# ELECTRONIC FORMS:
# ANOTHER STEP ON THE ROAD TO THE AUTOMATED OFFICE

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## THE CURSE OF THE PREPRINTED FORM

Forms are a good tool. They allow information to be categorized for ease of interpretation. They standardize and simplify the communication of complex corporate and legal data. A properly designed form can highlight information that would otherwise be lost in a sea of numbers.

Forms provide value, and that is why we use so many in business. Like any good tool, forms -- at least the traditional preprinted forms -- cost money:

* money to design
* money to print
* money to store

These are the visible costs associated with using preprinted forms, but what about the other costs -- the ones I refer to as "The Curse of the Preprinted Form." Let's briefly review some of these less obvious costs.

First, there is the cost of time spent finding the right form and then mounting and aligning it for printing. There is also the potential of using the wrong form. Here the cost is wasted time to re-run a job, or if no one detects the error, embarrassment or even a lawsuit.

Next, there are costs associated with managing preprinted forms. These include time and energy spent controlling access to forms, monitoring inventory levels and reordering forms, and making sure that only the current version of a form is being used.

The cost of obsolescence is a major consideration in using preprinted forms. As requirements change, forms must change; and the old forms aren't worth the paper they are printed on. Murphy's Law suggests that the obsolescence of a form will occur just after you have ordered a year's supply. (Many companies avoid the cost of disposing of obsolete forms by not throwing their obsolete forms away. Instead they hide them in dark places in the hope that the waste will remain undiscovered. I cannot help but wonder how much of America's office space is being used to store obsolete forms.)

Perhaps the most serious problem associated with using preprinted forms is the cost of keeping inefficient forms. These are forms which should be redesigned, but aren't because of the cost of creating and printing a new version.

Today, with the technology of laser printing and the sophistication of available software, there is no reason for a company to incur the excessive cost of buying preprinted forms or to continue to operate under the curse of the preprinted form. Electronic forms are here, and they represent a significant step on the road to the automated office.

In this presentation, we will discuss the electronic form as an alternative to the preprinted form. We plan to cover the capabilities of the laser printer which make electronic forms a viable alternative to preprinted forms in the typical office. We will then review the procedures involved in developing electronic forms, merging data with electronic forms from both mini and micro computer based applications, and finally we will review some actual cases involving the implementation of electronic forms. Throughout the presentation we will attempt to point out the advantages in cost savings and improved productivity resulting from the switch to this new technology.

First, what is an electronic form? Viewed very basically an electronic form is nothing more than a file containing instructions which allow a laser printer to print an image of the form. The instructions are stored in a host computer and sent to the laser printer's memory when needed.

Let's briefly review some of the advantages which electronic forms offer to the modern business office. We can begin with the obvious costs in time and money spent on designing and printing forms. With a preprinted form it can takes weeks to design the form, do the artwork, set the type, review proofs, make changes, and start the process all over again. Once the form is finalized, there is the actual cost of printing, shipping, and storing the preprinted form. With an electronic form you can create and begin using a new form in a matter of hours. You can fine tune the design without incurring additional costs other than your own time. There is no need to order and pay for a year's supply, you print the form only when it is needed. Because the electronic form is stored in the computer, it is always ready for use in each and every company location. You have eliminated the problem of wasted time spent looking for a form or inadvertently using the wrong form. And when the form is printed, it is done with laser printer quality and perfect alignment of data every time.

We spoke about the effort spent in managing preprinted forms. With electronic forms this effort is reduced significantly. Since forms are stored in the computer, you no longer have to worry about physical access control. You can restrict access to your electronic form files just as you restrict access to your computer programs. Certain forms can be restricted to individuals or departments, while others are universally available. You do not have to be concerned with inventory levels or lead times for reordering forms. Most important, there is only one version of the electronic form available -- the current version. You can forget about tracking down supplies of obsolete forms spread throughout the company.

Since forms are only printed when needed, there are no large inventories on hand when you decide to change a form. The redesign and implementation of a new electronic form is easy and straightforward. The day the new form becomes effective, it is the only form available for downloading to the laser printers.

One more benefit before we move on. With an electronic form it is easy to print the output on demand, and in the user's department. You do not have to batch the output until you have enough to justify the time to mount a new form, nor do you have to print all your forms centrally because your users cannot mount and align forms on their own department printers.

