Intelligent page printing systems

by DAVID MOSELEY

Traditionally, applications for printers have been divided into three segments — data processing, office automation and reprographics. Over the years printing devices have been developed to meet each segment's unique requirements:

- high-speed printers for data processing,
- medium-to-low-speed typewriter quality printers for business,
- multiple font, high resolution typesetters for reprographic applications.

However, the arrival of computer-driven, low-cost intelligent page printing systems, has essentially cut across the boundaries that have traditionally separated these area, by providing high speeds, high-quality output, graphics plotter capabilities and font flexibility, as well as opening new application areas, such as 'personal typesetting'.

Abstract: Intelligent page printing systems cut across the boundaries of traditional printing applications, and open up new applications, such as 'personal typesetting'. Such systems incorporate image processing and laser printing to allow users to assemble complex pages which can then be printed as such.

Keywords: data processing, printers, image processing.

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Technical publishing

In most instances both technical publishing and inhouse document production involve very low final print runs and, in comparison to the overall numbers produced, can seem highly expensive and time-consuming in terms of their production.

Typically, the document process is started by using a plotter to generate graphics and a word processor to write text. Then the text would be sent to a typesetter, the copy and graphics to a production artist for pasteup and then on to a professional printer for printing.

Intelligent page printing systems can replace this method. Best described as a blend of image processing and nonimpact laser printing techniques, they allow users to assemble on page a complex mixture of graphics, diagrams, plots and textual information to camera-ready quality, by converting the page data into a page image, which is then printed as a page of output.

Nonimpact intelligent page printing systems basically comprise three elements:

- a suitable page description language,
- a nonimpact printing engine
- a proprietary image processor.

The page description language runs on the host computer and compiles the information, the printing engine provides the mechanical print function, while the image processor is a specialized computer subsystem which generates images electronically and controls the functions of the printing engine (See Figure 1). The prime catalyst in the development of

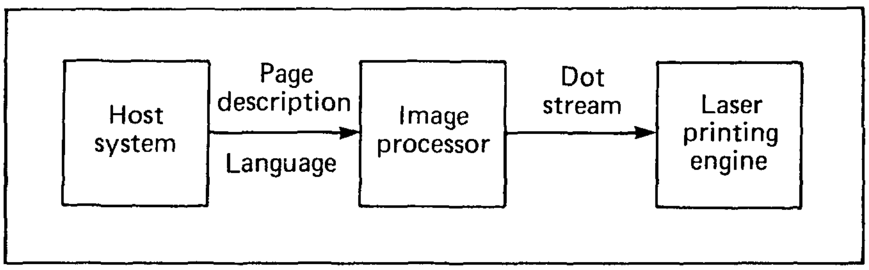

Figure 1. Image processors offload hosts

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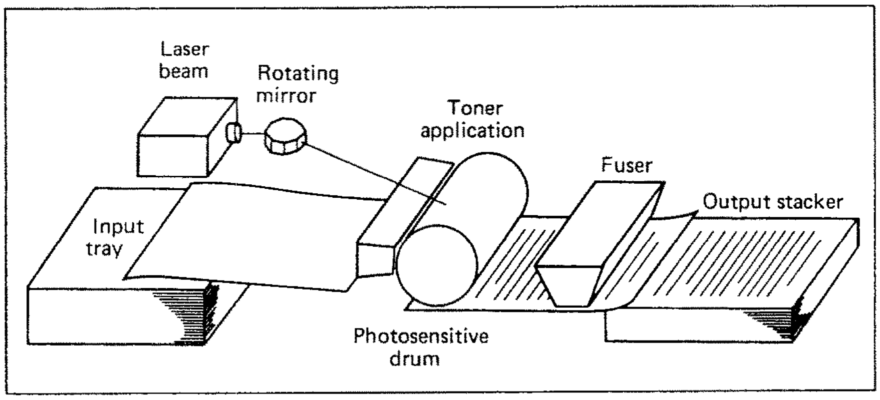

Figure 2. Laser printer operation

intelligent page printing systems has been the advent of laser printing technology.

