printer "PostScript Generator".

- Tests at INRO showed that the following was necessary to have the image printed on the PostScript printer: in the PostScript Generator Printing Properties, on the General tab, in the Printing Preferences, in the advanced options, in the PostScript Options, set the PostScript Output Option to "Encapsulated PostScript (EPS)".

- All Windows software, including Enif for Windows, prints via the Windows Print dialog. Choose the PostScript Generator and check the "print to file" checkbox. Click Print and specify the path and the file name with extension ".ps".

To view a PS file, install Ghostscript and GSview. Visit www.cs.wisc.edu/~ghost/

- Install the versions as suggested for generating PDF later in this document.

Vector graphics formats

- **PostScript**
 - a page description language designed to describe accurately the appearance of a page
 - a proprietary format owned by Adobe
 - commonly stored in PS, EPS, and PDF files
 - a Raster Image Processor (RIP) interprets textual PostScript code as dots
- **examples of other vector formats**
 - CGM: computer graphics metafile
 - WMF: Windows metafile
 - DXF: AutoCAD

All PostScript-compatible printers have a Raster Image Processor (RIP). Displaying a .ps file on the screen requires a viewer with a RIP, such as Ghostscript with GSView, and can be computationally expensive. Only high-end (expensive) publishing software have a built-in RIP to view and manipulate .ps graphics. It is more convenient to work with a raster preview of the graphic, which is embedded in the EPS format. EPS also simplifies the display of a vector graphic with a bounding box.

Some programs that can import EPS graphics:

- Microsoft Word 2000+ *
- Microsoft PowerPoint 2000+ *
- OpenOffice
- Quark Express
- Adobe Photoshop, Illustrator, InDesign...

* MS Office 1997 claims to import EPS files, but I was unable to make either Word '97 or Powerpoint '97 function properly.

PS and EPS file formats

- PS was designed for consistent, accurate printing of an entire file.
- Encapsulated PostScript files can be inserted into report-generating software
 - may contain an encapsulated raster preview image
 - a bounding box identifies the relevant portion of the page
- Printing PS and EPS requires a PostScript printer.

Excerpt of a PS file: Excerpt of an EPS file:

```
%!PS-Adobe-3.0                               %!PS-Adobe-3.0 EPSF-3.0
%%Title: MS Shell Dlg                          %%Title: MS Shell Dlg
%%Creator: PScript5.dll Version 5.2           %%Creator: PScript5.dll Version 5.2
...                                             ...
```

Converting PS to EPS in Windows:

- Open the .ps file with GSView. From the File menu select PS to EPS. Specify a file name with extension .eps when prompted.
- Open the .eps file with GSView. Select Edit > Add EPS Preview and choose a format. Specify a different file name with extension .eps when prompted.

To save an EPS graphic in Enif in Unix/Linux

- in Edit > Preferences, select the Print tab and check the "Margins applied to full page". This ensures that the output is portable and not printer dependent, since printers have different printable areas.
- Select "Print full view" or "Print current view" from the File menu. The output generated is EPS (1st line: %!PS-Adobe-1.0 EPSF-3.0).

PDF file format

- **Portable Document Format**
 - PDF is a PostScript file interpreted by a RIP into objects
 - PDF can also contain printing instructions, keywords for searching/indexing, hyperlinks, animation, etc.
- **Advantages over (E)PS**
 - smaller file size
 - printing PDF does not require a PostScript printer
- **Disadvantage**
 - cannot insert PDF images into most report-creation software

Portable Document Format is an alternative format for PS files and EPS files. PDF can contain information related to how a page looks, and can describe how it behaves and what kind of information is contained in the file. A PDF file can contain fonts, images, printing instructions, keywords for searching and indexing, job tickets, interactive hyperlinks, movies, etc.

- Adobe Acrobat Reader (free) can print PDF to non-PostScript printers by interpreting the PDF file into that printer's language.
- Disadvantage of PDF: cannot insert PDF images into most report-generating software

To generate a PDF graphic with Windows software install Adobe Acrobat (US\$249+) or follow the directions for Windows 9x/2000/XP to install (at no cost) and configure Redmon, FreePDF, and an Adobe PostScript Printer Driver with the Adobe Distiller PostScript Printer Definition (PPD) at

<http://www28.brinkster.com/freepdfsupport/>
with the following additional notes

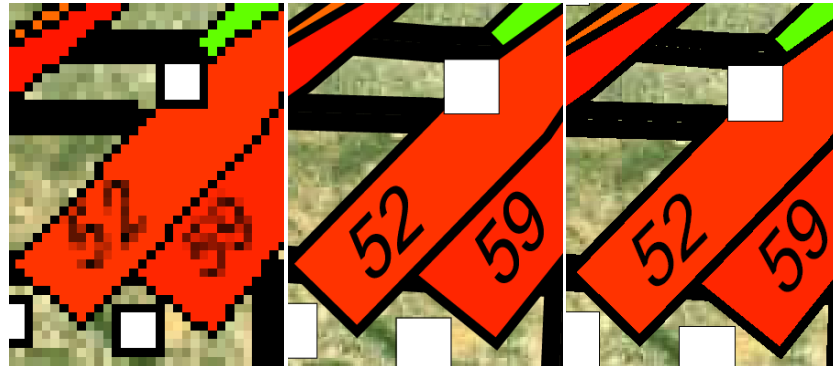
- Use GNU Ghostscript 7.05 since an error occurred when generating the PDF using FreePDF 0.98f with APFL Ghostscript 7.03, 7.04, and 8.00. APFL and GNU refer to copyrights. Both are free. See details at

