Color, PDF, & OPI … How It Fits Together

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Abstract

Most prepress companies or print shops use print spool systems and so-called Open Prepress Interface (OPI) servers to optimize their workflow. Helios Software GmbH is a well-known vendor of such software. With the standards set by the International Color Consortium (ICC) and with proper use of the Portable Document Format (PDF), as specified by Adobe, a consistent color managed workflow can now be implemented in server-based environments. The purpose of this article is threefold:

1. There are ongoing discussions about where color matching should happen: in the print client's application, in the RIP of the final output device, or somewhere else? Helios advocates color matching and separation in the print spooler or the OPI system where the final destination of a print job is best known. The article tells why and how.

2. Until recently, PDF could be used for electronic delivery and viewing on screen as well as for black & white printing, but not for color production. However, with proper server-based color matching and PDF support as e.g. with Helios PDF Handshake and Print Preview, perfect color printing of PDF documents on any PostScript device and even to non-PostScript printers like PC ink-jet printers becomes a reality.

3. What makes a good output device a perfect fit in a server-based workflow? The article lists some features which allow smoother and more efficient print production.

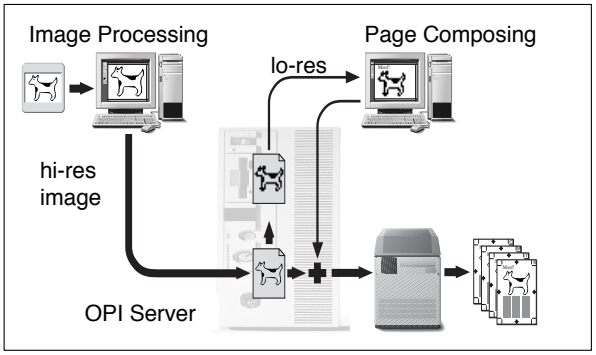
Typical Production Workflows

Print Spoolers

Print spoolers serve two basic purposes: They quickly accept print jobs from printing clients even when the final output device is busy with another job or when another client prints at the same time, and thus avoid any waiting period on the client side. And second, they can keep printers busy so that devices like expensive image setters are used to the fullest extent possible with minimum idle time. There are other benefits of spoolers like job accounting, central font storage, easier maintenance, load balancing, or support for additional printer access protocols like AppleTalk PAP or TCP Streams.

The Idea behind OPI

OPI servers are designed to speed up prepress and print productions with large images. A typical scanned image in high resolution easily is hundreds of megabytes in size. Access to the hi-res originals is needed for image retouching e.g. with PhotoShop. However, due to mere size, using them to compose and print a page in QuarkXPress, PageMaker, or in a specialized editorial or classified ad system, is extremely resource hungry and time consuming. OPI servers offer a solution for this. They generate lo-res placement files out of hi-res originals which can be conveniently used for composing the page. When the print client prints to an OPI enabled spool queue, the servers detect the lo-res placement files, search for the proper hi-res originals, and include the hi-res instead of the lo-res images in the outgoing PostScript job. The process of laying out and printing pages becomes significantly faster– up to fourty or more times– with OPI.



Typical OPI Workflow

Initially, OPI was intended for speed improvements and supported only the same kind of images which were used by the layout applications anyway, i.e. mainly pre-separated TIFF, EPS, or DCS images. A next generation OPI like Helios EtherShare OPI 2.0 vastly enlarges the scope of OPI:

- It will accept images of nearly any kind– e.g. PhotoShop native or even PDF files, in any color space– not only pre-separated CMYK, but RGB, Lab, etc.
- It generates standard separated EPS placement files for all those hi-res images which are otherwise not understood by the layout applications.
- It swaps lo-res by hi-res images for final output and at the same time applies all other necessary transformations– image format, color space, compression method, etc.

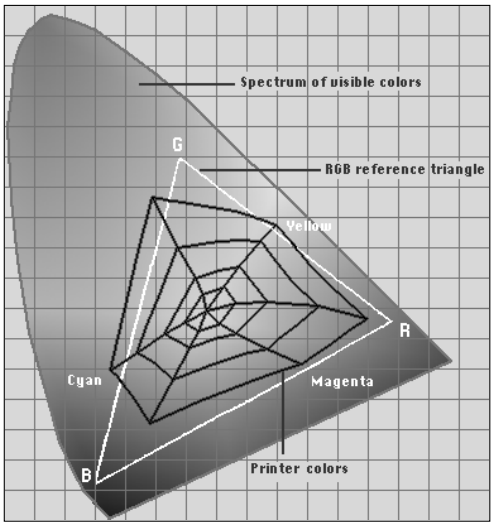
The benefits of such a next generation OPI are countless.

