Emerging Marking Technologies: A Review and Comparison of Xerographic and Ink-Based Imaging

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Abstract

Several ink-based marking technologies have recently surfaced, and these technologies are causing quite a stir in the market. The potential for inkjet technology is based on some basic principles: ink costs less than toner; ink print heads have relatively few parts; and the quality that can be delivered is high. This white paper provides an overview and history of marking technologies and explains the potential benefits that ink-based systems could deliver to the office printing market.

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Introduction

Today is a very exciting time in the printing market. After years of only incremental changes to imaging technology, new and important developments promise to usher in a new phase in printing—particularly color printing in the office environment.

Several ink-based marking technologies have recently surfaced, and these technologies are causing quite a stir in the market. The reason for this is simple. Ink-based imaging offers a number of attributes that address an underlying need in office printing: affordable color. In fact, for quite some time InfoTrends has forecasted a much broader deployment of inkjet-based technology to address these unmet needs.

After years of only incremental changes to imaging technology, new and important developments promise to usher in a new phase in printing.

The potential for inkjet technology is based on some basic principles: ink costs less than toner; ink print heads have relatively few parts; and the quality that can be delivered is high. This white paper provides an overview and history of marking technologies and explains the potential benefits that ink-based systems could deliver to the market.

Key Highlights

- Detailed description and comparison of inkjet imaging technologies including serial inkjet versus page-wide arrays, thermal inkjet, piezo inkjet, and solid inkjet marking technologies.

- In-depth explanation of various emerging ink-based technologies, including HP Edgeline, Memjet, and Brother's line head technology.

- Overview of Xerox's continued innovation with solid ink technology.

- Criteria that end-users should consider when reviewing alternatives to laser marking technology.

What is Marking Technology?

So, what is marking technology? Basically, every printer, copier, or multifunctional peripheral (MFP) uses a fundamental writing system, which serves as the process for putting marks on paper. Most writing systems fall into two specific categories: impact technology and non-impact technology.

Impact technology served as the primary writing system for many of the earliest computer printers: the old daisy wheel devices and serial dot matrix printers. These printers produced pages by using a forcible impact to transfer the ink to the media. Some of you may have fond memories of these early days, when pages were hammered out on printers that looked and sounded more like typewriters than digital printers.

That all changed, however, when Xerox developed the xerographic imaging process, which eventually led to the introduction of the first laser printer. With the laser printer, pages are produced using a non-impact writing system. Other non-impact marking technologies were soon developed, including inkjet, dye sublimation, and others. Non-impact printers offer many advantages over impact technology, including faster performance, better print quality, and a much quieter operation. For these reasons, non-impact printers dominate the market today, and most of these printers are based on a derivative of either inkjet or xerographic printing.

Surprisingly, impact printers remain popular today for certain applications, primarily in industrial areas where the environment can be harsh. Impact printers work quite well in these environments because they can hold up under demanding conditions. Impact printers are also very effective for producing multi-part forms. For general-purpose home and office printing, however, laser- and inkjet-based devices dominate the landscape. Generally speaking, inkjet printers are most popular for home consumers, while laser printers are used extensively in office-printing applications. There is some overlap, as laser printers have penetrated the home while inkjet has become quite popular in home office and smaller businesses.

Marking Technology Advancements

Considering how far computer printing technology has come since the old dot matrix days, it might seem as if marking technology has gone about as far as it needs to go. In reality, however, printer manufacturers are constantly making improvements to the writing systems used in their products. There are many reasons for this, not the least of which is competitive positioning. Basically, the writing system is one area where a printer company can claim competitive advantages, by producing a product that offers faster speed or better print quality, for example. Customer need, however, is the primary factor that drives the further advancement of marking technology. We live in a digital world, and today we have a wealth of information at our fingertips. Many have speculated that the influx of digital content combined with high-resolution display technology would eventually lead to the paperless office. In reality, the increase in digital content has led to the production of more pages, not less.

As a result, customers are faced with mountains of information that they need to view, process, and print. In short, customers want to produce better looking documents, they want to be more productive, and they want to lower their printing costs. To address these customer needs, printer manufacturers continue to improve the marking technology used in their products. In a recent survey, InfoTrends asked various business users to rank the importance of certain features relative to their next printer or MFP purchase. Not surprisingly, speed, image quality, and paper handling ranked highest as the most important features among all respondents (see Figure 1).

Figure 1: Importance of Printer/MFP Features
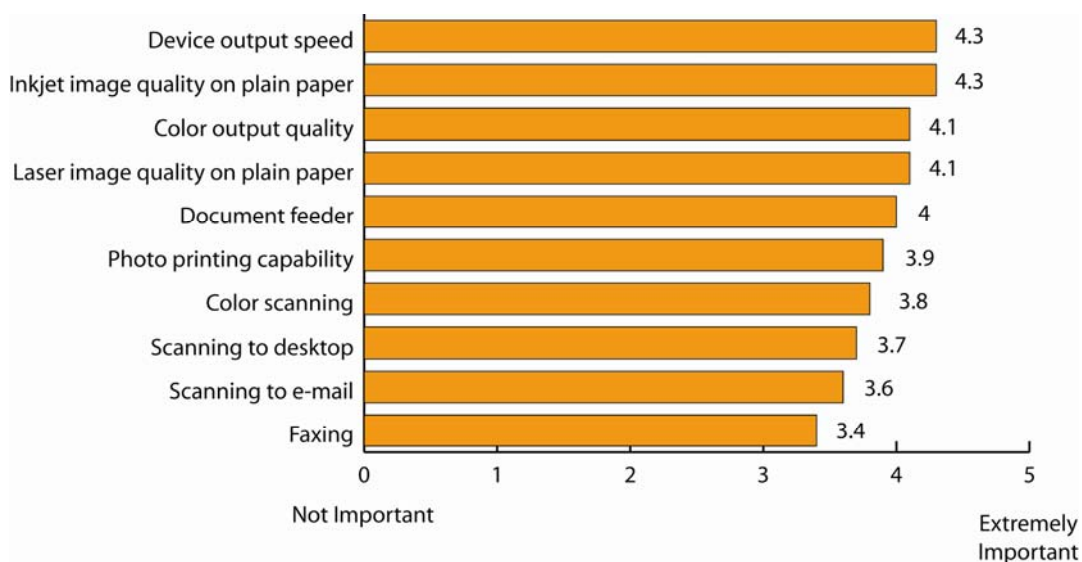
Source: InfoTrends, DPS 2007 Retail Channel Survey

Overview of Marking Technologies

Page Printers and Serial Printers

When reviewing various marking technologies, the first thing to consider is the difference between page printers and serial printers.

