your computer. Besides providing the interface, this expansion board also boosts the IQ of the tablet with an MC68000 microprocessor and a bevy of support circuits that power the print-recognition abilities. The Penpad 310 uses basically the same electronics but puts them in a heavy external box that connects to its computer host through a standard RS-232C link.

Installing the 320 host adapter steals an interrupt from its computer system host, factory configured as IRQ 2 but selectable between any of six values using on-board jumpers. The interface also requires the assignment of a port address, also selected with jumpers.

THE PEN

All Pencept products come with a pen as standard equipment. The Pencept pen is much like any other, about 6 inches long and a good match for a bulky fountain pen. Pens are supplied either with ink-filled cartridges or are inkless.

While the documentation claims Pencept pens are not field-serviceable (meaning you shouldn't dare try to change ink cartridges), the factory reports that most users take care of the simple cartridge replacement job themselves. Replacement cartridges, with or without ink, cost $2. The pen itself, one of which is standard equipment with any Pencept tablet, is pricey, listing at $250 when purchased separately.

However, instead of the pen, you can substitute a 4- or 16-button cursor to accompany a new Pencept tablet at no change in price. The cursors are gently curved though quite flat. The reticle, with horizontal and vertical cross hairs, is unusually large, and the resulting large sensing coil aids in achieving the tablet's high resolution. Purchased separately, the 16-button and 4-button cursors cost $200 apiece.

In use, the basic Penpad 300 proved itself nimble enough to keep up with our fastest drawing. Using its pen, its proximity range measured a healthy 0.87 inch. With a cursor, it reached out to a generous 1.25 inches.

When used strictly with *AutoCAD*, the Penpads 310 and 320 did not fare as well, occasionally missing a point during rapid drawing. The problem appeared not to be one of communication but rather of processing overhead and the delays built into the general-purpose recognition system. This problem should not arise when you are using Pencept's CAD interface software. The Penpads 310 and 320 also demonstrated a more consistent proximity range, 1 inch, for both pen and cursor.

HAND-PRINTING RECOGNITION

Pencept justifies the added expense of the 310 and 320 by citing their hand-printing-recognition abilities. On the surface, this technology is more than remarkable; it hints at the power tablets can bring to your PC. But, alas, it's only a hint. The recognition abilities of the Penpads are quite limited—restricted for the most part to monospaced printed numbers and capital letters.

Pencept brings a wondrous combination of revolutionary ideas and clever styling to digitization, including limited handwriting recognition.

Moreover, recognition is sensitive to the way you print individual characters. As with most inexpensive recognition systems, you must conform to the Penpad's wishes—it won't adjust to yours.

In the end, you must learn to print the way the Penpad wants you to. The better you get at scribbling the way it wants, the more accurately it will recognize what you print. After an hour of experimenting, some people in PC Labs were able to achieve a recognition rate of about 90 percent, which is exemplary performance according to Pencept. After you've used a Pencept tablet for a few weeks, the company reports, you can expect to achieve print-recognition accuracy of nearly 99 percent.

But recognizing characters seemed an agonizing chore, a process that dragged out for seconds with results that were, at best, a crapshoot. Don't judge the system by that, however. The free-form DOS recognition mode has built-in delays that help the tablet determine when you've finished scrawling each character. These intentional delays make the tablet slow.

Even within the DOS mode, however, the print-recognition system does some surprising things. For instance, when a character was misidentified on the command line, we traced over it again correctly on the Penpad. In an instant, the correct character appeared in its proper place on-screen and in the DOS keyboard buffer.

Print-recognition comes into its own with the three Penpad application packages offered by Pencept. (You get your choice of one of the three or an application development kit with both the Penpads 310 and 320. Separately these programs cost $195.) For example, the *Pencad* package offers a template for your favorite CAD program (providing your favorite is *AutoCAD*, *CADvance*, *CADKey*, *MegaCAD DBP*, *VersaCAD*, or the graphics presentation program *Lotus Freelance*) and a macro program. Combined, these features can considerably speed up the use of the underlying CAD application. For instance, to zoom in with *AutoCAD*, you don't have to tangle with commands or menus—just draw a Z on the Penpad.

Besides *Pencad*, Pencept also offers *Pendraw*, a screen-painting program for color presentation graphics that also includes screen grabber and slide show utilities (the current version has EGA but no VGA support); and *Penform*, a forms-creation package for data entry using the hand-printing recognition abilities of the Penpad to create either ASCII or .DIF files. Think of the latter as a product for people who fear the keyboard as if it were some dreaded social disease. In speed and accuracy, *Penform* is no threat to touch typists or even those of the two-fingered school. The Penpad Software Toolkit consists of thorough but brief technical documentation on how to program the Penpad and develop drivers for it.

Unfortunately, the documentation accompanying these applications is not up to the quality level of the Penpads themselves. For example, the *Pencad* manual is a daunting work that should make some technical writer's English instructor bury his or her head in shame.

Pencept brings a wondrous combination of revolutionary ideas, clever styling, and wide functionality to digitization, though the loose details of the Penpad applications need work. If you need accuracy, the Penpad 300 is your best choice. If you need to recognize hand-printing, the 310 and 320 are your only choices.

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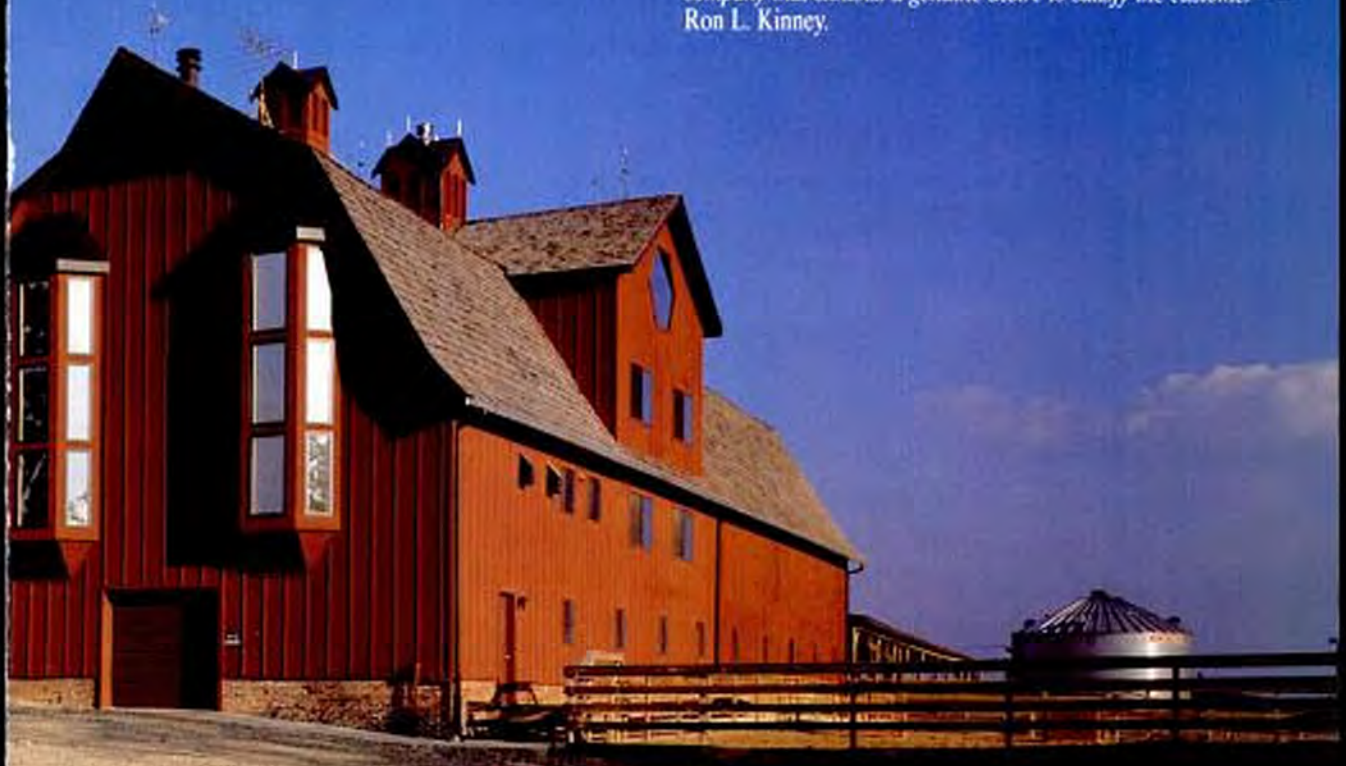
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PENTEL OF AMERICA LTD.