The Challenge of Colors

Differences in Color Spaces

The human eye senses colors as combinations of red, green, and blue. But the human mind interprets colors as hue, saturation and lightness. In addition, the colors we see are heavily dependent on many other factors including eye problems, ambient light, or even our mood.

Television sets and computer monitors also use red, green, and blue to generate colors. Scanners and electronic cameras work with light to get electronic representations of images and are RGB-based, too. For printing, however, one has to put some kind of ink, i.e. physical particles, on a surface, usually some kind of paper, to create the proper impression. In most cases, these inks are in cyan, magenta and yellow colors together with a fourth black ink. For better color results, many high-end printers, as e.g. Hexachrome presses, and nowadays even consumer ink-jet printers are using two or more additional inks. Sometimes spot colors are used in addition to the standard process colors. In special circumstances, like packaging printing that may have special requirements, one of the standard process colors is swapped in favor of a slightly different color. However, even the very best printer is not able to reproduce as many colors as the human eye can see.



Color Spaces of Human Eye, Monitor, and Press

CIE and ICC Standards for Colors

Neither RGB nor CMYK colors are well defined by the respective values of red, green, and blue, or cyan, magenta, yellow, and black for the simple reason that the base colors are not well defined; just look at the TVs in a department store all showing the same movie in totally different colors. Also paper, print process, or ambient light heavily influence the final color impression. There is, however, an agreed standard for device independent colors called CIE Lab. Any color can be unambigously identified by its L, a, and b values and many measurement devices report colors in Lab values. As a consequence, scanned images converted to Lab are always well-defined, but RGB or CMYK scans can be used reliably only as long as people remember the initial devices, the film material, and the scan software's settings.

There is also an agreed upon standard set by the ICC for how to describe the color capabilities of devices by so-called ICC profiles and how to attach them to scanned images. An ICC profile is an electronic file which is either generic for a certain device (scanner, monitor, etc.) and delivered by the vendor or which was individually created by the customer by means of special profile generation tools. An ICC profile can fully describe the color characteristics of a device. E.g. an ICC profile for a press reflects the inks, the paper stock, the way the press is operated, the environmental conditions, and the chosen UCR and GCR settings. Customers should use high quality profile generation tools because the quality of the profiles significantly impacts the quality of the matched colors. Similarly, many generic profiles provided by vendors are just good defaults, but better results are achieved with individual profiles. The latter holds especially true for color proof printers.

The Color Management Workflow

The differences in the color spaces of scanners, electronic cameras, monitors, and various kinds of printers and presses are significant. The challenge is to match the colors of the original images for the final print output in a way that the human observer conceives them as the same or, at least, as very closely matched colors. In addition, prepress people would like to see correct colors on their computer screens and on hard copy prints they can present to their clients. At the printer's site, press operators appreciate proofs with colors they can actually print on their presses and prefer separations which do not require tweaking the press to achieve reasonable results.

More and more vendors have implemented ICC-compliant color matching on a system level. Apple Computer led the way by integrating ColorSync 2 into the Macintosh operating system years ago. Microsoft followed with ICM 2 for PCs. Thanks to the ICC standards and their support by the vendors, a completely color-managed workflow from image acquisition to final output has become a reality. Consistent and reliable colors are now within reach of anybody.

Where Should Separation Happen?

Most images used in todays' print production are already pre-separated CMYK for a good-quality, standard offset press. If such images are to be used on a different press– e.g. for a newspaper instead of a magazine, or with different paper stock– they have either to be scanned again for a different separation or must be manually retouched to get acceptable color. These manual tasks are time consuming, often tedious, and always error-prone.

The fact that one cannot use the same original image files for different production tasks slows down everything and adds cost. There is an alternative: Don't separate in the application by which the images were scanned or retouched, but use the original images for composing a page and postpone final separation or color matching until the jobs get printed.

There are essentially three instances where separation can be done at print time:

• The application which prints can take care of proper separation. E.g. on an Apple Macintosh, QuarkXPress can call Apple ColorSync with proper ICC profiles for best possible separation.

• The RIP can separate if it is high end PostScript Level 2

with an integrated color matching engine.
• In a production environement with a print spooler or OPI server, the server can take care of separations and color matching.