## LASER PRINTERS -- THE HIDDEN CAPABILITIES

According to industry sources, laser printer sales for calendar year 1987 were approximately 500,000 units. Most of these units are being used to produce high quality word processed documents. But as those of you who have ventured into desktop publishing are probably aware, the laser printer offers some unique capabilities. We would like to discuss these first, and then discuss how they have opened the door for electronic forms. Our discussion of capabilities will focus on the Hewlett-Packard LaserJet Plus family of printers. These include the LaserJet Plus, the LaserJet 500 Plus, the LaserJet Series II, and the LaserJet 2000.

### 1. Print Quality

The laser printer with its 300 x 300 dots per inch resolution creates documents which come very close in quality to typeset documents. It handles both graphic images and text on a single page, and allows up to 16 different fonts to be used on a page.

### 2. Fonts

The laser printer offers an almost unlimited variety of fonts, with both fixed and proportional spacing. These can be mixed to replicate most preprinted forms. The LaserJet Series II has 6 internal fonts available plus two font cartridge slots. In addition, it can store up to 32 soft (downloadable) fonts with sizes ranging from 6 to 30 point.

Cartridge fonts (which are also referred to as hard fonts) plug into font cartridge slots in the printer. The fonts contained in the cartridge become available once the cartridge is plugged in. They do not have to be downloaded and they do not take up any of the printer's memory.

Soft fonts are supplied on diskettes or tape and must be transferred (downloaded) into the printer's RAM memory. Soft fonts generally cost less than cartridge fonts and provide more versatility in the combinations you can use and the size of fonts available.

Fonts are identified and may be selected by their individual characteristics. These include orientation, symbol set, spacing, pitch, height, style, stroke weight, and typeface. The printer maintains a table which contains the values of all of the currently specified characteristics. These values are described in an "escape sequence". We will discuss escape sequences later. Generally, electronic forms software will allow you to identify fonts with a number or short name which is cross referenced to the table of font characteristics.

3. Memory

The laser printer has its own memory which is used to hold fonts and commands for forms and graphic images. The memory is also used by the printer for buffering input and for building a page image. The LaserJet Series II comes with 512K of memory and can be upgraded with an additional 4 megabyte memory board. The LaserJet 2000 comes with 1.5 megabytes of memory and can be upgraded to a total of 5.5 megabytes.

4. Programming

Laser printers provide a control language which can be used to communicate from the system to the printer in order to access the printer features. Hewlett-Packard's printer language is the "Printer Command Language" or PCL. PCL provides four levels of printer features ranging from level 1 which handles basic character printing and spacing, to level 4 which handles page formatting. The original LaserJet uses level 3 (the office word processing feature set) while the LaserJet Plus family uses level 4. Each level is a proper super-set of the previous level, providing upward compatibility.

PCL commands are also referred to as escape sequences. These commands are used to control cursor movement, font selection, line drawing, job control, definition and placement of graphic images, and to access other printer features.

5. Storage of form files and graphic images

The laser printer's memory is not limited to storage of fonts. It can also store macro files which contain commands which direct the printer. These files are used to define electronic forms or other graphic images. The advantage is that once the files are stored in the laser printer's memory they are available for use throughout the day. Thus, in most situations, only data is transmitted to the printer from the computer. The electronic form is already present. The LaserJet Plus and the Series II can store up to 32 form files. The LaserJet 2000 has a capacity of over 32,000 forms.

These are some to the laser printer capabilities which make electronic forms a reality. Next, we will discuss the process of defining an electronic form.

## ELECTRONIC FORMS DEFINED WITH PCL

If you analyze most business forms you will notice that they typically contain lines, boxes, shaded areas, text, and graphic images. Each of these components can be defined with PCL commands. With enough experience, anyone can design even a complex form using PCL commands and scanned images. For example, to draw a horizontal line the escape sequence has to specify the starting cursor position, the line thickness, the length, and the dot pattern. The PCL command to draw a line would look like this:

{ESC}*p300x400Y{ESC}*c90a150bP

It is not our intention to teach you how to write escape sequences. There is an abundance of forms design software which will create these PCL commands for you. It is, however, important for you to understand which components of a form can be drawn with PCL commands and which need to be scanned images, and the difference between storing a form in raster format or vector format.

First, let's review the components of a form and identify those specified with PCL commands and those which must be scanned images.

* Horizontal Lines - PCL
* Vertical Lines - PCL
* Boxes - PCL using horizontal and vertical lines
* Shaded Areas - PCL
* Text - PCL
* Logos - scanned image
* Special Characters - some with PCL, others must be scanned
* Mixed Orientation Text - scanned
* Reverse Text - scanned

At this point some of you may be wondering why not scan an entire form and forget about PCL commands. In order to answer that question, you should understand the significance of defining and storing a form in raster versus vector format.

