Color Page Printers: Market View and Color Technology Trends

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プリンタ市場は過去15年間PC市場の成長と共に市場規模の拡大を続け，その間，インパクトからモノクロ・ページ，そしてインクジェットへとプリンタ技術のシフトが見られた。今後の成長領域としてはカラー・ページ市場があり，2001年から2006年にかけて全世界出荷台数が2倍に伸びると予測されている。この成長の理由として，カラーページプリンタの急激な低価格化だけでなく，プリントショップや印刷機で印字していたものが，オンデマンドでオフィス内でネットワーク経由印字される等の新規アプリケーションの出現がある。オフィス内のネットワークプリンタとして，インクジェットとの競合の観点で，印字品位の改善や色空間の改善等が求められるが，それに加え，これら新規アプリケーションの対応で，カラーマネジメント，ドキュメントワークフロー，処理速度の観点での大幅な改善が求められる。特に，電子ドキュメントファイルのフォーマット（PDF，X-HTML，TIFF）を直接印字する機能や，その中に埋め込まれたICCプロファイルを処理する機能も含めたICCプロファイルへの対応，また，一般オフィスで標準になりつつある色空間

sRGBへの対応が，これら業界標準の進化のサポートも含め，重要な顧客要求となるであろう。

Worldwide Printer Market

The worldwide printer market directly benefited from the tremendous growth of the personal computer industry over last fifteen years. During this period, the dominant printer technology shifted from impact to monochrome LED/laser and inkjet, but total printer sales consistently grew in tandem with PC sales. Today, the printer market growth has slowed and in some areas declined, but not to the extent that PC sales have declined. In the future, impact printer sales are expected to decline further, while inkjet will continue to grow but at a much slower rate. Monochrome page printer sales growth will remain flat, but color page printers will experience large sales growth. Figure 1 shows the worldwide page printer unit sales forecast by region. Color page printer sales are expected
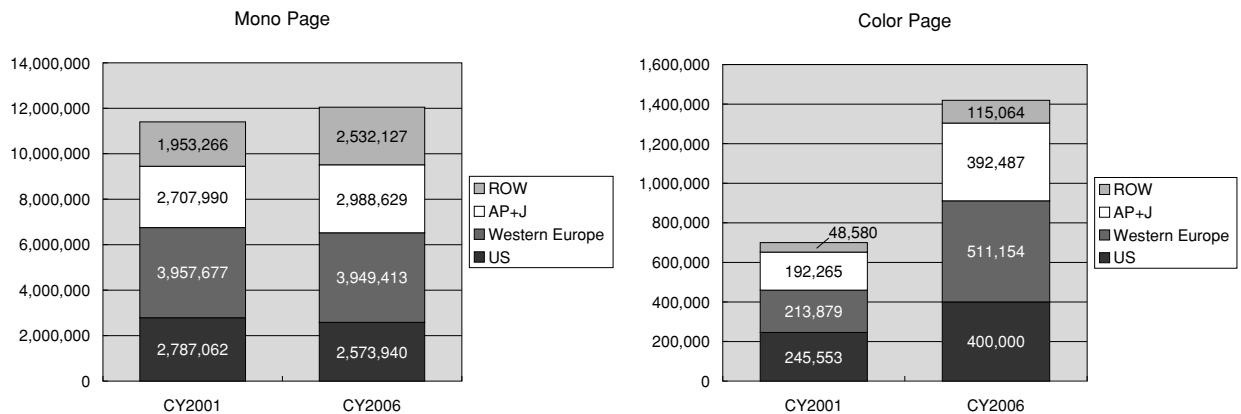

Figure 1 Worldwide Printer Forecast (Source: IDC)

Notes:
AP+J = Asia Pacific and Japan
ROW = Rest Of World
Page Printer = Laser or LED printer = Toner-based printer

to double during over this time, and Oki Data Corporation is well positioned to benefit from the growth in the color page printer market.