The first option serves small shops or individuals well who work in home offices. In-RIP separation, the second option, makes sense for separating CIE Lab print jobs to device specific press CMYK. But in all other cases, Helios promotes color matching and separation in a prepress server for many reasons:
• Server-based separation can support any PostScript RIP, even Level 1 clone RIPs. There is no need for costly upgrades and, maybe even more important, customers get full flexibility for scheduling print jobs in plants which have older RIPs or more than one output device.
• Server-based separation not only gives best possible separations for the final output. It also allows additional spool queues to be set up for color proof printing, e.g. for simulating the colors of a newspaper advertisement on a color copier. RIPs cannot do color proofs.
• Usually, RIPs and imagesetters are bottle-necks in the production workflow. It makes sense to offload heavy-duty color separation from the RIP to a prepress server.
• Server-based separation always guarantees identical results regardless of RIP. As the Helios prepress server uses the LinoColor engine, even identical color results with Apple ColorSync and Microsoft ICM 2.0 are guaranteed. On the contrary, RIP-based separation depends on the RIP's make or model.
• Server-based separation can easily handle images in any color space, be it RGB, CMYK, or Lab. Most RIPs can't match CMYK.
• For print jobs that include images from multiple sources the various Color Rendering Dictionaries (CRDs)– CRDs are the RIP's equivalent to ICC profiles– need to be downloaded to the RIP. Currently this can't be done and RIPs are restricted to one color rendering dictionary per job. With RIP-based color separation it's impossible to correctly use images from different sources. Server-based separation handles such jobs without problems.
• Server-based color matching allows media independent production, e.g. in order to match the output to RGB for usage on a web server or on CD-ROM publication, as well as to match to CIE Lab for archival purposes or for remote printing on multiple locations.

Which Image Formats are Best?

It is not likely that people will agree on a "best" image format for press production. The requirements at various sites or for various purposes are too different. The golden rule is: Avoid any loss in quality, be it resolution or colors, during image acquisition. This will allow you to reuse the same original file again and again for different purposes. It is a good idea to leave scanned images in RGB or translate them immediately to CIE Lab. No colors are lost and the images are significantly smaller in size than when separated to four channel CMYK images. A prepress server with automatic separation will quickly produce the needed separation at print time.

Most images are retouched by PhotoShop using multiple layers. In such workflows, another good piece of advice is to keep the images in PhotoShop native file format and to avoid multiple versions of the same image in different formats like TIFF or EPS. A state-of-the-art OPI server will generate standard EPS lo-res placement images out of PhotoShop native files which can be used by any page composing system. This keeps hard disk requirements down, avoids handling errors, and speeds up production.

PDF for Color Production

PDF's Many Advantages

The well-defined Adobe PDF file format has many advantages. It is cross-platform and supports PC, Macintosh, and Unix. There is Adobe's inexpensive Acrobat product suite for the creation and manipulation of PDF files, and Acrobat Reader is even free of charge. PDF fully supports laid-out pages in all aspects; nearly everything used for today's print output can be represented in PDF including of course fonts or page elements in various color spaces. PDF files are extremely compact in size– PostScript files of several megabytes are just a few hundred kilobytes when distilled to PDF. You can edit PDF files, e.g. in order to correct typing errors, up to the very last minute which is not feasible with PostScript files. And best of all, PDF files will most likely print properly on any RIP, because Acrobat Distiller normalizes PostScript to PDF elements so that good PostScript is generated at print time.

Today's Obstacle for PDF Color Printing

Unfortunately, Acrobat's default settings are intended for a RGB workflow with minimum file size as its number one criteria– something which does not fit the requirements of print production. A second obstacle is the fact that you cannot print proper separations with Adobe Acrobat. Nevertheless, documents according to the current Adobe's PDF 1.2 specifications are well suited for color production if they are generated by Acrobat Distiller version 3 with correct settings and if a proper separation workflow is used. Contrary to common belief and experience, PDF files can carry all necessary information for best possible color output– including spot colors, OPI comments etc.

A PDF Color Production Workflow

As with automated color production, PDF separation printing could be implemented in the print application itself, or the RIP, or by means of a proper prepress server. The same arguments as with automated color production apply for the question where in the production chain the translation of PDF files to separated PostScript jobs should take place:
• Unfortunately, as of summer 1998, there is no application that generates proper PDF separations for any RIP. Currently, there is only a plug-in for Acrobat Exchange which supports PDF color printing on certain RIPs. However, it does not support older RIPs, or non-Adobe RIPs, or non high-end RIPs.

• Only the most recent PostScript 3 RIPs are able to directly accept and output PDF files. However, the standard printer drivers on PC or Macintosh do not (yet) support direct PDF printing.
• Using a prepress server for PDF separation printing makes a lot of sense. Such a server can take care of font issues as well as of any color issues and can output to any PostScript RIP regardless of vendor or make.