Let's begin with an explanation of raster. Raster refers to images which are composed of groups of dots. When a laser printer prints an image it creates the image by laying down a pattern of dots (90,000 for each square inch).

These dots are actually specified by individual bits of data, each bit being either on or off. These patterns of dots can be communicated from the host computer to the printer in either their dot format (raster) or as vector commands which the printer converts to dots at the time the image is printed.

In raster each individual dot (or bit) is transmitted from the host computer to the printer. It requires a large amount of information (in byte format) to describe even a small raster image. For example, a one square inch box would require 90,000 bits (300 x 300) or 11,250 bytes of data. A complete 8.5 by 11 inch form would require over one million bytes of data.

In vector an image is communicated to the printer in a command format similar to the line draw command previously described. The printer converts the commands into dot patterns just prior to printing.

While raster provides ultimate versatility and flexibility in defining laser output, its use should be limited to those situations where vector commands are not available. Using vector commands to define an electronic form saves transmission time from the host computer to the printer, and requires less printer memory to store the form. It also saves disk space on the host computer.

Now that you understand that, we can get into how electronic forms are designed. There are a number of electronic form design methodologies available. We will briefly describe the most common, and discuss some pros and cons of each approach.

1. Scanning Forms

We have already touched upon this approach when we discussed raster images. In scanning, you use a scanning device to create a raster image of an entire form (lines, text, logos, etc.). Scanning a form appears to be quick and precise. But, actually the scanned form requires extensive editing to meet even a minimum standard of acceptability. Even with editing, a scanned form will rarely match the printers potential quality. Of course we have already discussed the size of a scanned form file and the excessive time to transmit the form file from the host computer to the printer. Another problem with scanned forms is the difficulty in registering the form for data.

2. Forms Designed with Commands

Many forms design packages allow you to draw a form by entering commands. For example, to draw lines and boxes you enter commands for the starting and ending positions and the thickness of the lines. This approach allows extreme precision and is especially useful for forms which will be filled in with computer data. No special equipment is required. A disadvantage is that the form cannot be viewed on the computer terminal. It must be printed. Actually for complex forms, the image displayed on a graphics terminal usually is not in sufficient detail to be of much value to the designer, so printing the form at each major step in the development is usually required anyway.

3. Drawing Forms on a Graphics Terminal with a Mouse

This approach is popular with many of the PC based forms design packages. It allows lines and boxes to be drawn on a graphics terminal. Text must still be entered from the keyboard, but the form can be visualized as it is developed. This approach is valuable for simple forms, however as the form gets more complex, the graphic image on the terminal screen is not sufficiently precise to be of value. The problem goes back to the typical graphics monitor at a resolution of 640 x 350 dots for the entire screen trying to adequately display a form which will be printed at a much higher resolution and with much more detail. Our experience is that for simple forms, the mouse drawing approach is fast and easy, but for anything above a very simple form this approach is slower and more difficult.

4. Using a Digitizer Tablet

This may be the fastest method for converting existing preprinted forms into electronic forms, especially if the forms have a large number of lines and boxes. It does require additional hardware and text items still have to be entered from the keyboard. The approach is of limited value in designing new forms, and it is difficult to register a form for computer data.

In selecting form design software, some of the factors which you should consider are:

1) The number of forms to be designed.

2) The amount of text versus lines and boxes on the typical form.

3) Equipment available and the experience of the personnel designing the forms on that equipment.

4) How the forms are to be filled in (computer or manually).

This last consideration may be the most important. A form is designed only once, but filled in many times. If a form is to be filled in with computer generated data, you must be concerned with how easily the package allows you to register the form for data, and how easily the data merging part of the package allows you to integrate the electronic form into your computer application. We suggest that when you select a package make sure it allows you to print a copy of the form overlaid with a printer spacing grid based on the pitch and lines per inch of the data. This is an extremely valuable tool for fine tuning an electronic form for data merging with computer generated data.

## DATA MERGING REQUIREMENTS

Data merging is the process of merging data from a host computer application with an electronic form. The concept is essentially the same as when using an impact printer and preprinted forms. First, the form must be available when the data arrives at the printer; and second, the positioning of the data on the form is handled by the computer application.

Let's begin with the elements needed for successful merging of data with an electronic form. These are:

1) The form to be filled in must be in the printer's memory.

2) Any font required by the form or the data must be available.

3) The form must be activated for overlay with the data.

4) The data from the host computer application with proper printer spacing must be available.

When and how the printer is prepared for data merging depends on your application. We will outline several alternatives which fall under the two broad categories, which we refer to as, Application Control and User Control.