The primary difference between these two technologies relates to how the page is processed and imaged. Page printers, such as laser, LED, and solid ink devices, use an imaging mechanism that spans the full width of the page, which provides the ability to process the entire page in a single pass. To do this, the entire page must be constructed (or rasterized) and stored in memory before it can be imaged. Once this occurs, the rasterized page is imaged and fed through the printer at the rated speed of the device. This is why laser printers produce pages at a constant rate. In other words, once the printing process starts, the paper moves through the device at a constant speed.

Serial printers, such as dot matrix and consumer inkjet products, use a print head that is actually much smaller than the width of the paper. Pages are produced on a line-by-line basis by scanning the print head back and forth across the page. With an inkjet printer, data is fed to the imaging mechanism when it is needed as each line or group of lines is imaged (see Figure 2).

Figure 2: Imaging Process for Page Printers Compared with Serial Printers
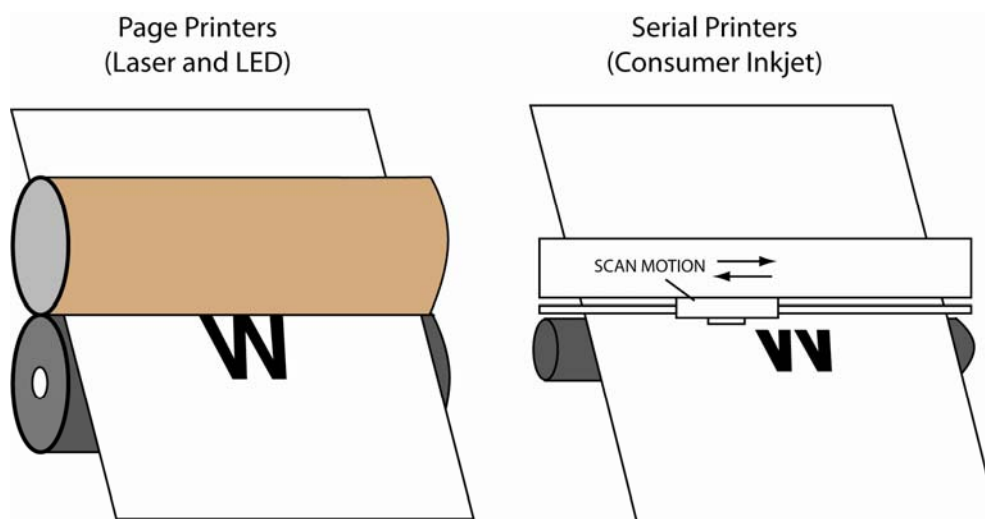
Source: InfoTrends

The constant stopping and starting of the print head explains why pages do not move through a serial inkjet printer at a constant rate of speed. Fundamentally, laser printer speeds are dependent on how quickly the engine can move pages through the printer: the faster the engine—the faster the printer. For serial inkjet printers, print speed depends on a number of variables, including the size of the print head, the rate at which the print head moves across the carriage, and the complexity of the page.

This fundamental difference explains why page printers, particularly laser printers, have become more popular for office printing environments. In general, page printers are faster, more reliable, quieter, and can more easily handle the heavier workloads associated with office printing.

Xerographic Imaging

The marking technology used in laser printers is called Xerographic imaging. Although this type of writing system has improved dramatically over the years, the fundamental process remains the same. Additionally, while manufacturers have refined the process and taken much of the cost out of the system, Xerographic printing remains a fairly complicated process.

There are many elements that make up a Xerographic laser printer. To produce a printed page, a laser beam light is directed toward a series of rotating mirrors, which directs the beam onto a photoreceptor drum. Based on page data that is fed to the writing system, the laser is turned on and off to create a latent image on the drum. For LED printers, the process is similar except that a print head with an array of laser diodes spans the width of the page, and these diodes are turned on and off to form the latent image. The latent image can be transferred from the drum and fused to the paper using many different techniques, most often involving a combination of heat and pressure. In comparison to other marking technologies, Xerographic imaging is quite complicated and involves precise control over many moving parts (see Figure 3).