The laser print engine consists of a photosensitive drum, which is scanned by the laser beam in a fashion analagous to raster-scanning within a television set. The laser striking the drum surface creates a charge differential, which is transferred to the paper by contact with the drum. The paper then passes over a toner supply which moves onto the charged portions of the paper and is subsequently fused onto it by a heat source (see Figure 2). Conventional computer systems send page descriptions to printers at the host's leisure, in a form that differs little from the text file that was originally created. Laser engines, on the other hand, demand a stream of dot information at video transmission speeds in excess of 1M pixel/s, and within very tight timing constraints, as once the paper has started through the printer, the data must be kept on schedule. It is the job of the image processor to offload the host from the processing task of creating the stream of dots, and the controlling task of sending those bits at the appropriate times.

Consequently, all laser printing engines require a degree of intelligence to function either in the form of a printer controller used in straightforward laser printers or as an image processor in the more complex intelligent page printing systems. The degree of intelligence determines the complexity of the images that can be handled (See Figure 3).

Image processor or printer controller

To understand the difference between a nonimpact intelligent page printing system and a laser printer it is important to understand the difference between an image processor and a printer controller.

A printer controller understands only low-level, assembly-language-like information and performs the control task of feeding the print engine dot data rapidly and precisely, but does only minimal processing of the input data. An image processor performs the same control functions, but can understand high-level languages and is additionally capable of transforming and expanding a wide range of input formats.

The most popular approach to designing an image processor is to use a simple, full-page bit map, to finish processing and then proceed with sending it out to the print engine. Such a design is straightforward, as the image processor is performing only one task at a time. However the limitations of this design are twofold: task by task operation and poor use of resources.

Imagen Corporation's intelligent page processing systems, for example, (available in the UK through Sintrom Electronics), adopt sophisticated, real-time rasterisation techniques in the image processing function, thereby negating the need for the simple task process/print cycle. Instead of processing the input description directly into a full-page bit map, an intermediate page description is created, normally taking up about one or two per cent of the size of a typical bit map. The controlling task paints the dot image of the page, one scan line at a time, staying just ahead of the print engine, which is outputting while both processing and controlling are occurring. Since the controlling task is working with a preprocessed page description, its task is simplified, and relatively little processing is required.

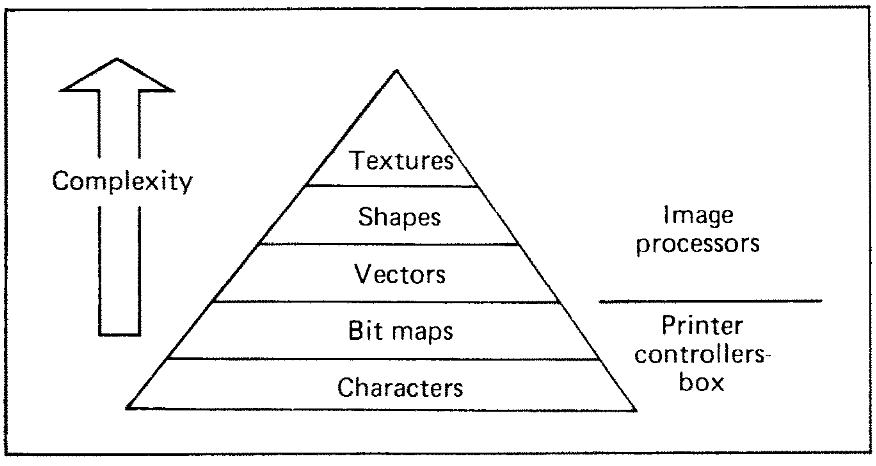

Figure 3. The degree of intelligence determines the complexity of images that can be handled