Under the Application Control method, one approach is to download soft fonts and the form required by a particular application each time data is sent for printing. The sequence would be to send the soft fonts, then send the form, reposition the cursor by sending a PCL command, and finally sending the data. This approach should only be used for low volume forms that are printed infrequently. Its main advantage is reliability, that is, all required elements are guaranteed to be available when needed. The main disadvantage is the overhead involved in sending font and form files to the printer for each page of data.

A slightly modified version of this approach is to download the soft fonts and the form required by a particular application at the beginning of the application job stream. This eliminates the repetitive downloading of fonts and form for each page of output, while still maintaining a high degree of reliability that the fonts and form will be available when the data arrives at the printer.

A superior approach for handling printer preparation, in situations where forms are used on a routine basis, is to store all of the soft fonts and the electronic form files required by each of your applications in the printer's memory so that they are available whenever needed. This is the User Control approach. As we discussed previously, the LaserJet Series II can store up to 32 macro files in its memory. (Forms are stored as macro files.) Under this approach, you establish host computer job streams to download the fonts and forms required by each laser printer. The jobs are run each time the printers are powered up. Forms and fonts remain resident in a printer's memory as long as it remains powered up. Since more than a single form can be in the printer's memory, the printer must be told which form is to be overlaid with the data from your application. The printer has a feature called auto-macro overlay, which allows a previously loaded macro (form) file to be merged with data from an application. The signal to start auto-macro overlay (which is referred to as activating a form) is an escape sequence sent by your host application as the first characters in your output data string. Once a form is activated it will be overlaid with each page of output until another form is activated or until the printer is reset.

## APPLICATION OF ELECTRONIC FORMS ON THE HP3000

Next we will discuss some of the considerations in using electronic forms on the HP3000. Typically, you will be integrating the electronic form with an existing application which is already printing output on a preprinted form with an impact printer. Your main concern should be how easily can the data merging requirements of the electronic form be integrated into the application.

Let's start with procedures for downloading fonts and forms to the laser printer. You need a program to download soft fonts and forms from the host computer to the laser printer. They cannot be merely copied with a utility program. The actual program is typically executed in one of three ways. The first method is on-line with the particular font and form files to be downloaded selected by the user or operator. The other two methods were described under data merging. The program can be set-up as a batch job which can be run by itself or as part of an application job stream, or as a subprogram called by the application program which generates the data.

One advantage in some software packages is the ability for the fonts required by a form to be automatically downloaded with the form. This saves time and eliminates the potential for error. Of course, the same fonts should not be repeatedly downloaded when you specify several forms, instead the software should identify the common fonts and only sends them once. Another valuable feature is the ability to group forms so that only a group name need be specified in order to download all of the forms in the group.

We spoke of activating the auto-macro overlay feature for a form stored in the printer. Usually this is accomplished by including the escape sequence as the first characters in the output data string. If a second form is required, its escape sequence is included in the next string of data. This procedure of sending an escape sequence, data, another escape sequence, and more data is referred to as dynamic form switching. After the last record of data is sent, the printer must be reset in order to terminate the auto-macro overlay. Usually this is handled by the spooler, however your program can also send its own PCL reset command.

## APPLICATION OF ELECTRONIC FORMS ON THE PC

Whereas, replacing preprinted forms with electronic forms on the HP3000 usually involves an existing application program which is processing and printing the data, on the PC you frequently find electronic forms being implemented to replace preprinted forms filled out by hand or on typewriters. Thus, the first concern in dealing with electronic forms on the PC is determining the application to be used to fill out the form. Typically the application is a word processing program, a spread sheet program, or a data base management program. There are also specialized data entry programs which can be used to display a data entry screen that looks like the form.

The procedures for downloading forms and fonts from a PC to the printer are the same as on the HP3000. Likewise, the basic requirement for activating the auto-macro overlay feature is the same. However, implementation of the auto-macro overlay can be complicated with some PC packages which restrict the inclusion of escape sequences within the data string. In these cases the escape sequence to activate the form must be sent outside the data string, and if the program sends a printer reset prior to data, the reset must be disabled.

The bottom line is that there is no standard approach for handling electronic forms on the PC because each package provides different approaches for interfacing with the printer. At BSI, we routinely use electronic forms with dBASE, R-BASE, Lotus 1-2-3, Word Star 2000, Word Perfect, and Advance Write.

One important consideration in using electronic forms on the PC is control over the master version of each form. When you have individual PC users, PC network users, and HP3000 users all using electronic forms, it is essential that a central library of forms be established. Otherwise, you will soon fine various versions of the same form spread throughout the company. At BSI, we maintain the library of master electronic forms on the HP3000. Both our HP3000 users and PC users access this library for the current version of electronic forms.