Figure 3: Typical Xerographic Imaging Process
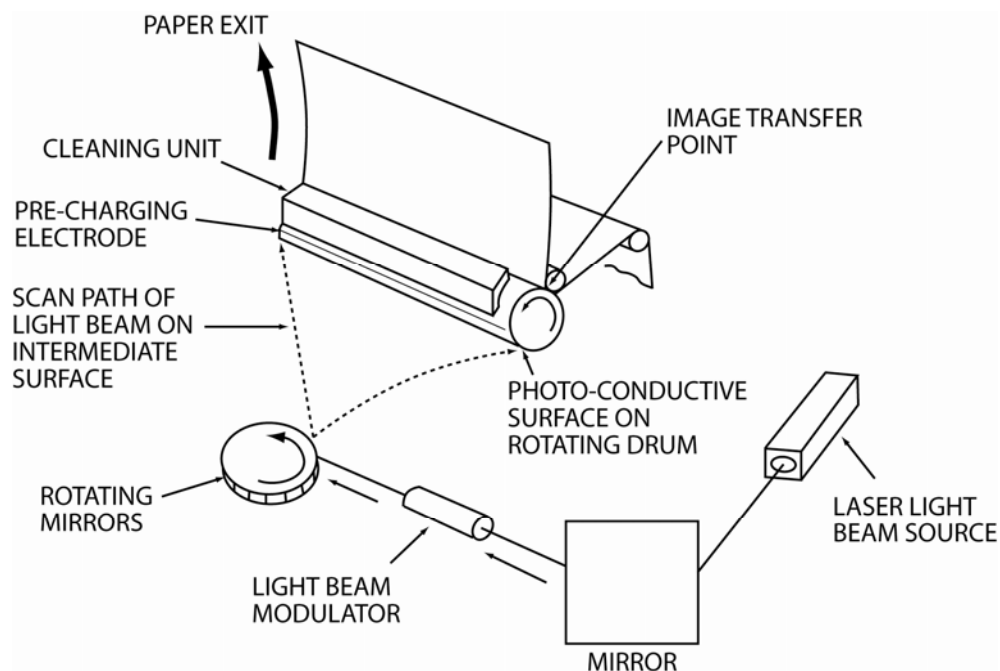
Source: Xerox, InfoTrends

Since the first desktop laser printer (the original HP LaserJet) was introduced in 1984, Xerographic printing technology has advanced significantly in areas of print quality and performance. The first color laser printers were multi-pass products, which meant that it took four rotations (one for each color) to print a color page. By 2000, single-pass tandem color engines hit the market, which dramatically improved the output speeds for color printing. While there are still a few multi-pass color laser printers on the market, most vendors have moved to single-pass tandem color laser technology.

In 2005, Dell introduced the 1100 monochrome laser printer, which was the first laser printer introduced to the market at a price below $100. With a print speed of 15 ppm, the 1100 demonstrates just how far price/performance has progressed since the first desktop laser printer. The original HP LaserJet carried a price of roughly $437 for each page per minute. By comparison, the Dell 1100 carried a price of less than $7 per page per minute.

Today, laser printing technology has come to dominate the office printing space, and by 2006 more than 100 million laser printers had been sold worldwide.

Inkjet Imaging

Inkjet marking technology also has a long history in the market. From its inception, however, inkjet technology has primarily been designed for use in consumer-class products. The reason for this is that there is much less cost associated with the basic writing system. Therefore, the technology could more easily be deployed in lower priced products.

Today, inkjet technology dominates the personal and home printing markets. Nonetheless, the technology has found its way into other market segments. Xerox's solid ink technology, which will be discussed in detail later, actually owns a substantial share in the office color workgroup printing market. Other areas where inkjet has garnered significant penetration include the wide-format printing market and the production printing market. So, while most tend to view inkjet as a consumer printing technology, in reality it has achieved strong success outside of that application.

Figure 4: Penetration of Marking Technologies by Market Segment
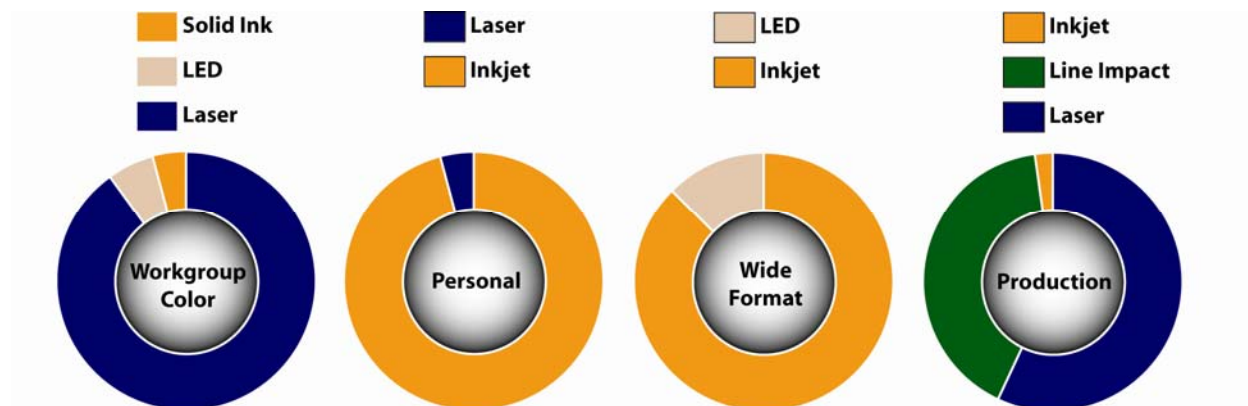
There are numerous types of inkjet marking technologies, all of which are differentiated by the way that the print head actually disperses the ink.

Continuous Flow versus Drop-on-Demand

There are basically two different types of inkjet print head technology: continuous flow and Drop-on-Demand (DOD). With continuous flow inkjet printing, a continuous stream of ink droplets is projected through a nozzle under constant pressure. During the ejection process, electric charges are applied to drops that form an image on the media or substrate. The amount of charge applied determines where the drops fall. Drops that are not charged deflect away from the substrate into a recovery bin where they are collected and recycled. Continuous flow inkjet printing technology is used primarily in high-speed printing applications for production markets.

The second technique is called drop-on-demand inkjet printing, which means that ink droplets are ejected through the nozzle only when needed. The three most popular Drop-on-Demand inkjet printing methods are thermal inkjet, piezoelectric inkjet, and solid ink. Thermal and piezo-based inkjet printing systems are both used primarily in consumer printing products. Meanwhile, Xerox's solid ink technology is used exclusively in workgroup color printing products.

Piezoelectric versus Thermal Inkjet Printers

Drop-on-Demand inkjet printers use a similar imaging process, but there are differences related to how droplets are created and expelled through the print head mechanism. Piezo-based inkjet printers use a crystal to produce an electric charge, which causes the drop to be expelled through the nozzle. With thermal inkjet printers, an electric charge is applied to a tiny resistor, which causes a small quantity of ink to boil and form a bubble. As the bubble expands, a drop of ink is forced out of the nozzle. Piezo- and thermal-based inkjet printers use liquid ink, which can be supplied to the print head either from an attached tank or through a tubing system connected to a separate reservoir.