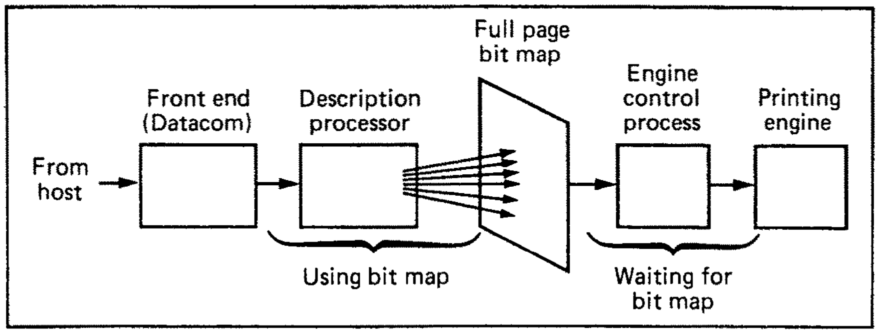

Figure 4a. Generic rasterisation techniques

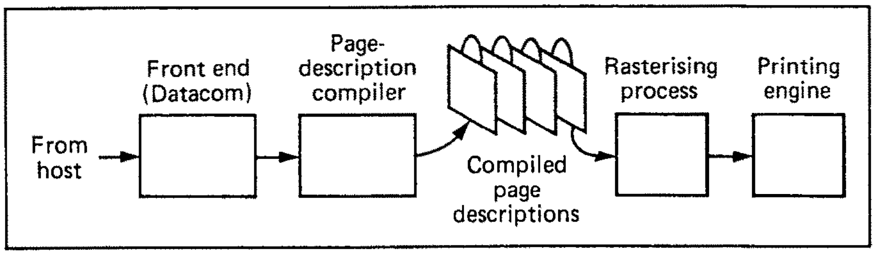

Figure 4b. Real-time rasterisation techniques

The intermediate page description has also been ordered, so that the controlling task can work through the description sequentially.

The advantage of real-time rasterisation is that the whole process can be speeded up consideraly, as both processing and control functions are simultaneous allowing the print engine to run as fast as it can feed paper (see Figure 4).

In addition, because there is no need to allocate processor memory to the white space on a page, the page descriptions are compact, which not only allows the image processor to consider a wider context than simply the current page being printed, but also to perform document features such as page reversal, collation and multiple copies.

There are cases, however, when real-time rasterisation is not appropriate. If the scan-line being rasterised has too many vectors passing through it, each of which must be rasterised, then prerasterisation is used. If a prerasterisation code is used, the image processor will preprocess the pages in a different manner. Instead of creating page descriptions that are partially processed for rasterisation, page descriptions will be completely processed.

Both real-time rasterisation and prerasterisation use memory in a flexible and dynamic way. This allows memory to be available for alternative uses, such as fonts, logos, and other images which persist between jobs and there are no hard partitions in the management of memory to starve one usage of memory while another has excess.

Another important element of any intelligent page printing system is a suitable, high-level page description language, running on the host computer. Even conventional methods of computer-to-printer communication present a considerable processing and input/output burden in describing the dot stream information to be computed and sent every second.

The earliest languages were document composition languages, intended for mainly text-oriented output devices. More recent software has been written to allow these languages to drive laser printers. Typical typesetting languages include 'Scribe' and 'Troff' and the first intermediate languages to support graphics with text were imPRESS from Imagen and QIC from QMS, which radically reduce the transmission time between the host computer and the image processor.

Most recent languages such as DDL from Imagen, PostScript from Adobe and Interpress from Xerox allow any page imaginable to be described. Text fonts can be either printer resident or downloaded from the host computer. Imagen, for example, offers 'Courier' as standard with optional fonts such as Times, Roman and Helvetica, plus Lucida, the first font designed for laser printers. These are available from an extremely large library, which includes specialist mathematic and scientific typestyles.

Intelligent page printing systems normally provide emulation for a wide range of conventional printers so they can be easily incorporated into existing computer environments or as direct replacements for other computer printers. Imagen, for example, incorporates a wide range of emulators for dot matrix, daisywheel and line printers, as well as providing compatibility with such popular systems as Diablo 630 and Tektronix 4014 graphics.

The nonimpact printer market, for laser printers in particular, is growing rapidly, and it can be seen that not only new applications, such as technical publishing, are benefiting, but also traditional applications. In the office, image processing systems offer type font flexibility and the ability to easily merge text and graphics producing high quality reports, documents, letters and transparencies. In data processing, they deliver higher quality output than line printers, at comparable speeds. For reprographics applications, image processors function as a proofing device for typesetting and provide final output for demand publishing at acceptable price/performance levels. □

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