Pentel DST-4AN

by Frank Bican

Best known as a purveyor of pens and pencils, Pentel of America is also a leading supplier of replacement plotter pens. With the association between plotters and tablets as close as it is, the company's move into the tablet market seems only logical.

Pentel's initial offering, the DST-4AN, is something of a Lilliputian, even among this group of bantamweights. Measuring just 17.3 by 11 inches and weighing just over 3 pounds, it is one of the few tablets that seem equally at home on your lap or desktop. That may not mean much to CAD mavens, but it should be appreciated by those principally concerned with freehand drawing. In fact, serious *AutoCAD* users would most likely find the 6.3- by 7-inch workspace with that application inadequate.

The actual workspace on the DST-4AN is smaller still, measuring 11.7 inches in width by 8.3 inches in height. The remaining area, mainly along the right side of the enclosure, houses the circuitry and provides an indentation for holding the pen when it is not in use.

On its underside is a bank of ten DIP switches for setting communication parameters and operating modes. Fortunately, switch settings tend to be set just once and then forgotten about—the instruction manual doesn't make the process particularly easy.

Pentel's trilingual (English, French, and German) documentation is quite terse in general, but the switch-setting table is as dizzying as they get.

Nowhere does the manual mention how to configure the DST-4AN to operate with *AutoCAD* or which *AutoCAD* device driver to use, so we called technical support at Pentel. With its courteous help, the switches were promptly set and installed using *AutoCAD*'s Summagraphics Bit Pad driver.

Pentel is proud that the pen supplied with the DST-4AN is equipped with an uncommonly flexible cable. Indeed, the 36-inch cord rarely gets in the way, but it is no match for the cordless one available on Kurta's IS/ONE. Although an optional ($90) four-button cursor is available, none was supplied for our review.



The lightweight Pentel DST-4AN is a good performer, but it will be appealing to people who do not have high-end needs. For $420 Pentel supplies users with the tablet and a pen whose highly flexible cable is the next best thing to cordlessness.

FACT FILE

Pentel DST-4AN
Pentel of America Ltd., 2805 Columbia St., Torrance, CA 90503; (800) 421-1419, (800) 262-1127 in Calif., (213) 320-3831.
List Price: $420; 4-button cursor, $90.
Requires: Serial port.
In Short: The price is right, but amenities, performance, and software are distinctly lacking. At its best, the Pentel's light weight makes it best suited to use by artists who want to use it in their laps.

CIRCLE 418 ON READER SERVICE CARD

The manufacturer claims that the DST-4AN is usable with objects up to 3 millimeters thick, but our evaluation unit wasn't nearly as generous. Indeed, it didn't always respond reliably even with the pen in contact with the board. This was most notable when the pen was being held exactly perpendicular to the work surface. It was far more dependable when the pen was held in a more natural writing position.

Metallic objects also have a tendency to give the DST-4AN a case of indigestion. A metal ruler resting on its surface caused the output to stop whenever the pen was brought within 0.5 inch of it.

The Pentel's maximum data output rate of 60 points per second would seem to be entirely adequate, but the speed at which the tablet itself recognizes the position of the pen is quite slow. As a result, moving the pen around the work surface quickly results in hesitant on-screen image changes.

Although it can hardly be considered a top performer, the Pentel DST-4AN is reasonably inexpensive, and with a longer serial port cable it might just appeal to those who want to do a little freehand work from their laps rather than at their desks.

SCIENCE ACCESSORIES CORP.

Grafbar GP-7 Mark II

by Winn L. Rosch

Something's missing. Unpack Science Accessories Corp.'s Grafbar GP-7 Mark II tablet and you'll swear someone forgot to pack the tablet in the box. Once you have the system running, however, you'll wonder why other manufacturers waste so much space and energy in making tablets.

With the $1,315 Grafbar, any tabletop becomes a digitizing surface. Using its own modified form of sonar, the Grafbar detects with amazing resolution the location of its pen or cursor on any surface. Science Accessories claims a resolution of 254 lines per inch (0.1 millimeter) and accuracy of .01 inch, matching most conventional tablets.

The electronics and microphones are contained in the Grafbar control unit, an aluminum box measuring 1.8 by 19 by 6.5 inches (HWD). The microphones are visible on the front panel as small black bull's-eyes near either side of the front panel. Closer to the center of the front panel are two LEDs. The red one on the right is a power indicator; on the left, a green one is labeled "Menu." The Grafbar menu itself is unique. Black silk-screening on the gray-beige front panel denotes five control areas—zones that stretch about 4 inches in front of the control box—in which pressing a cursor or pen button will activate special functions. From left to right, these are labeled Origin, Point/Line, English/Metric, Stream, and Cancel.

Origin allows you to move the digitizing area almost anywhere on your work surface by relocating the origin of the Grafbar's coordinate system. Point/Line determines whether the tablet sends out data only when buttons are pressed at end points or continuously as lines in between presses. English/Metric controls the mea-

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suring system used. Stream forces the Grafbar to transmit data to its host continuously. Cancel resets these options to their defaults.