Figure 5: Simplified Examples of Drop-On-Demand Inkjet Printing
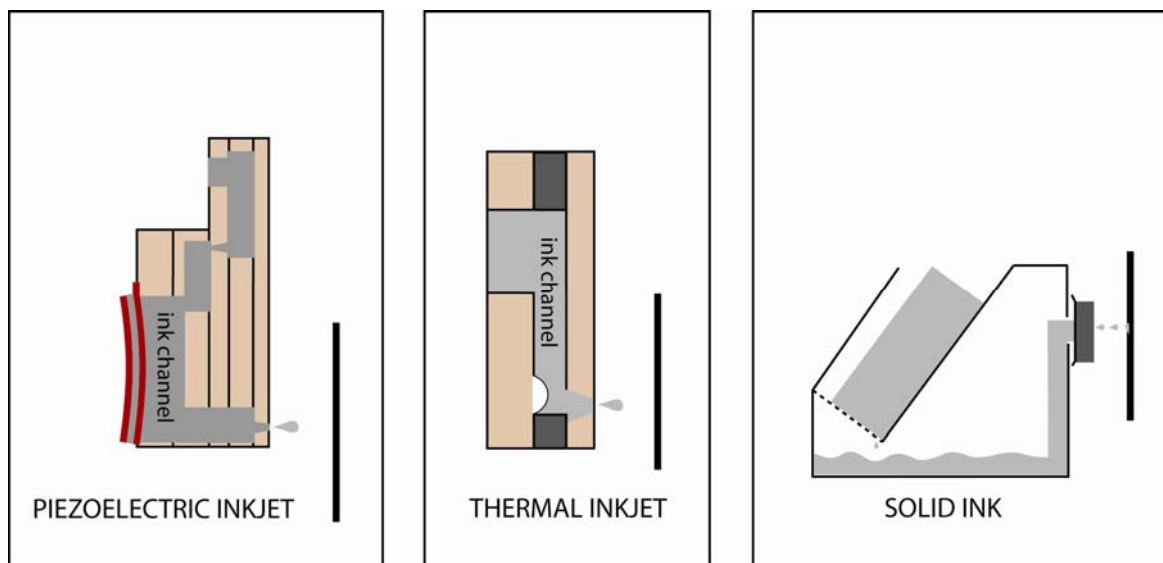
Solid Ink Technology

The third technology in the Drop-On-Demand inkjet category is solid ink, which is used exclusively in Xerox's Phaser workgroup color products. Xerox's solid ink technology could almost be thought of as a hybrid of liquid ink and toner-based technologies. Rather than using liquid ink, solid ink printers use ink sticks that are similar to crayons. During the imaging process, the ink is first melted quickly into liquid form and then jetted onto a transfer drum. The drum is then pressed against the media to transfer the image from the drum to the paper. The ink solidifies immediately upon contact with the substrate, which prevents ink smudging and smearing.

Each of the various Drop-on-Demand printing technologies offers inherent advantages and disadvantages. For example, piezo-based inkjet printing technology provides high reliability and the potential for very fast print speeds depending upon the implementation. Nevertheless, the manufacturing and fabrication process for piezo-based print heads is fairly complicated, which means it could be costly to produce

robust products with fast printing speeds. Epson is one vendor that has managed to overcome these obstacles to a great degree thanks to its Thin-Film Micro-piezo print head manufacturing process, which has enabled the company to produce a high nozzle density on relatively low-cost print heads.

Thermal inkjet printing, which is used by HP in its desktop printing products, is perhaps the most widely deployed inkjet technology today. Thermal inkjet printing offers low-cost manufacturing, high reliability, and excellent print quality. Meanwhile, Xerox's solid ink technology offers excellent color print quality, reliability, and support for a variety of media substrates, which makes it attractive for office-printing applications.

Despite the differences in the described Drop-on-Demand inkjet technologies, each approach shares many of the inherent benefits of the inkjet writing system. What really separates ink-based printing from laser imaging is the simplicity of the marking system. As described earlier, laser imaging is a fairly complicated process. For inkjet, however, the imaging process involves spraying ink directly onto a substrate. In other words, it is a direct writing system, as opposed to the indirect process associated with Xerography.

Ink-Based Technology for the Office

Benefits and Advantages

So, what are the inherent benefits of ink-based marking technology? To begin with, the writing system is relatively simple with only a few major components. Of course, ink is required as well as some sort of ejector or print head. In addition, the ink must be dried once it has been applied to the page. Most liquid inkjet systems use forced air dryers for this process, while Xerox's solid ink technology uses a cold fusing process to bond the ink to the media.

Although it depends on the implementation, most ink-based writing systems can produce high-quality prints at very fast speeds. At the same time, the direct writing process used with ink-based technologies allows for broad support of different media and substrates. Perhaps most importantly, ink-based marking technologies provide for lower hardware and operating costs compared with other marking technologies. The reasons for this are simple: ink is relatively inexpensive compared with toner and there are fewer moving parts, which translates to fewer maintenance items and replaceable components.

Despite advancements in marking technology, customers continue to demand more from their office equipment. At the top of the list for most customers today is increased productivity, which does not always mean a faster printer. Often, increased productivity relates more to the need for a product with the right set of features and paper handling capabilities to meet customer needs. Purchase price is also a key component in any future buying decision. In fact, InfoTrends' own research shows that the cost of the device, the cost of the supplies, and the cost of service continue to be the top three factors influencing future office equipment buying decisions.

Finally, office customers are looking to integrate more color into their documents. They understand the value of color—particularly for those documents that touch their own customers. At the same time, however, most of today's office customers feel that color printing is too expensive. Considering current customer needs and the benefits of inkjet technology, it makes sense to consider an ink-based page printer

for the office. An ink-based page printer could address many of the barriers that are prohibiting growth in office color pages today.