## IMPLEMENTATION OF ELECTRONIC FORMS - CASE STUDIES

In this section, we will cover two situations where electronic forms have been implemented with great success. The first situation, which was described in an article in the November, 1987 issue of The HP Chronicle, involves the Central Coast Computing Authority (CCCA) in Santa Barbara, California. CCCA is a public agency with data processing responsibility for the Santa Barbara Community College District, as well as two school districts comprised of 24 high schools, junior high schools and elementary schools. They service approximately 130 users, most of whom are at remote locations.

CCCA's initial application of electronic forms was for printing student transcripts. Under the old method, a student or parent requested a transcript from one of the member schools. The request was then transmitted on-line to CCCA, where it was held until off hours for printing. At that point it was necessary for the computer operator to mount the preprinted transcript forms and then print the small number of requested transcripts (usually from 1 to 20).

After printing, the transcripts were sorted by requesting school, and sent to the requesting schools either via mail or courier. Considerable time delays occurred routinely, and a number of people were involved in the process.

The implementation of electronic forms for this application was simple and straightforward. Most of the schools already had laser printers on site so the actual printing of the requested transcripts was shifted from the central facility to the individual requesting schools. Here is how the system works. The file containing the electronic transcript form is maintained in the central computer. Access to the form and the font files is via an on-line request screen which allows each school to request that these be downloaded to its laser printer. When a transcript is requested, the job is submitted on-line from the remote location. The job is processed on the HP3000 and the data is sent to the laser printer at the school where it is overlaid onto the form and printed.

The application was easy to implement, but the benefits were significant. Now instead of days, the turnaround time from request to printing is just minutes. Also, most of the man hours have been eliminated from the process since the computer operator and the mail room are no longer involved.

CCCA is a typical example of electronic forms replacing preprinted forms. The process was simple and no modification to the existing program was required. Another example of electronic forms is an application involving the TDY travel order form for the U.S. Navy. This application involves the use of both an electronic form and electronic signatures.

The Naval Ship Weapons Systems Engineering Station at Port Hueneme implemented a new on-line financial management system (referred to as STAFS) which included a number of very sophisticated on-line approval processes. One of these involves the generation of TDY travel orders for Department of Defense personnel. The TDY travel order allows government personnel to receive advances for business travel expenses. The system allows for the requesting, approving and authenticating of travel orders to be done entirely on-line. However, once the actual travel order is printed, each of the officials involved is required to sign the form.

At Port Hueneme, over 50 travel order requests are processed and printed each day. Prior to electronic forms, the approved travel orders from the STAFS system were printed in the travel office on preprinted forms, and then someone would carry them around the base getting the appropriate officials to sign the orders (which they had already electronically approved on the new computer system). The implementation of electronic forms and electronic signatures was designed to eliminate this duplicate effort, and to streamline the process of generating travel orders.

The system operates on a Hewlett-Packard Vectra computer which is located in the travel office and connected to the STAFS computer. Printing of the travel orders is done on a LaserJet Series II. Approved travel orders which are to be printed are transmitted from the STAFS computer to a signature merge program operating on the Vectra. The names of the requesting and approving officials on the travel order record are used to search for the appropriate electronic signature images, which are stored in encrypted form on the Vectra's hard disk. The travel order data, the signature images, and the electronic form are merged and printed by the laser printer.

The system saves time and money, but more importantly it allows the Navy to take advantage of the control and approval functions built into the STAFS system. The electronic signature image on the physical document is proof that the travel order was in fact electronically approved in the STAFS system.

## CONCLUSION

We have covered a lot of ground in our discussion of laser printers and electronic forms. Hopefully we have succeeded in demonstrating that the laser printer has the potential to be an invaluable tool capable of assisting you in achieving tremendous cost savings and efficiencies within your office. At this point, we would like to recap some of the key advantages to be gained in using electronic forms in place of preprinted forms.

Reduced cost is one of the primary benefits to be gained with electronic forms. The direct costs associated with using preprinted forms are high and they continues to go up. The indirect costs of storage space and wasted time are also significant. All of these costs can be eliminated or drastically reduced with electronic forms.

Electronic forms provide you with almost complete control, something that is impossible with preprinted forms. Access to any particular form can be restricted to certain people or departments, and the current version of an electronic form is the only one available for use throughout the entire company.

Printing of forms can take place in the user departments without worrying about inexperienced people having to mount and align preprinted forms.

Finally, you never run out of electronic forms.

The bottom line is that the laser printer has opened the door to a new office technology -- electronic forms. With it, you can make your forms the efficient tools they were intended to be.