The rear panel of the control unit is devoted to switches and connectors. A standard female 25-pin D-shell connector hosts the serial input/output signal (no serial cable is supplied by Science Accessories) while the odd proprietary connector links to the pointing device. One bank of DIP switches is used for system setup (including selecting cursor or pen). The control unit runs from ordinary AC, tapped through its 87-inch cable and power jack. A small toggle switch for power completes the rear-panel accoutrements.

A pen and two cursors (one-button and four-button) are available to complete the Grafbar system. Either the pen or the one-button cursor comes as standard equipment. The Science Accessories pen uses only a tip switch and can be equipped with standard ballpoint pen cartridges with ink or without.

Only the four-button cursor was shipped with the evaluation unit. A $170 option, it's basically a rectangular chunk of gray plastic measuring 0.9 by 2 by 3 inches (HWD) with a 1.4-inch clear extension paddle for the reticle cross hairs. Its four round buttons have their own unique arrangement. One is a large, black pad about half an inch in diameter. Below it are three 0.25-inch buttons in blue, yellow, and orange. The one-button cursor has the same shape; it lacks only the second row of buttons.



The $1,315 Grafbar GP-7 Mark II is the only sonic digitizer in this roundup. There is no tablet, so the unit occupies very little desk space, but because of its 27-inch proximity, it has the unique ability to work around obstacles anywhere on your desk.

The bottom of the cursor is finished with exactly the same plastic as the rest of the case; it has no special slippery surface. Its most unfortunate aspect is the 55-inch tail that drags behind it to connect with the control unit. The freedom afforded by tabletless operation makes you long for cordless operation as well. According to Science Accessories, however, no cordless models are planned because little demand exists.

The Grafbar works surprisingly well—surprisingly, that is, only if you're not familiar with the technology. It proved able to identify the location of the cursor readily. Small objects between the cursor and control unit did not cause location difficulties, although the ultrasonic signals could be blocked with book-size objects in their path. When the signals were blocked, no errors resulted. Instead, the on-screen cursor simply did not move until signals were again available to the cursor.

FACT FILE

Grafbar GP-7 Mark II
Science Accessories Corp., 200 Watson Blvd., P.O. Box 587, Stratford, CT 06497; (203) 386-9978.
List Price: Tablet, $1,315; four-button cursor, $170.
Requires: Serial port.
In Short: A sonic digitizing system that turns any surface into a 25.5- by 23.5-inch tablet with moderate precision and average accuracy. The Grafbar's biggest problem is a severe shortage of software support.

CIRCLE 419 ON READER SERVICE CARD

Proximity is an odd issue when you're dealing with the Grafbar system. The range of the ultrasonics is roughly the same in three-dimensional space. That is, you can move the cursor in a horizontal plane away from the control box or move it vertically to effect the same displacement on the screen. In effect, the proximity is almost equal to the length of the active digitizing area, over 2 feet.

The active area will cover a great deal of your desktop, 25.5 inches wide by 23.5 inches long. Using the *AutoCAD* ADI driver that was supplied with the system, the Grafbar produced a default active area of 15.5 by 17.25 inches, corresponding to the drawing space on the screen. The only other software driver provided is for *Microsoft Windows*. You'll either have to write your software or ensure that your application already has specific support for the Grafbar.

Overall, the Grafbar is as novel as it is useful. Line the bottom of the control unit with Velcro, and you can fix it on top of your drafting board or light table, move it around, and digitize on each surface. If you want flexibility in choosing where you work—and what you work on—the Grafbar is for you.

SCRIPTEL CORP.

SPC-1212 Opaque Digitizer
RDT Transparent Glass Digitizer

by Winn L. Rosch

Despite its logo, which looks like type that was pried off a 1950s coffee maker, Scriptel Corp. incorporates a number of innovative ideas into its line of tablets. Its products all use a unique and patented technology called resistive decoding. One line of tablets is crafted from glass and incorporates a clever integrated setup procedure and an eight-digit LCD readout. In fact, transparency is such an important feature of Scriptel's RDT series of tablets that the company's more-ordinary tablets are called SPC Opaque Digitizers, almost with a trace of disdain.

Currently, the $599 SPC-1212 Opaque Digitizer is the sole member of Scriptel's Designer Series, although similar opaque tablets are offered as its Animator Series, the 12- by 12-inch LCA4Z and the 12- by 17-inch LCA3Z.

A wedge of the future, the pale gray Scriptel SPC-1212 rises dramatically from its 1-inch front edge to 2.9 inches at the top, the sides swept in like the latest in Italian sports coupes. The 15.5-inch-wide surface itself is completely flat for most of its 16.5-inch height. Up top are the silk-screened Scriptel retroscript logo and two LED indicators.

The actual drawing surface is marked off by a thin, darker gray border. At the top, several square function-control areas are designated within the confines of this border. Actually, the drawing area that Scriptel designates is quite pessimistic. In testing, the active drawing area was found

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to extend an additional half inch to the right and a full inch higher than the markings.

Construction of the SPC-1212 rates as solid. Its bottom is a flat aluminum sheet, folded up around the rear panel and partly covered by the top of the case. At the back of the tablet expect to connect a Scriptel pointing device using a modular Berg connector as well as a power cord to connect the tablet to any standard 115-volt outlet. Two banks of DIP switches are used for setup. The 74-inch serial cord is not removable but terminates in a standard 25-pin D-shell connector.

THE RDT SERIES

As completely clear, see-through digitizing tablets, the entire Scriptel RDT series really stands out in both appearance and functionality. You can lay any one of them atop a blueprint or drawing and trace to your heart's content.

Each tablet is made from a quarter-inch sheet of heavy tempered glass with smoothed edges. Although the durability of the tablet was not tested, Scriptel reports that the tempered glass shatters like the side window of an automobile, disintegrating into tiny pieces instead of sharp shards.



The $599 Scriptel SPC-1212 Opaque Digitizer (top) and the $995 RDT Transparent Glass Digitizer (bottom) are strong performers. Both use Scriptel's unique and patented resistive decoding technology, but what makes the RDT models special is that they are made of glass—perfect for tracing anything you set beneath them.

The RDT line is composed of five models varying only in size: 24 by 36, 20 by 20, 18 by 24, 12 by 18, and 12 by 12 inches. Prices follow size, from $4,195 at the large end of the scale to the $995 cost of the 12- by 12-inch tablet tested. The overall measurement of the smallest RDT tablet is 16.5 by 17.5 inches.

Each of the RDT series wears the same strange growth at the top, a sculpted medium-gray plastic block that contains the control electronics.

The expanse of glass is marked with several patterns. A border of silver *Hs* runs along about an inch outside the active pad area, a remnant of the resistive coating. The active digitizing area is somewhat inaccurately demarcated by a narrow black border. The actual active area extended about one inch to the right and one inch above the designated 12- by 12-inch area.

Centered on the glass above the normal digitizing area is a small, round-cornered rectangle that's outlined with a black border. Move your pointing device over this area, and the RDT's menu pops onto its eight-character LCD display in the tablet handgrip. System setup is accomplished by stepping through the menu with various presses of cursor buttons. While daunting at first, it quickly becomes a convenient process.