This approach would combine the best of ink and laser marking technologies. The first step would be to develop page-wide print heads for full page printing. The next step involves building that imaging platform into a robust engine that could handle office workloads. Many liquid inkjet vendors are pursuing just that strategy today. Interestingly, Xerox has already accomplished this feat with its solid ink technology.

One important attribute that ink-based technology offers is the ability to precisely measure the amount of ink that is laid down on each page. This means that vendors could implement unique usage-based pricing programs—charging customers only for the amount of color ink that is used on each page. This would be particularly attractive for copiers or workgroup-level MFPs, which are often leased under a contract that includes a per-page click charge. With toner-based copiers, customers pay a set price for color pages regardless of how much color toner is used. With ink technology, vendors could create pricing programs that charge much less for pages that contain only small amounts of color ink.

Barriers and Inhibitors

There are some potential barriers for inkjet technology in the office. The most significant of these is the challenge of combining speed, high print quality, and low costs in the same product. That's why many of the first such products will likely include only one two of these attributes. Xerox is one vendor that is a bit ahead of the curve in this regard with its solid ink technology. Xerox has continued to advance the performance of solid ink while bringing hardware costs down, which has led to products that in many cases are setting or meeting market standards for price/performance.

Because it is typically associated with consumer printers, inkjet technology could be viewed by some as not reliable enough to withstand the rigorous demands of workgroup printing. Nevertheless, InfoTrends believes that this is not necessarily an issue related to the marking technology but rather to the product itself. In other words, if inkjet technology is implemented in a product that is clearly designed for office users with the right set of features for paper handling and networking this issue could be overcome. While technology bias may not necessarily be a big deterrent, inkjet technology will have to overcome the strong and favorable opinion that many office customers have for laser-based printers and copiers.

Finally, inkjet technology does have some current imaging limitations. Perhaps the most important of these is plain paper printing. Liquid ink works best with special media that is designed to bond the ink and keep it from smearing once it is on the page. That is why plain paper prints on typical consumer inkjet printers will smear or smudge when they come in contact with water. Smudging can even occur if you use a highlighting pen on the printed page. Inkjet vendors have attempted to address this issue by using a bonding agent for plain paper printing. In some cases, the bonding agent is a separate chemical agent that is laid down during the imaging process. In other cases, a special media that includes the bonding agent is required. Once again, this is not an issue for Xerox solid ink technology because the inks are cold fused to plain paper, which eliminates concerns for water fastness.

Emerging Ink-Based Technologies

It's interesting to review the history of inkjet technology in the office-printing segment. In reality, inkjet printers are very prevalent in the office today. At the same time, however, most of these are consumer desktop printers used as secondary color machines for producing presentations and other marketing collateral. As mentioned earlier, Xerox's solid ink technology actually owns a substantial share of the workgroup color market.
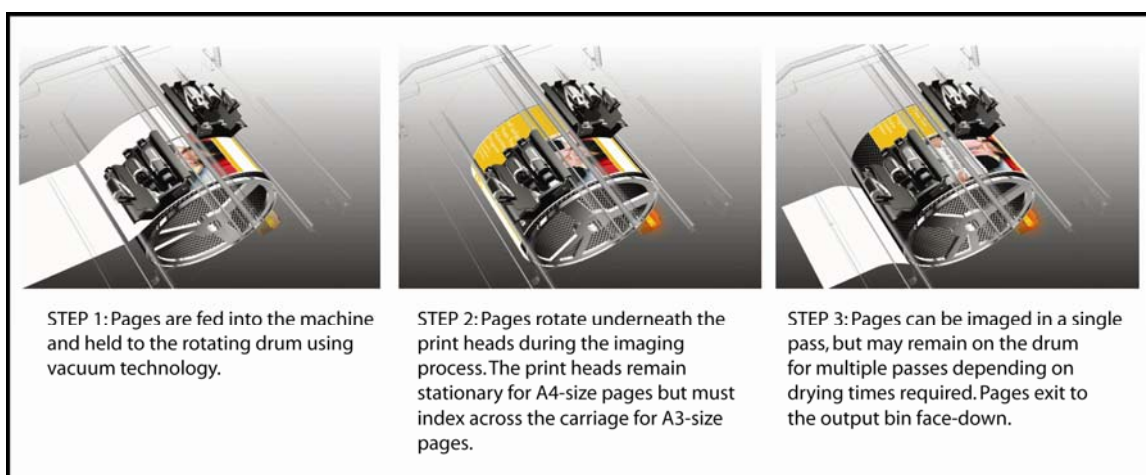
In the business inkjet category, HP is really the only vendor with measurable success. Unlike its competitors, HP continues to market its serial inkjet technology at business applications, but most of these products are used in the small office/home office (SOHO) environment. Other vendors have tried to push their liquid ink technologies into the office, but with limited success.

Nevertheless, InfoTrends believes that there are several significant technologies on the horizon that will change the office-printing landscape. HP's new Edgeline technology is based on a page-wide inkjet printing array that has been used in a high-end, departmental machine. Another company, called Memjet, has demonstrated a page-wide inkjet print head that can produce very fast print speeds with hardware costs that rival traditional consumer inkjet printers. Meanwhile, Xerox continues to advance its solid ink technology, and the firm has leveraged solid ink in products that offer very compelling price/performance values for office customers.

HP Edgeline Technology

Hewlett-Packard's Edgeline technology is based on thermal inkjet imaging but the print heads have been arranged in an 8.5-inch array that spans the full width of a letter-size page. Unlike HP's serial inkjet imaging technology, the print heads for Edgeline do not scan back and forth across the page for letter-size printing. Instead, the print heads remain stationary and the paper rotates underneath using a drum-based system (see Figure 6). The result is an inkjet printer with very fast color print speeds (up to 60 ppm). To date, HP has implemented this technology in two high-end, departmental multifunctional products called the CM8050 and CM8060.