It is important to understand the basic customer needs and applications responsible for driving the printer market. The impact printer market was driven by the emergence of accounting applications (e.g. Lotus 123) and specialized software for Point of Sale/Service (POS) applications. The monochrome page printer market was driven by the emergence of graphical computing and desktop publishing, and was initially enabled by Postscript printing technology. Inkjet was further able to meet the demand for affordable color desktop printing, with no cost increase to the basic monochrome inkjet hardware. This allowed inkjet to win the mass consumer market, and its position in this market was constantly reinforced through technology and manufacturing advancements over the last ten years. Critical technology improvements have included more permanent and durable inks, and ultra fine drop sizes and associated digital imaging techniques for image quality. Lastly, the sharpness of the text has improved to be much closer to that of page printers, and the reliability of the devices has greatly improved.

As we look forward to the emerging market for color page printers, the key market drivers will be based upon the following trends and new applications:

- Migration from monochrome to color page printers and MFPs (Multi-Function Peripheral) for the general office, where inkjet is often seen as inferior.
- Much smaller size and weight of new color page printers especially the new Oki C5100 and C5300 printers, and much lower prices.
- Increased reliance on in-house graphics and short-run production instead of using independent print-for-pay shops.
- Migration of jobs from offset presses to color page printers through "distribute-and-print" workflows combined with "just-in-time" printing.
- New printing applications that support that the mobile workforce and new computing platforms such as PDAs and Internet-capable cellular phones.

As color page printers gain market share, they will have to demonstrate their ability to match inkjet in critical areas such as color gamut and photo image print quality, otherwise many customers might be disappointed. Oki Data Corporation continues to develop new printer technologies to match or exceed inkjet in such areas, and Oki page printers today exhibit a much larger color gamut than the leading competitor's page printers. In other areas such as duty cycle, cost-per-page, failure rate, paper handling, finishing, text quality, and network management and security features, color page printers will maintain superiority over inkjet into the future and therefore increasingly appeal to the general office segment based upon the above market drivers.

The transition from offset and print-for-pay shops to in-house color page printers will happen over the next three to five years, and place much higher requirements on color page printers regarding color management, document workflows, and processing speed. For example, the ability to directly print (without a software driver) a variety of file formats will become very important. Adobe Portable Document Format (PDF) is the most important format for direct printing today, but others such as X-HTML (Extensible Hyper Text Markup Language) and Tagged Image File Format (TIFF) are increasing in importance. Note that with the release of PDF version 1.4, Adobe began to provide the capability to embed ICC(International Color Consortium) color profiles directly into the PDF file, and therefore future color printers must be capable of processing embedded color profiles for direct printing. The embedded print controllers which Oki develops for the color page printers will need to provide features found today in expensive PC-based print servers, including advanced queue management and color adjustment, and much faster print job processing.

Color Management Trends

The basic problem to be solved with color management is to provide a method by which vendors of color technology products can ensure the predictability and consistency of color. In addition, the issue of color accuracy is very important, especially in demanding
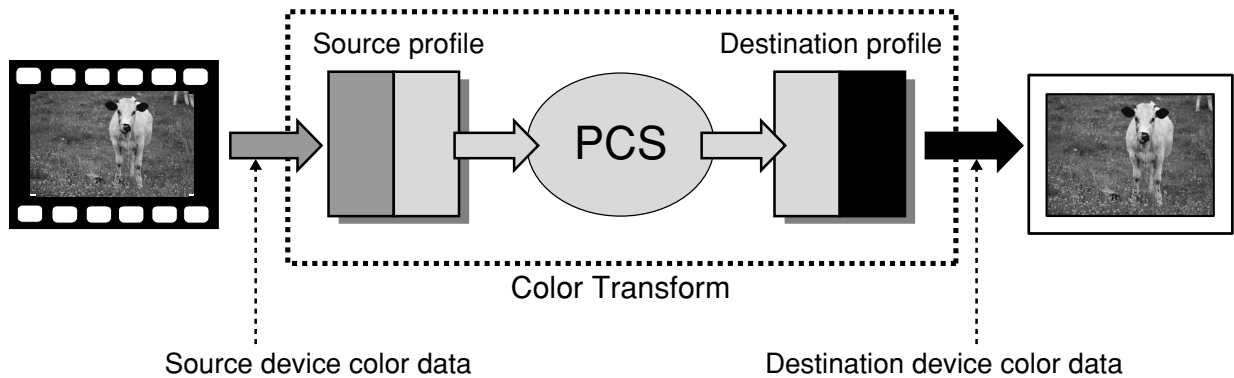
Figure 2 ICC Workflow Example