Power for the RDT is drawn through a bothersome outboard box measuring 2.5 by 3 by 7 inches. Two cords trail from it, a 7-footer that connects with a 115 VAC outlet and a 67-inch secondary cable that plugs into the tablet using a modular Berg connector. The serial communications cable, 74 inches long, is attached directly to the control electronics box and cannot be removed. The cable ends in a 25-pin D-shell connector.

Either a cursor or pen is included in the purchase price of a Scriptel tablet. As options, each costs $110. No pen was received for evaluation. The same Scriptel cursor, which the company calls a "Tracer" (for which Scriptel claims a trademark) is used by both tablets. The 2.5-inch-wide by 4.75-inch-long by 1-inch-high object is oddly shaped, to say the least. At its base it's a truncated pyramid that leads to a lower area with four buttons. Rubber chiclets, they seem to require inordinate force for activation.

Offset to the left above the keys is a 1.25-inch paddle holding the Tracer's reticle—X-shaped cross hairs outlined by a darker target. The bottom of the cursor is covered with black felt to make it slide easily. However, the odd shape and slippery plastic of the top make it one of the least desirable cursors, and one of the hardest to get a good grip on.

Besides the transparency of the RDTs, the biggest distinction of the Scriptel tablets is their wide range of compatibilities and data formats. Emulations accommodated by the SPC series in binary, ASCII/BCD, and remote programming formats include Scriptel, Summagraphics Bit Pad Plus, Summagraphics MM Digitizer series, GTCO's Digi-Pad, Houston Instrument's HIPAD, and Hitachi's Tiger Tablet. The RDT series adds Summagraphics Bit Pad II and built-in Microsoft Mouse emulation as well. The wide range of emulations makes up for one noticeable shortfall of the Scriptel tablets. They include no software and no templates. You must rely on the emulations and the tablet support built into your applications.

On the SPC tablets, the emulation as well as the serial data format and reporting speed are all selected through DIP switches on the rear panel. RDT operational modes are selected through its integrated setup system.

The downsides of these Scriptel tablets are minor. Their resistive decoding technology proved to be more sensitive to metal objects on the digitizing surface than in other makers' digitizers. For example, a

FACT FILE

Scriptel Corp., 4145 Arlingate Plaza, Columbus, OH 43228; (800) Scriptel, (614) 276-8402.

SPC-1212 Opaque Digitizer
List price: With pen or cursor, $599.
Requires: Serial port.
In Short: A lightweight, general-purpose tablet that uses resistive decoding technology for good resolution and accuracy, but this yields slow drawing speed. Although no software is provided, the tablet emulates a wide range of other products.

CIRCLE 420 ON READER SERVICE CARD

RDT Transparent Glass Digitizer
List Price: With pen or cursor, $995.
Requires: Serial port.
In Short: A see-through tablet with resistive decoding technology that's perfect for tracing artwork. No software is provided, but the tablet's emulations are complete.

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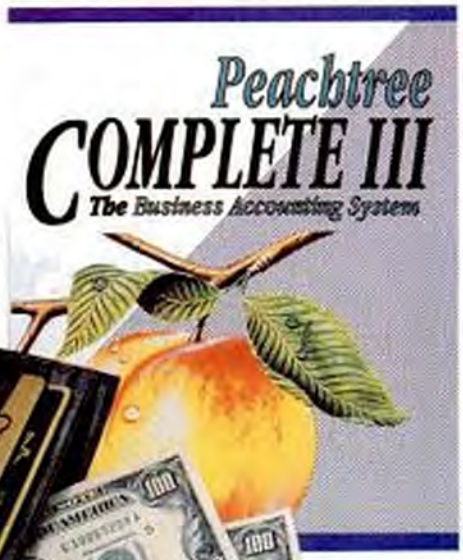
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metal tape measure caused the sensed position of the cursor to vary by more than an inch. Any problems arising from this sensitive technology can be avoided simply by removing paper clips and staples before taping drawings to the Scriptel tablets.

While the glass tablet makes a good choice for tracing just about anything flat, the thickness of the glass does impose a parallax problem that may make precise tracing impossible. Parallax deviations are exacerbated by the four tiny vinyl feet that raise the tablet about a quarter of an inch above whatever work surface the tablet is put upon. Of course, you can trace transparent and translucent films (say medical X rays) and drawings without parallax by taping that art to the glass and resting the tablet atop a light table for illumination.

The novel technology used by the Scriptel opaque tablets does not make them stand out among their competition. Regard them as good performers that speak a number of languages. If the notion of a see-through tablet appeals to you, however, you have no other choice than a Scriptel RDT. They're good enough that you should have no misgivings.



Summagraphics has the most widely emulated and best-selling digitizing tablets. Both the SummaSketch II (bottom) and SummaSketch II Professional (top) are lightweight and fast. At $599 and $999 they're reasonably priced, considering the completeness of the packages.

SUMMAGRAPHICS CORP.

SummaSketch II
SummaSketch II Professional

by Winn L. Rosch

The best-selling digitizing tablet in the world, according to Summagraphics, the SummaSketch II has a lot going for it. It's compact, lightweight, fast, affordably priced, and benefits from the most extensive industry support of any tablet. A complete system, including input/output cable, power supply, pen, cursor, and software disk, lists for $599. Add "Professional" as a surname, and the tablet grows 50 percent in size and becomes 66 percent more expensive: $999 for the full kit.

Summagraphics is perhaps the oldest name in PC tablets, predating the introduction of IBM's first Personal Computer by nearly a decade. The company, started in 1972, launched the well-received Bit Pad One magnetostrictive tablet in 1975. The present series of electromagnetic tablets was first introduced in 1983. Known generically as the MM Series (the SummaSketch II is more formally known as the MM1201; the Professional, the MM1812), Summagraphics tablets have used basically the same design and communications protocol and code since then. These have been popular enough that over 250 software publishers take advantage of them, and nearly every other digitizing tablet has some facility to emulate them.

Opting for the real thing will pay big dividends, however. Although the SummaSketch II weighs hardly more than 3 pounds, it gives a feeling of permanence, almost as if it were carved from a solid slab of plastic—no rattles, nothing loose.

Both the standard tablet and the Professional seem to have been made from the same mold. Both appear to be little more than a flat panel of gray-beige plastic on top, filled plastic on the bottom. Styling is plain and squared off. The SummaSketch II measures a comfortable 16.25 inches wide by 16.5 inches long by 1.75 inches thick, not much more than a tablet of drawing paper. The Professional stretches out somewhat wider and an inch longer, measuring 23 by 17.5 by 1.75 inches (width, length, thickness).