Figure 6: HP Edgeline Print Head Configuration

STEP 1: Pages are fed into the machine and held to the rotating drum using vacuum technology.

STEP 2: Pages rotate underneath the print heads during the imaging process. The print heads remain stationary for A4-size pages but must index across the carriage for A3-size pages.

STEP 3: Pages can be imaged in a single pass, but may remain on the drum for multiple passes depending on drying times required. Pages exit to the output bin face-down.

With Edgeline, HP has addressed specific barriers limiting penetration of inkjet in the office. Specifically, the technology provides for very fast color printing on plain paper. To address the issue of plain paper printing, HP's Edgeline technology uses a special bonding agent that is used to bond the ink to the paper. The bonding agent is applied before the ink is laid down and is only used on those areas of the page where ink is applied.

It is important to note that the print speed ratings for HP's new MFPs are based on A4-size pages. For A3-size printing and copying, print speeds are slower because of the need to index the print heads to support the wider print width. When printing A3-size pages, the CM8060 and CM8050 image the part of the page that is closest to the front panel and then index over to image the remaining part of the page. Unfortunately, HP does not provide print speeds for A3-size pages, which suggests that speeds might be so slow that they are reluctant to report them. Indeed, HP says only that A3-size print speeds are slower than A4, but the difference varies depending upon page complexity.

Figure 7: HP Edgeline-based CM8060 Multifunctional Product

HP's competitors are likely to focus intently on this issue, and will no doubt view it as a disadvantage for Edgeline technology. In the copier market, quoted print speeds are based on A3-size documents, and for laser technology paper size has less of an impact on overall throughput. HP counters by claiming that A3-size printing is a minor requirement for most office customers and it does not expect this issue to be a major inhibitor. In fact, HP points out that there are other tradeoffs between the two technologies. For example, Edgeline might be slower for A3-size printing but it can actually print heavy paper stock much faster than laser-based products.

Edgeline technology allows HP to offer some unique usage-based color pricing programs. HP's Edgeline-based products have three separate operating modes: Monochrome, General Office color, and Professional color. HP will establish separate click charges for each page depending on the print mode that is used. HP has stated that monochrome cost per page (CPP) will be competitive with a departmental Segment 4-class copier product. HP also claims that color operating costs will be up to 30% lower than competitive products in a similar speed class.

HP is confident that it can be competitive with Edgeline operating costs and that the technology has the ability to provide for lower operating costs compared with laser-based devices. The new Edgeline products also offer a Color Accent feature, which will allow HP to charge a black-and-white click charge for pages that use a very small amount of color, for example an e-mail message or letterhead with a small color logo. The various color pricing modes are perhaps the most important element behind HP's Edgeline technology. For quite some time, InfoTrends has suggested a need for this type of per-page pricing, which essentially allows customers to pay only for the amount of color they use. With most copier contracts today, customers pay a set price for each color page regardless of coverage or the amount of color on the page.
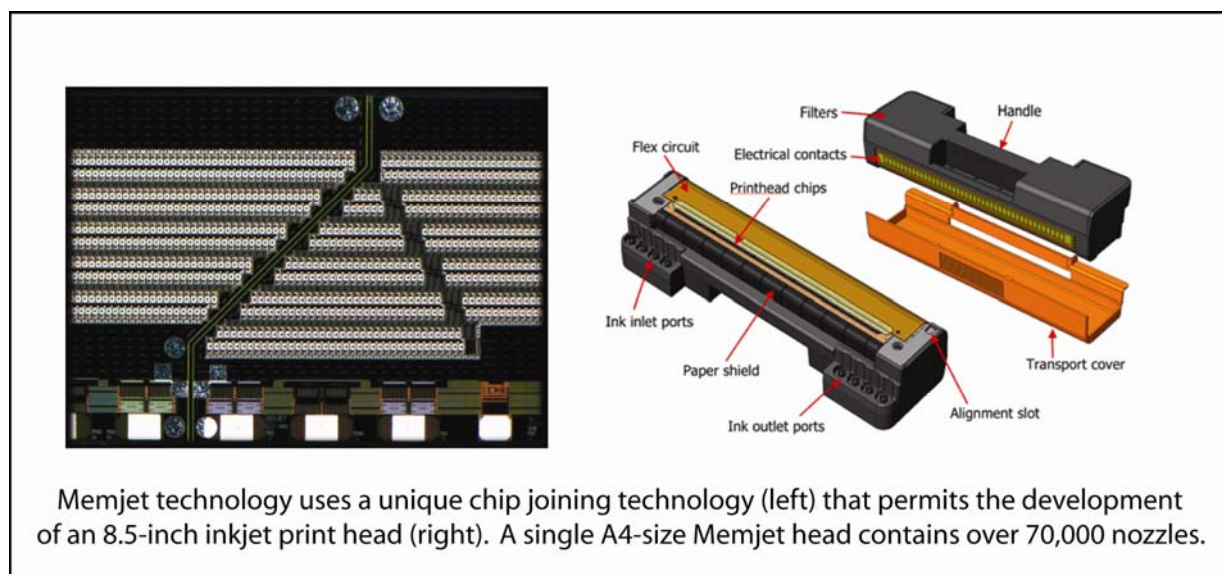
HP's Edgeline technology is only one implementation of a page-wide inkjet array, which means that it does have certain market limitations. For example, the technology offers fast print speed and good color quality on plain paper but it comes in a product that sells for about $20,000. There are technical issues that might make it difficult for HP to migrate the technology down to the workgroup or desktop. The Edgeline imaging architecture involves stitched print heads with a large drum to accommodate drying times. The overall footprint of the writing system itself is so large that it seems unlikely that HP could create a desktop implementation of Edgeline until it has developed a single 8.5-inch print head array.