http://www.cs.wisc.edu/~ghost/doc/faq.htm#afpl_gnu

- Download GNU Ghostscript 7.05 from

<ftp://mirror.cs.wisc.edu/pub/mirrors/ghost/gnu/gs705/>

Raster v. vector graphics



BMP format
relative file size 100

PS/EPS format
relative file size 1108
+EPS preview

PDF format
relative file size 46

Vector graphics provide far better image quality due to unlimited scalability, which takes advantage of the best possible resolution of the output device.

Enif generated a PostScript graphic using the Adobe PostScript Driver. The background satellite image yielded a PS file requiring over 10x the storage capacity of the bitmap format. The other Enif sample plot (without a background photo) resulted in a relative file size equal to 43 when saved to PS. The conversion of PS to EPS has minimal impact on the file size. Adding a raster preview image can result in an arbitrarily large EPS file.

Enif generated a PDF graphic using FreePDF. The PDF format is of comparable quality to the PS/EPS format, with a much smaller file size. The other Enif sample plot resulted in a relative file size equal to 3.

Demonstration: Enif vector graphics

- Print an Enif plot to PDF
 - cannot easily include the PDF image in a report
- Print an Enif plot to PS
 - convert PS to EPS
 - add an EPS preview
- Insert the EPS image into a report
 - save the report to PDF format

To save a PS graphic in Enif in Windows

- Select "Print full view" or "Print current view" from the File menu. Select the "PostScript Generator" printer. Check the "Print to file" checkbox in the print manager. Specify a file name with extension .ps when prompted.

* If fonts do not scale properly or if fonts change when saved to a .ps file, you may not be using scalable fonts. Specify TrueType or OpenType fonts in Enif Preferences.

Generating a PDF from Enif:

- In Enif, select File > Print current view or Print full view, and select the "FreePDF - Acrobat Distiller" printer with the "print to file" unchecked. Follow the instructions in the FreePDF dialog to save the PDF file.

Graphics format recommendations

- Printed reports should use vector graphics.
 - insert EPS images into the report
 - save the report to PDF
- Printed reports can use raster graphics
 - resolution for printing images (300-600dpi) leads to huge file sizes, so use PNG or convert to TIFF
- Web sites should use raster graphics
 - use PNG if possible
 - alternatively, use a limited color palette and convert from PNG/BMP/PPM/XPM to GIF
 - not recommended: JPEG

Although vector graphics are recommended for printed reports, if the report creation software cannot accommodate insertion of EPS images, then it is necessary to use raster graphics.

- The image resolution depends on the screen resolution. The screen resolution is 72 or 96 dpi (dots per inch). Check by exporting an image from Enif, then checking the resolution with an image editor. For example, open the image with Paint and select Attributes from the Image menu.

- Use Enif's Enlargement factor in the "export plot to image file" dialog to generate an adequate number of pixels for good quality printing. Adequate print resolution is usually 300 to 600 dpi. If the required graphic measures 20 cm on the printed page at 300 dpi, it is necessary for the image to have a width of 2362 pixels. Adjust the Enif window so that the view port is 787 pixels wide, and use an Enlargement factor 3 when exporting the plot image from Enif.

- Adjust the resolution of the image with the report creation software if possible, for example Quark Express. If the report creation software cannot adjust the image resolution, then use a graphics editing program to increase the resolution by resampling the image. Paint cannot perform this operation. Use Paint Shop Pro from Jasc software or Adobe Photoshop or a similar program.

Tips for Enif output

- Plot size
 - Enif window
 - Enlargement factor
- Different screen and printer output
 - mapper flags
 - out-of-screen print legends
 - stylus pen width 0
- View scale threshold
 - displays a mapper only if the scale is smaller than the threshold
- Print Preferences

Now that we know how to output Enif plots to useful formats, how can we use Enif to obtain the images we want?

Plot size

- The network plane dictates the size and proportion of the exported image and the printed plot.
- To reduce the plot size, you may need to hide parts of the Enif interface (in configuration mode) with Options > Show ...
- The tool tip of the pan panel displays the size of the view port.

Different screen and printer output

- mapper flags
- out-of-screen print legends
- stylus pen width 0

View scale threshold

- displays the mapper if the scale is smaller than the view scale threshold
- value specified in the extended configuration (in configuration mode) in the *Basic* tab
- the display scale is displayed in the tool tip of the pan panel

Print Preferences

- applied only after a new session of Enif is opened