One design aspect of the SummaSketch II that's so providential it might not have been intentional is the twin knee-relief areas on its underside. These two flat-sculpted areas add stability should you balance the tablet on your knees. It can be a godsend for finicky, artistic types (such as this author) who like to work with a digitizing tablet as if it were a sketch pad rather than with one that is immovably chained to a desktop.

The top surface of either tablet bears little decoration to break up its plainness, only the tablet name and a flashing green power/proximity indicator LED near the top edge. The LED normally flashes if a pointing device is not within range of the tablet's circuitry, turning steady when pen or cursor comes within operational proximity. As such, the LED gives a quick way of diagnosing problems. If it lights properly with pen or cursor movement yet your application doesn't agree, you know the tablet is working and you should check the communications cable.

The only other adornment on the tablet surface is a thin groove, as wide as a dime is thick, that exactly defines the active touchpad area—12 by 12 inches on the standard SummaSketch II and 18 by 12 inches (long axis horizontal) on the Profes-

PC MAGAZINE FACT FILE
EDITOR'S CHOICE

Summagraphics Corp., 60 Silvermine Rd., Seymour, CT 06483; (800) 243-9388, (203) 881-5400.

▶ **SummaSketch II**
List Price: With pen and cursor, $599; with 16-button cursor, $699.
Requires: Serial port.
In Short: A lightweight 12- by 12-inch tablet with sufficient accuracy for normal use, resolution matching today's 1,000-line-per-inch standard, excellent ergonomics suited to both desktop and laptop use, the most widely supported command set, and an all-in-one-box approach that makes getting started in digitizing as easy as fingerpainting.

CIRCLE 422 ON READER SERVICE CARD

SummaSketch II Professional
List Price: With pen and 4-button cursor, $999; with 16-button cursor, $1,099.
Requires: Serial port.
In Short: A lightweight 17-by 12-inch digitizing table with adequate (not exemplary) accuracy, good resolution, and excellent ergonomics.

CIRCLE 423 ON READER SERVICE CARD

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sional. When you're using *AutoCAD*'s default setup and the standard Summagraphics ADI driver, having the larger tablet isn't an advantage. In this case both tablets provide an active area of 10 by 8 inches. The balance of the active tablet was devoted to menus. The Summagraphics MM driver built into *AutoCAD* does better and includes provisions for selecting the tablet size.

While the tablet itself has no mechanical provisions for holding down templates, it is amenable to masking tape. Summagraphics does not supply any templates but does include a coupon that can be returned to the company in exchange for one of the following four templates: *AutoCAD, Cadkey, VersaCAD Design,* or *Microsoft Windows*.

Both tablets deliver the same resolution, up to 1,016 lines per inch (the odd number works out to be 40 lines per millimeter), with an accuracy of 0.015 inch. Although the accuracy sounds subpar compared with that of tablets claiming 0.01 inch, for most applications it's not likely to make a practical difference. Both tablets also draw with equal speed, up to 116 points per second, more than enough to outrun *AutoCAD* even on a 25-MHz 80386 machine.

STYLUS AND CURSOR

What Summagraphics calls a stylus is actually a 7-inch pen, nominally supplied with a nylon stylus tip. Inside you'll discover the all-plastic cartridge that dimensionally matches a ballpoint cartridge, should you need to turn the Summagraphics pen into a genuine pen with ink. Classed as a two-button pen, one button registers through a tip-activated switch; the other through a button near the tip of the pen. Overall, it has a good feel, comparable to wielding a fat technical pen. The pen is tethered to the tablet with a 1-meter cord that's limp enough not to interfere with normal use.

The 1.75- by 4.5-inch standard cursor sports a 1.25-inch clear plastic paddle, its cross hairs encircled by a wide band of thin wire coil to detect the tablet's signal. Its four buttons are arranged in a diamond formation. The black velvet bottom of the four-button cursor slides smoothly and easily across the tablet surface. The cursor, too, was tethered by a meter of very thin, limp cable.

A 16-button cursor is available and can be substituted for the four-button model when you buy the SummaSketch package. The extra buttons add $100 to the price of either tablet.

Both of the Summagraphics tablets plug into their computer hosts through a standard serial connection. The 60-inch cable supplied with the system terminates in a 25-pin D-shell connector, but Summagraphics also supplies a 9- to 25-pin adapter for ATs. The D-shell connector itself also provides the linkup to get power to the tablet. A small external transformer plugs directly into a standard wall outlet and supplies the electricity the SummaSketch requires through a 4-foot wire that plugs into the 25-pin connector. At the other end, the serial cable ends in a modular connector for plugging into the left side of the back of the tablet. The cursor or pen plugs into the other jack on the right.

The firm includes some software with either SummaSketch II system: an *AutoCAD* ADI driver, a universal mouse emulation driver (compatible with Version 6.13 of the Microsoft mouse), a *Windows* driver, a reset utility, and a test utility. According to Summagraphics, the tablets work with all versions of *Windows* after 2.03 including *Windows/386*.

With the proper choice of pen from its diverse line, Wacom tablets are the top choice for artists.

The Summagraphics system has several strengths. The SummaSketch tablets are packaged as complete kits, including everything you need to instantly get into operation. Complementing that is the extensive industry support of the MM data format that makes the SummaSketch series compatible with more programs than almost any other tablet (except, of course, other tablets that also use the MM format). And the SummaSketch tablets are just plain good—solidly built and good performers. The only additional thing you could ask for would be a cordless cursor or pen. If that's not an issue for you, you'll be delighted with the SummaSketch II.

WACOM

Wacom SD-322L
Wacom SD-420L
Wacom SD-421L

by Winn L. Rosch

Like Kurta, Wacom cuts the cord and brings freedom to digitizing. Using a novel technology, the entire line of Wacom tablets works without wires to pen or cursor and without batteries, yet the entire system works smoothly and without errors. With the proper choice of pen from Wacom's diverse line, the company's tablets rate as the top choice for artists.

A newcomer to the United States, Wacom has been selling magnetostrictive tablets in Japan since 1983. Its unique give-and-receive magnetic resonance technology was developed in 1987 and first went on sale in the United States with FCC Class A approval in January.

The give-and-receive resonance system relies on the energy that's briefly stored in resonant circuits. The electromagnetic field in the tablet itself excites an LC circuit (one that combines an inductive coil and a capacitor) in the pen. The inductive coil does double duty and also serves to electrically couple the pointing device with the tablet. When the circuit discharges, the resulting signal flowing through the coil is picked up by a matrix of flat-wound coils in the tablet. The relative strength of the signal in tablet coils helps determine the location of the pointing device.

Pressing a button on the pointing device alters the tuning of its LC network, and the resulting change in phase angle can be detected by the tablet. Because the LC circuit in the pointing device is entirely passive, no batteries or other power source (besides the current induced from the tablet) is necessary for its operation.

