Technological Trends of Printer and MFP
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Abstract
The environment surrounding printers has been radically changed by improvements in PC performance and due to the rapid advancement of networking and digitalization. Okidata has a role to provide a print-on-demand environment to end users so that printing is possible whenever necessary. This article presents the general technological trend of printers and MFP (Multi-Function Peripherals) which can adapt to such environmental changes.

1. Introduction

In the early 1980s, high cost performance computer systems where personal computers (PC) and wire dot printers were combined appeared, which accelerated the office automation trend. After 1985, high resolution and high-speed printing electrophotographic printers and high performance PC technology made it possible to print various fonts, opening up the world of desktop publishing (DTP). As the DTP environment became popular, the PC market expanded as well. Color printers, which emerged around 1990, have spread into homes because prices made it affordable for private individuals and because of the appearance of high performance of printers, which could process images sufficiently.

Changes in the PC environment around printers are now subject to downsizing, openness, networking, and multimedia information. On the other hand, the semiconductor technology that supports the advancement of PC technology is promoting the digitalization of electronic equipment, including cameras, copiers and TVs, creating a world of digital media. Printers and MFP (Multi-Function Peripherals) are becoming more and more important as the output equipment of digital media, or as composite equipment for handling digital media. MFP is equipment which combines various digital electronic equipment, such as scanner, facsimile and printer.

2. PC network environment and printer business

Figure 1 shows the trend in capability of microprocessors (MPU) used for PCs and the bit unit price of DRAM, along with the trend of printers. In the year 2000, it is forecasted that the capability of an MPU will reach 2 GMIPS or more, and the bit unit price of memory will be 1/3 the price now. Figures 2 and 3 show the trend in the number of printers shipped and the respective price\(^1\). This data forecasts that the printer market will grow until the year 2000 at an annual percentage rate of 15% in terms of the number of units shipped. It looks as if the spread of the Internet and electronic mail will fuel a paperless trend, but the increase in information volume that flows through networks is generating a need for printers more than ever before. As a result the demand for printers is expanding along with downsizing, lower prices and the higher performance trend of PCs.

3. Trend of printing technology

The evolution of printing technology is seen in the technological development process for color printing, higher speed and higher resolution\(^2\). This section describes each technological field and our efforts.

3.1 Color printing

The recent improvement in image quality of color printers is remarkable, opening up a new world of digital photo print as output equipment for Internet information and digital cameras. The color materials of a printer generally differs depend-
ing on the printer, therefore color conversion processing is necessary to reproduce the desired colors. A framework to handle such processing in the PC environment is standardized by ICC (International Color Consortium) / ICM (Image Color Matching). As a result, an information environment for handling color is becoming organized.

Okidata has been working on technological developments for both electrophotographic type and inkjet type printers in the area of color printing. The feature of our electrophotographic printers is a tandem system equipped with an LED array head, which is suitable for high-speed printing and compact packaging. For inkjet type printers, we are developing heads using piezoelectric materials. In addition to these print engine technologies, we are developing a color matching technology for implementing color WYSIWYG in PC and network environments.

3.2 High-speed
Electrophotographic printers that have high speed features are reaching function and performance levels that are very close to conventional analog copiers with the further increases in speed. As printer speeds increase, new ways of use are emerging. For example, an original draft which was once output to a printer and then massively copied with a high-speed copier is now massively printed directly by a printer. It is also possible to complete simple commercial printing work by using a printer. This opens up a new multi-original digital print field. Along with this trend, such media processing as double sided printing function, large paper feed function, sorting function after printing and simple binding function are becoming important technological factors.

Okidata developed a double sided printing printer with a printing speed of 20 ppm as a technology to support this field.

3.3 High resolution
Resolution is a major factor that determines image quality, and 600 dpi is most frequently used at the moment. In this case, printing output consists of sets of approximately 1/600 inch diameter pixels. Printing with such small pixels makes it possible to print many different fonts, and to digitally generate photograph images with dots. Now resolution is further improving and Okidata has been releasing 1200 dpi printers based on LED head technology. This has expanded the application range of printers to the simple digital prepress area.