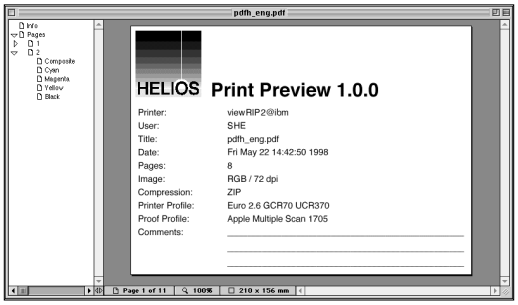
Helios supports PDF by means of its PDF Handshake server product which allows you to print PDF files with proper colors and to use PDF as a high-resolution input format for the OPI workflow. PostScript Type 1 and 3 as well as TrueType fonts are supported. You can print PDF files with a Helios supplied Acrobat plug-in or Unix tool:
• Separated for final print or matched for proof print,
• To any PostScript device, incl. Level 1 RIPs,
• With optional merging of spot to process colors, and
• With proper hairlines, font handling, registration, etc.

In case of OPI, PDF Handshake generates color correct EPS lo-res images of PDF originals. These lo-res representations can be used like any other EPS. During output the Helios server swaps EPS lo-res by PDF hi-res and sends it as color matched/separated PostScript to the printer.

A PDF server with the above-mentioned features gives prepress and printing customers all the benefits of PDF as universal exchange format in their current environment. It supports the existing page composing applications and the currently installed output devices without any need for costly and time consuming upgrades.

PDF for Last Minute Production Checks

To go one big step further, PDF is also an excellent format for checking print productions prior to final output. The Helios Print Preview server software allows you to preview any composite or separation PostScript job as a PDF file with all pages in proper separations and/or composites according to the final output device's characteristics. The previews are based on the presses' PPDs . They are true representations of the final output in all aspects regarding completeness and accuray of page elements, correct colors, and font usage. A ticket tells job details.



Separation Job with Separation & Composite Preview Pages

You can set up preview spool queues in a way that the final print is simulated correctly on various devices: on a monitor for soft proofing, on a locally attached PC or Macintosh printer for hard copy color proofs, or even for remote proofs over modem, ISDN, or the Internet.

Features for Server-Based Printing

Support of PostScript and availability of a proper PostScript Printer Description PPD file which characterizes the device's capabilities is a must for devices used by prepress professionals. However, as mentioned above, one can actually color proof a print preview on today's high-quality consumer ink-jet printers with RGB bitmaps if the previews are generated with the proper tool.

To be used with print spoolers, reliable and fast network interfaces, most likely Ethernet, with printer-access protocols on top are required. AppleTalk PAP is extremely convenient as a printer-access protocol because it is easy to set up, allows bi-directional communication and specifies font inquiries, alerts, and error messages. TCP Streams printing is fast, but unfortunately lacks back-channel communication to the print client.

Helios specifies an "Enhanced TCP Streams Printing Protocol" which offers the convenience of AppleTalk PAP over TCP/IP links and can be implemented with minimum effort on devices that already support AppleTalk PAP and TCP/IP.

In cases where the RIP is running on the same machine as the spool system, a "shared memory interface" allows you to hand over print jobs in main memory by exchanging memory addresses. This is the fastest and most efficient way to feed data from the spooler to the postprocessing application. The specifications for enhanced TCP as well as for shared memory printing are available on the Helios web site http://www.helios.com.

A color output device must meet three criteria to be used as color proofing device:
• Large color gamut, i.e. the more colors a device can print the better;
• Consistent colors over time, i.e. the device must reproduce the same colors in the course of time, and
• Consistent colors over the whole printed area, i.e. it may not matter where on the page a certain color is printed.

From Helios' point of view, a color device should offer as large a color space as possible and stay calibrated. However, there should be no additional color matching done in the printer.

Biography

Dipl.-Math. Peter Mayr holds university degrees in Mathematics and Physics from the university of Munich with post-degree studies at the department for economics and computer sciences in Mannheim. After two years in the strategic IS planning department of a large German bank he joined Apple Computer, Munich, where he held various positions in product management and marketing during his seven-year tenure. For the last four years he has directed marketing and distribution for HELIOS Software GmbH, Hannover. Helios develops and markets networking products for general use as well as professional solutions for the prepress and printing industry. Mr. Mayr has world wide experience and extensive knowledge in the networking and publishing arenas. He can be reached via e-mail address marketing@helios.de.