The current line of Wacom electromagnetic resonance tablets embraces six different model series, all of which use the same technology, but only three of which are imported to the U.S. Of these six series, PC Labs examined three separate models representing two different tablet sizes and three different working surfaces. The SD-320 series, represented here by the $1,345 SD-322L, is the larger of the two, with an active area that measured 16 by 16 inches, in excess of the conservative 15- by 15-inch claim of the manufacturer. The $795

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SD-420L and the $895 SD-421L yield active digitizing areas measuring 12 by 12 inches. The prices include only a modest amount of software but do not include pointing devices, which must be purchased separately.

All of Wacom's tablets proved large and heavy for the digitizing areas they yielded. The weight penalty is not a result of the technology used but related more to the tablets' construction. These are built to be industrial-strength tablets; they contain sheet steel inside as shielding. In addition, the Wacom tablets put the entire power supply inside—that means you just plug them into the wall without an external transformer. The transformer resides inside the tablet, adding to both its volume and mass. The SD420 series tablets weigh nearly 10 pounds; the SD-320 series, nearly 15. These are not tablets that you can rest on your lap.

Note, too, that although the pointing devices used by the Wacom tablets are cordless, the tablets themselves are not. Each one requires two cables to be plugged in—power and signal. The signal cable handles only serial data and connects with a standard RS-232C port—the only interface supported by the Wacom system. The one shipped with the tablets by Wacom was 80 inches long and featured a 9-pin D-shell connector at one end for attaching the tablet and a 25-pin D-shell at the other for your computer. Wacom also supplied a 9-to-25-pin adapter.

The SD-420 series of tablets are flat wedges measuring 16.5 by 16.5 by 3 inches, sloping down to less than an inch at the front edge. The corners and edges of the generally square tablet are gently rounded. At the upper left, three LEDs indicate system functions: a power-on indicator, a ready light (indicating that the pen or cursor is within proximity), and a status light (indicating switch activation).

The SD-320 series conforms to the layout and shape of its smaller sibling. The principal difference is its size, necessarily larger to accommodate more digitizing area. Overall, it measures 20.75 inches square and about 3.5 inches high.

Under *AutoCAD*'s ADI driver, the two smaller tablets fit the on-screen drawing space into a 9.5- by 10.25-inch digitizing area on the tablet, about the same as most tablets their size. The larger SD-322L tablet yielded a 12- by 13-inch range that corresponded to the *AutoCAD* drawing area.

According to Wacom, the resolution of either series of tablets is a sharp 1,270 lines per inch (50 lines per millimeter) with an accuracy of .01 inch. Either tablet is capable of drawing 205 points per second, more than enough to operate smoothly with *AutoCAD*.

Either size of tablet is available with one of three working surfaces, designated by the final numeral in each model number. A final digit of 0 indicates a conventional digitizing surface, termed "plain" by Wacom. The same white-beige as the rest of the tablet, the slightly textured plastic surface is otherwise unremarkable except that the active area is in no way delineated from the rest of the tablet surface.

A final 1 in the model number indicates an "adhesion plate" surface. At first glance, this series of tablets appears only to have changed the color of the active area to black, which at least lets you know the bounds of the system's digitizing abilities. Flip a switch hidden under the left edge of the tablet, however, and a magical transformation occurs. Any paper that's on the digitizing area suddenly clings to the tablet. Once the switch is flipped, paper sticks to the surface and won't move unless you peel it up. This unique feature generated many oohs and aahs from onlookers in PC Labs.

The secret is static electricity. The switch controls an internal power supply that puts a 2,000-volt charge under the drawing area that holds paper down the same way balloons stick to sweaters.

The third choice, with a final 2 in the model number, is a "menu panel" tablet, which uses a removable transparent panel to cover the drawing area. The idea is to allow you to put your templates safely and

FACT FILE
EDITOR'S CHOICE

Wacom Inc., Country Club Plaza, West 115 Century Rd., Paramus, NJ 07652; (800) 922-6613; (201) 265-4226.

Wacom SD-322L
List Price: $1,345.
Requires: Serial port.
In Short: A heavyweight tablet with a 17- by 12-inch active area that uses a variation on electromagnetic operation to make its pointing devices cordless. Features a special removable "menu-panel" to hold down and protect templates.

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Wacom SD-420L
List Price: $795.
Requires: Serial port.
In Short: The SD-420L has a 12- by 12-inch active area and offers cordless operation of its pointing devices, making it a good choice for freehand artists.

CIRCLE 425 ON READER SERVICE CARD

Wacom SD-421L
List Price: $895.
Requires: Serial port.
In Short: An electrostatic plate below its 12- by 12-inch digitizing area holds tracing paper and templates firmly in place on the SD-421L. That, coupled with solid engineering, makes it a winning choice.

CIRCLE 426 ON READER SERVICE CARD



Wacom is Kurta's only rival in the cordless digitizing arena. Pictured here from left to right are the $1,345 Wacom SD-322L, the $795 Wacom SD-420L, and the $895 Wacom SD-421L. The Editor's Choice SD-421L has an innovative electrostatic generator that holds any draft paper firmly in place while you draw or trace.

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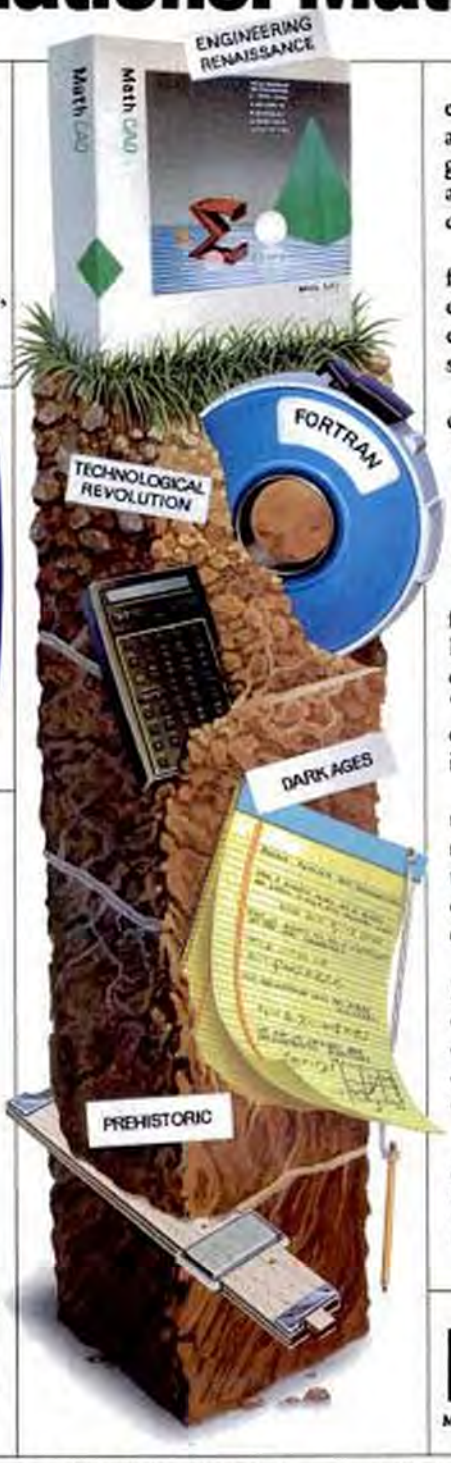