The information volume handled by a printer increases as resolution increases and colors are used. The information volume per an A4 size page was once several kilo bytes when only characters and graphics were used, but now has reached 50 ~ 60 mega bytes when printing high resolution color images. This means that the processor used in a printer requires a capability equivalent to or more than that of a PC.

For Okidata’s high-speed color electrophotographic printer, a 64 bit RISC type MPU is used as the processor.

An improvement of general throughput, including the control system, is a critical issue from now on, along with the further improvement of printing quality of high quality color images.

4. Technological trend of printer interface
The trend of printer interface is moving in the direction of openness, bi-direction and higher speeds. The trend to openness means a change from a dedicated printer interface to integration under a standard PC interface. A bi-directional interface makes monitoring printer status and plug-and-play easier, and higher speeds make it possible to send large volumes of data, such as an image, to a printer in a short time. The standards related to a host interface are IEEE 1284, USB (Universal Serial Bus), and IEEE 1394. For networking, a LAN standard (10 / 10 base TX) for wire communication and the IEEE 802.11 standard for wireless LAN has either been established or is under consideration.

The connection formats of printers are also diversifying as networking and the digitalization of electronic equipment progress. A printer was once the output equipment of a computer, and at that time a printer was connected to a host computer. Today a facsimile can receive and output data from the Internet, and a printer can directly output data from a scanner and digital camera without using a computer. This means that a printer is now directly connected to a network and digital electronic equipment, in addition to being con-
5. Expansion to MFP

Data handled by electronic equipment is digitized and information once handled by a dedicated machine (printer, fax, copier) can now be shared.

The possible data sharing environments are:
1. sharing equipment by using a network
2. sharing each dedicated machine using a PC as the core
3. sharing a central machine that has integrated composite functions using a network

Each environment has advantages and disadvantages depending on the operation area (home, SOHO, business). In 1992, Okidata released DOC • IT, which is a composite machine where each dedicated machine has been integrated with a PC as the core. This is one example of the integration of public lines and a LAN network.

Recently the information environment has dramatically changed, and the emergence of a new type of network terminal or composite peripherals of a PC to support LAN, the Internet and public lines is anticipated. To meet such demands of society, we are integrating the latest communication technology to conventional facsimile technology to expand printer / facsimile functions. In such a digital information environment, Okidata feels that it is our responsibility to provide an environment that makes printing possible whenever necessary, that is, an environment of print-on-demand, for users (Figure 4).

6. Efforts for global environmental protection

Design aimed at recycling is Okidata’s design philosophy. Recovering and regenerating waste is often discussed in relation to recycling. Okidata’s recycling is different from this, for decreasing waste itself is the key of our design philosophy. Oki has been adopting a reinking system using a short ribbon for serial impact dot printers. For electrophotographic type printers, only toner has been replenished and toner that remains on light sensitive elements has been recovered and reused after recharging.

Low melting point double structure toner used for electrophotographic recording contributes to lowering power consumption, since the fixing temperature can be decreased. LED light sources, which are more compact than laser, contribute to resource saving because the printer can be downsized.

In the future, insuring printing quality, when plain paper without resin coating is color-printed on both sides, will be important from the point of view of protecting the natural environment.

7. Conclusion

This paper presented an overview on the technological trends of printers and how Okidata has been coping with these trends. Component and material technology, which was not discussed in this paper, is also important as a base technology that supports printers. Okidata has been developing low temperature fixing encapsulated toner, 1200 dpi LED heads and various roller components for electrophotographic printers.
Providing a print-on-demand environment is the mission assigned to Okidata. The market environment is right in the middle of technological innovation, just like the PC market. Therefore a key to success is “Time to Market”, which means quickly turning new technology into a new product and releasing it to market. For this we are actively introducing simulation technology and a superb design and information environment paying attention to the importance of concurrent designing.

8. References