applications such as graphics arts. In order to define a color management system, certain assumptions must be made about the devices and computer applications that process color data. For example, the calibration and stability of the color devices such as printers, scanners, digital cameras, computer displays, and television sets are outside the scope of color management. Computers must provide basic color management functions within the operating system, in order to provide the necessary color transformations, and to support the creation, modification, and distribution of the color profiles associated with electronic files. Unique requirements for color are supported by software drivers and applications provided by the color device manufacturers, which in turn utilize the basic color processing capabilities provided by the operating system.

The ICC was established to standardize the creation of color profiles. It defines relatively large reference color spaces (CIELUV and CIELAB), which are also called the "Profile Connection Space" (PCS), and also defines the file format and contents for device color profiles. These profiles allow a color device to be mapped to/from the PCS from its device-specific color space. In essence, the PCS provides a standard representation of the color characteristics of any device. The ICC specification stopped short of actually defining the color mapping mathematics, and so there still exists some variation among vendors in this area. In fact, this is a current project within the ICC, which is to define a reference implementation. The ICC workflow is illustrated in Figure 2. Further information can be found ICC website at www.color.org, including the latest version of the specification (Version 3.4).

More recently, some new color standards have emerged providing emphasis towards the consumer and "prosumer" markets. Typically, such mainstream users will tolerate minimal involvement in making color adjustments, but most will prefer color management to be invisible. Given that many novice users increasingly employ the Internet to distribute color documents and images without

- ●An "80%" solution for most of the office, home, and web users
- ●Provides ease of use, interoperability, and performance
- ●Colorimetric standard based on common CRTs －defines gamma and chromaticity
- ●Compatible with the ICC standard － an sRGB ICC profile is freely available

Figure 3 sRGB Benefits

- Fixed Gamma:

    − Not everybody uses 2.2: For example, 1.8 used for Mac; 2.4 for UNIX

- Viewing conditions:

    − 64 lux is lower than typical office (about 500 lux)

    − High lux level reduces gamut due to high glare

- Gamut:

    − sRGB gamut is not a solution to all the problems

Figure 4 sRGB Weaknesses

using ICC profiles, a new standard called sRGB was created satisfy most requirements in the event that the ICC workflow is not utilized. Included in this group is the general office worker, the main target customer for Oki color printers. The sRGB standard recognizes that while the mainstream consumer market is more forgiving regarding color accuracy, it does demand color consistency. In addition, the overall product cost is a very important factor. By contrast, the ICC standard requires a relatively high degree of computational power and therefore cost, and bandwidth is required to send color profiles with each image through the Internet. In recent years, sRGB has gained wide acceptance, and is now the default color space for both Oki and HP color page printers. In fact, it is also the default color space for the Postscript emulation in Oki color printers as well. Additional information can be found at www.srgb.com, and at Microsoft's web site. Extensive information is also available at www.ipa.org/tech/color_management.php3. The main benefits and weaknesses of sRGB are summarized in Figures 3 and 4.

An extension to the original sRGB standard has been drafted to address the weaknesses, and is named sRGB64. The sRGB64 standard will not replace sRGB, because sRGB is ideally suited for the low-end consumer markets. Nor will it replace ICC solutions that are entrenched in the graphics art market and provide a much higher level of features. Rather, it is the final piece of technology that will allow operating systems to provide a complete and scalable color management solution to

meet the full range of customer needs. Detailed information can be found at www.microsoft.com/hwdev/tech./color/sRGB64.asp.Oki Data continues to monitor its progress, and will likely support sRGB64 in the future as it becomes prevalent.

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