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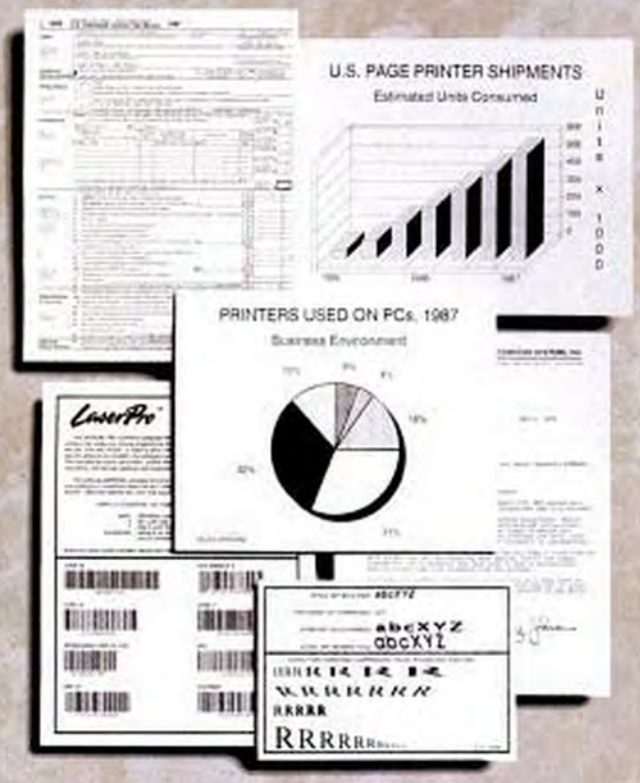
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immovably under this panel. A transparent silicone-rubber suction cup allows you to lift the 0.12-inch-thick plastic panel to change templates or menus. The slightly textured finish of the panel resembles ground glass and reduces glare. In testing, the sheet did not alter the proximity range of the Wacom pointing devices.

POINTING DEVICES

Five pointing devices are available, all as extra-price options. Four of the choices are pens. All are cordless and operate without batteries or any power other than what they pick up from the tablet.

Two of these are pressure pens, priced at $125 each. As the name indicates, they rely on the pressure applied to their points to indicate the amount of force applied to the pen tip. Although sent to the host system in digital form, the pressure actually represents an analog value that can be used by software to control the width of a drawn line or simulated brushstroke.

The two pens differ in the force required for activation; a green band around the pen indicates the model SP-300, which responds to higher pressure (up to 500 grams), while the red band of the model SP-310 denotes the lighter touch (0 to 300 grams) it responds to. The pressure pens proved nearly unworkable with *AutoCAD* 10. Since they seem to have no proximity, the slightest interruption of pressure causes menus to pop onto the screen. The problem results from a bad interaction of the pressure data, the Wacom ADI driver, and *AutoCAD*. However, the pressure pens come into their own with drawing programs. They have a real pen feel when you're drawing lines, and they offer 256 discrete pressure levels.

According to Wacom, the pressure pens are the first ever to operate cordlessly. They use a variable ferrite inductor, controlled by pen displacement, to alter the resonance of the tuned circuit in the pen. From this change, the tablet electronics can accurately calculate the pressure applied to the pen point.

Wacom's standard pens function more conventionally, although still cordless. An elongated button complements the internal switch that registers when you press down on the point. A gray band indicates the model SP-200 nonstroke pen—there's virtually no downward motion required to activate the switch. A red band designates the SP-210 stroke pen, which requires short but definite travel to activate the tip switch. The proximity range of the two Wacom switched pens was limited to about 0.25 inch with *AutoCAD*, but they nevertheless proved quite workable. Either pen costs $80.

All pens are about 5.75 inches long. Wacom supplies pen holders and a pocket clip with each tablet. The pens are packaged in lush boxes, exactly what you'd expect for a premium pen-and-pencil set in their price range.

Wacom also offers a $150 cordless four-button cursor. Measuring about 3.25 inches long (the reticle paddle adds 1.25 inches) and about 2 inches wide, it's semi-streamlined and easy to grab while keeping the buttons under your index finger.

EDITOR'S CHOICE

- HIPAD Plus 9018
- IS/ONE
- SummaSketch II
- Wacom SD-421L

There are very few reasons not to buy a cordless tablet. The freedom gained by cordlessness can be invaluable, especially to freehand artists. The Kurta IS/ONE, a former Editor's Choice and winner of a 1988 *PC Magazine* Award for Technical Excellence, has yet to be upstaged by the competition. Even at $995, it's a high-quality bargain.

The Wacom SD-421L also features cordless pointing. Its special feature is its electrostatic surface that makes papers cling to it while you work. At $895, it's pricier than much of the competition, but its construction quality is excellent, and the availability of an optional $125 pressure pen should cause artists to take note.

Of the corded tablets, the $895 12- by 18-inch Houston Instrument HIPAD Plus 9018 scores high marks for its excellent resolution (2,540 lines per inch) and data transfer speed (38,400 bits per second).

The $599 Summagraphics SummaSketch II remains the quintessential general purpose tablet for all-around use. It is light and complete, and as the de facto industry standard, it's compatible with more application software than any other tablet. Keep in mind that several of the tablets evaluated here are outstanding for specialized applications but are less effective as general-purpose instruments. The Scriptel RDT glass tablet is a good example.

INSTALLATION

Installation of the Wacom tablets at first appears confusing because of three banks of DIP switches on the rear panel of each tablet. For the most part, these switches establish communication parameters for the tablet's serial port. On the positive side, the function of each switch is well documented, and no adjustment is likely to be needed for normal operation. The switches become bothersome, however, when you want to change emulation modes. Each of the three modes requires slightly different switch settings.

Software installation for normal operation is minimal. A test program verifies the correct operation of the tablet electronics (although at the time of evaluation, the Compaq Deskpro 386/25 test-bed found some timing problems in the software that resulted in nonexistent errors being reported). The only additional step is to select an emulation using the WMODE program. Summagraphics Bit Pad II, MM1201, or Wacom II command sets can be selected with command-line options.

Drivers are provided to allow the Wacom tablets to emulate the Microsoft Mouse for use with *Windows/286* or *GEM*. At the time of evaluation, no software for *Windows/386* was available, although Wacom believes it will be able to offer it by the time this article appears. An *AutoCAD* ADI driver is also supplied.