Memjet Technology

A company called Silverbrook Research has recently announced a new inkjet technology called Memjet. Silverbrook, which was founded in 1994 by ex-Canon engineers, was chartered with the single goal of creating a disruptive inkjet-based marking system. Since that time, Silverbrook has been among the leaders in the industry in patents filed and awarded for inkjet technology. The company has established a very strong patent position, with over 1,400 patents awarded and another 2,000 pending worldwide.

Silverbrook recently announced its Memjet technology, which is based on a MEMS-based page-wide inkjet array. The firm says that it will have a 4.25-inch array ready for production in 2008 and an 8.5-inch array that will be ready for commercialization in 2009.

Figure 8: Memjet Print Head Architecture

Memjet technology uses a unique chip joining technology (left) that permits the development of an 8.5-inch inkjet print head (right). A single A4-size Memjet head contains over 70,000 nozzles.

Like HP's Edgeline technology, the Memjet printing architecture is based on Drop-on-Demand thermal inkjet technology. The significant difference between Memjet and HP's Edgeline technology is the single 8.5-inch array. This single head can be incorporated into low-priced products with a very small form factor, which could allow it to be more disruptive across a broader range of markets. The most important element in the design of the Memjet print head is the unique chip joining technology, which allows for continuous printing at the gap (joint) between chips. The nozzles in the triangular segment are timed so that they fire to fill the gap above them. This assures seamless printing across the width of the print head. Because of the unique design and the 8.5-inch array, InfoTrends believes that Memjet has a strong possibility for success because the technology can be implemented in a broad range of products.
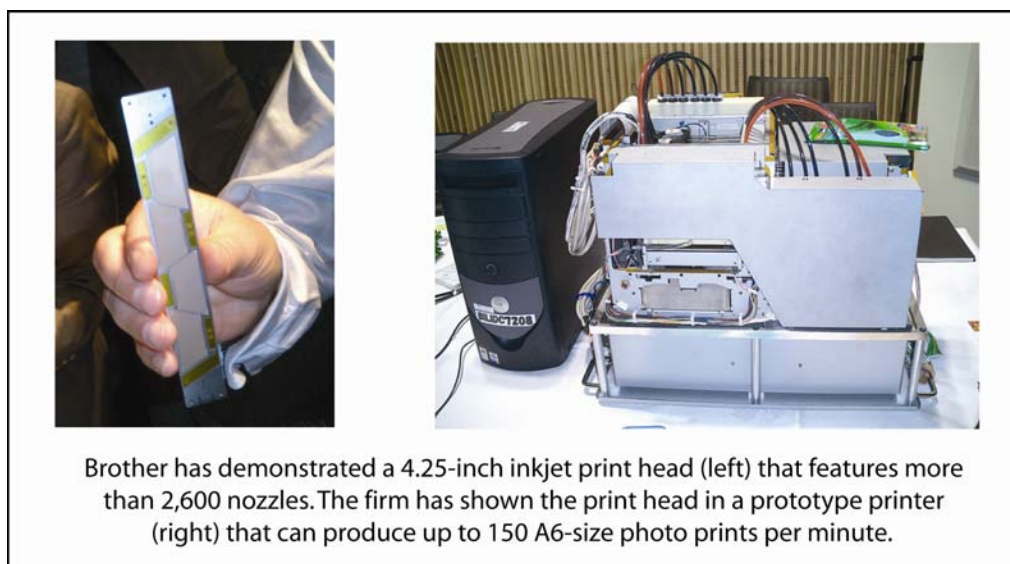
It is important to note that Memjet plans only to supply its inkjet printing components to other OEM equipment providers. In other words, there will be no printing products introduced to the market under the Memjet brand name. Instead, the firm will partner with other suppliers to bring its technology to market. As a result, it is difficult to gauge the potential impact of Memjet's technology until it has OEM partners with products in the market. It is unclear exactly what these products will look like, but Memjet has demonstrated numerous prototype products, including interesting concepts aimed at workgroup color, consumer photo printing, retail photo printing, and wide-format applications.

Memjet has claimed that its technology could result in a 60 ppm color printer that sells for less than $200. This type of price/performance value could be very disruptive if the technology is implemented in a product that meets other market requirements for paper handling, duty cycle, and other variables.

Brother Line Head Technology

Brother is another firm that is demonstrating a new page-wide inkjet array based on thermal inkjet technology. At this point, Brother has disclosed very little about its Line Head technology except to say that it has created a 4.25-inch inkjet array that could be implemented in photo-printing and workgroup color printing products (see Figure 9).

Figure 9: Brother's 4.25-inch Line Head Inkjet Array

Brother has demonstrated a 4.25-inch inkjet print head (left) that features more than 2,600 nozzles. The firm has shown the print head in a prototype printer (right) that can produce up to 150 A6-size photo prints per minute.

Brother has demonstrated its 4.25-inch print head in prototype products that can produce up to 150 A6-size photo prints per minute. The firm also notes that it could stitch two 4.25-inch heads together to produce an 8.5-inch array, similar to HP's Edgeline implementation. Given the current speed metrics achieved, it seems plausible that Brother's Line Head technology could achieve speeds of up to 60 ppm for letter- and A4-size pages.

Xerox Solid Ink Technology

Xerox has continued to evolve its solid ink technology, which has a long history in the market and has actually been quite successful in the workgroup printing segment. Unlike liquid inkjet printers, solid ink does not suffer from the technology bias that is typically related to serial inkjet printers. That is because from its inception, solid ink technology was designed as a page-printing process and has been implemented in products clearly intended for workgroups and office users. Xerox's solid ink printers use page-wide print heads to produce excellent color print quality at print speeds comparable to or faster than laser-based products.

Yet, Xerox's solid ink technology shares many of the same attributes as liquid ink that make it attractive for further penetration in the office segment. Namely, the writing system is much less complicated compared to Xerography with fewer moving components and fewer replaceable supplies, which translates to the potential for lower overall operating costs. In addition, the print quality produced from Xerox's solid ink technology is very good and the engine technology is quite reliable. In fact, one of the advantages that Xerox has over its liquid ink competitors is the fact that solid ink technology already has a proven track record in the workgroup environment.

Xerox is already pushing the boundaries for office color printing costs with its latest "Color for the Price of Black-and-White" strategy. Xerox's advancements in solid ink enable customers to print color documents for the same price as black & white when purchasing supplies separately—assuming they are willing to absorb the additional up-front cost of the hardware. With its latest solid ink products, the Phaser 8860 series, Xerox expects that companies will be able to remove the restrictions that prevent color printing for certain users within a company. The solid ink technology used in the new Phaser 8860 printers also provides for environmental advantages. Xerox claims that its solid ink products generate 90% less waste than comparable laser printers. Other advantages of solid ink include no smearing or drying time, consistent color on a wider range of media, and the ability to top ink off before starting long print jobs.

Summary

Evaluating New Marking Technologies

Customers will need to consider various elements when evaluating ink-based technologies. First of all, it is important to note that new technology rarely displaces older technology without an underlying benefit. Consider the Mazda rotary engine, for example. This was exceptional technology but without a real advantage over the typical combustion engine it gained very little traction in the market. Additionally, the benefits of a new technology usually come with some sacrifice in other areas. So, the best approach is to consider all the attributes that are important to the customer and the application. There are many attributes to consider when evaluating marking technologies—particularly new technologies that have little time in the market. Essentially, there are five key categories to consider: quality, performance, costs, reliability, and maturity.

It is important to remember, however, that within each of these categories there are several sub-categories that should be considered. Print quality may be a primary concern, but customers should consider all of the print quality attributes before making a decision. For example, customers should determine whether they are most interested in black or color quality, or a combination of both. Is the desire to produce optimum quality on plain paper or to print mostly on coated stock or special media?

Each of the marking technologies described offer benefits and sacrifices in some of these areas. The key is to identify specific needs before considering which marking technology is best for the application. The table below identifies the various attributes that should be considered when evaluating new marking technologies along with the various strengths and weaknesses of each.

Figure 10: Attributes of Marking Technologies

	Quality	Performance	Costs	Reliability	Maturity
Laser/LED	Excellent mono and color text on plain paper Limitations for color graphics and special media (textured)	Excellent mono performance Color performance is good but typically comes with a price Limitations on special media	Sets the standard for monochrome hardware – color still coming down Color operating costs are high	Exceptional in all reliability criteria Generates a lot of waste from unused supplies materials	Proven technology Long history in the market with track record of technical advancements Very broad range of products
Page-Wide Liquid Ink	Good mono and color text quality Good photo and graphics (special media) Bonding agent needed for plain paper	Excellent mono and color performance A3-size speeds very slow depending on implementation Affected by high coverage	Potential to set new standards for color equipment and operating costs Allows for usage-based pricing models	Many unknowns but these variables are typically aligned with engine design and not imaging technology Chemical agents in inks and bonding agents	Unproven technology Will experience some technology bias Few products to date
Solid Ink	Excellent mono and color text on plain paper Good graphics and strong support for special media	Excellent mono performance Color performance is good but typically comes with a price Excellent with special media	Equivalent or better hardware pricing compared with comparable laser products Color operating costs are high but coming down	Exceptional in all criteria Perhaps the most environmentally-friendly imaging technology currently available	Proven technology Long history in the market but with limited product line No A3-size products

Market Outlook

Even with all the market activity surrounding new inkjet-based marking technologies there is little chance that these will completely displace existing marking technologies. In fact, InfoTrends believes that liquid ink, solid ink, and laser/LED technologies will continue to serve the market—and vendors will focus on the strengths and differentiation offered by each.

Laser/LED technology already has strong penetration for monochrome and color in all environments, although color laser is beginning to migrate more aggressively into the home. Liquid inkjet is primarily used in home, home office, and small business applications today, but it is expected to migrate quickly into workgroup and departmental environments thanks to the advancements of page-wide array technology. Meanwhile, Xerox solid Ink technology is primarily found in the general office workgroup but it is expected to move into small business and into faster workgroup and departmental applications as the technology progresses.

As a result, there will continue to be strong markets for all marking technologies. Perhaps more important than the marking technology will be the product's ability to support additional solutions and services, which InfoTrends believes will be key to driving future penetration in the office. In addition, new usage-based pricing programs and service models will be instrumental in helping office customers transition more of their documents to color.

Xerox's Competitive Position

Xerox is attractively positioned to take advantage of recent marketing activity related to new and emerging marking technologies. The company has a very broad product portfolio with good breadth and depth in the workgroup and departmental environments. Xerox's MFPs are skewed more toward A3-size devices, which results from its more traditional copier heritage. Nonetheless, Xerox has made some strong plays recently with A4-size MFPs. One of Xerox's major strengths is its rapidly expanding color product portfolio, which is unmatched in the industry.

Xerox is also expanding more aggressively into SMB (small and medium-sized business) applications by extending its reseller channel and product line. This will further strengthen Xerox's brand awareness and will help to further the message of a balanced deployment strategy.

A strong technology and patent portfolio will allow Xerox to take advantage of the key attributes of existing marking technologies. Xerox has a strong partnership with Fuji Xerox for laser technology, and the joint venture has developed a broad line of laser-based engine platforms. Meanwhile, Xerox solid ink technology is a mature writing system that delivers on the key benefits identified for ink-based page printers. This experience will prove valuable to Xerox as the office market becomes more comfortable with ink-based platforms. In addition, Xerox solid ink technology provides good differentiation through its environmentally-friendly approach.

Xerox technology is not limited to marking technology, which is why the firm has such a strong presence in the corporate environment. Xerox has invested heavily in areas such as ease of use and device concurrency issues, both of which are essential to success with multifunctional products. Finally, Xerox is recognized as the document company, and the firm's background in document management, workflow, and security will prove invaluable to many of its customers.