Cordless operation alone is enough to recommend the Wacom system. But even if cordlessness doesn't matter to you, the optional tablet surfaces make the Wacom tablets desirable. For drawing programs, the pressure pens are unmatched, approached only by Numonics' ZedPEN and CalComp's DrawingBoard 2300 with its optional external box (neither of which, of course, is cordless). The only drawback to the Wacom system is the weight of the tablets themselves. If you're looking for a tablet that will stay in place on your desk and give you the freedom to work the way you want to, you'll want a Wacom. For the most convenience, the Wacom SD-421L, which keeps your paper in place, is the pick of the litter. ■

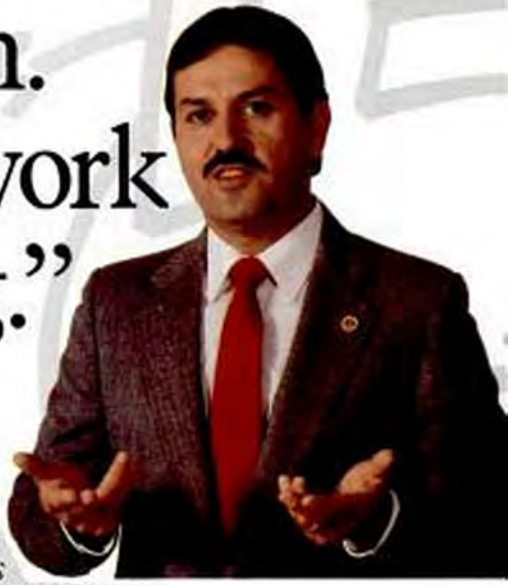
Frank Bican and Winn L. Rosch are contributing editors of PC Magazine.

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* EDITOR'S CHOICE 9/15/86



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CIRCLE 281 ON READER SERVICE CARD

BUILDING WORKGROUP SOLUTIONS

LAN Management Systems

Every good LAN deserves quality management and monitoring facilities. One possible solution: a sophisticated network management and control package from Cabletron Systems, Proteon, or Synoptics Communications.

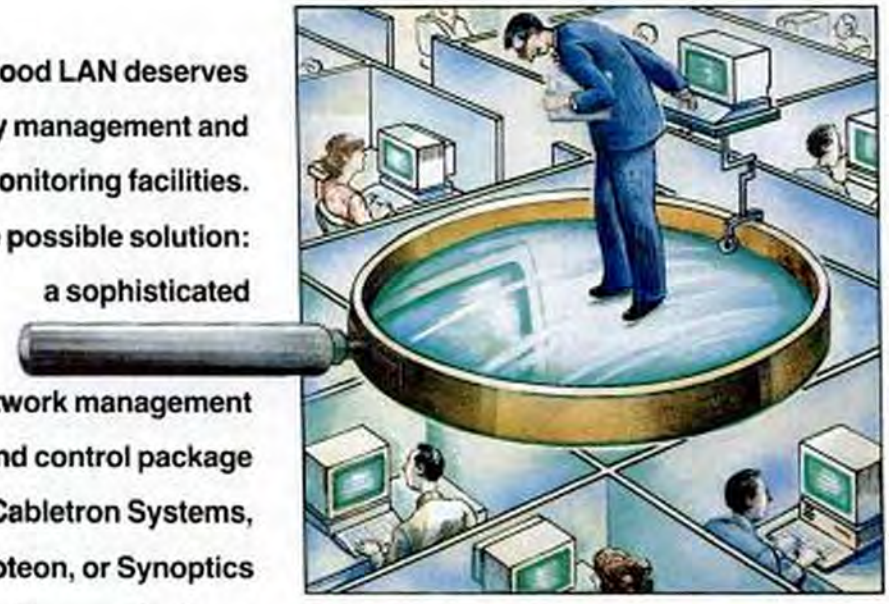


ILLUSTRATION: TOM LULEVITCH

by Frank J. Derfler, Jr.

LAN management systems hold a special place in the world of networking software. Unlike the accounting, database, e-mail, and workgroup productivity packages reviewed in this issue, these products are designed only for the network manager. None of these systems sends communications across a network, and one of the products doesn't even have to run on a PC. Their function is to provide the manager with a great deal of control over network activity by gathering data from special wiring hubs at the geographic center of the LAN.

The field of network management systems is confusing, primarily because network control and reporting take place at so many levels. There is a hierarchy of devices and programs at several levels reporting status and problems upstream to an overall data-gathering and reporting system.

The lowest level of network reporting devices consists of hardware with internal microprocessors and programming.

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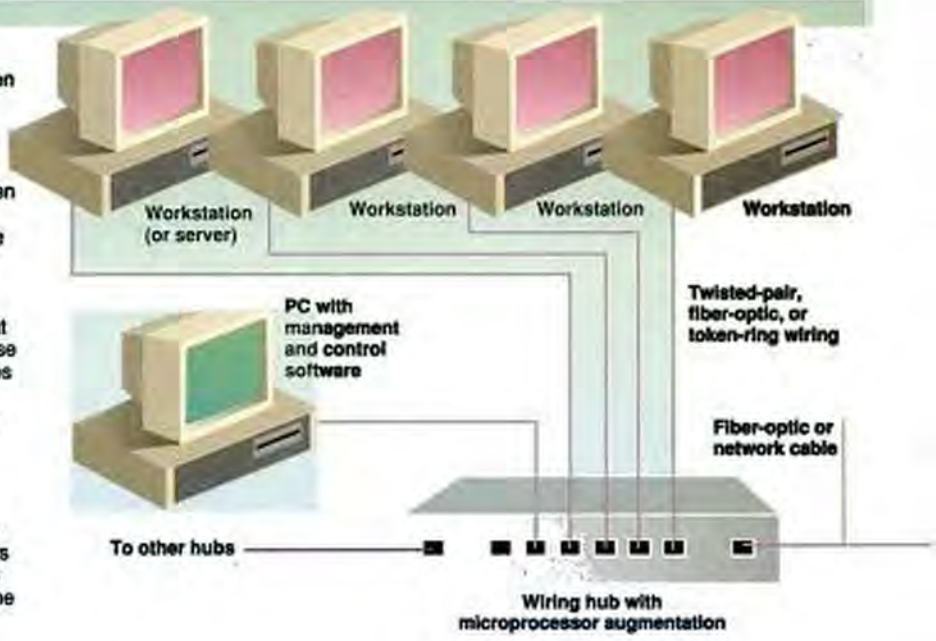
HOW LAN MANAGEMENT SYSTEMS GATHER INFORMATION

Each PC in this generic network has a direct link to a wiring hub. The link between the PCs and the hubs is made over twisted-pair, token-ring, or fiber-optic cabling—whatever is appropriate to the network adapter cards and connection modules in the hubs. Connections between the hubs might be made by fiber-optic cable to increase the permissible distance and reliability, regardless of the type of cable used between the hubs and PCs.

Each hub contains an internal microprocessor, along with a program that gathers data on network traffic and can use the hub's components to disconnect nodes under certain conditions.

Some systems transmit management data between hubs using the network wiring. Other systems use a separate wiring path, or modems, as a means of connection between the hubs.

A specific PC on the network runs the reporting and control software that gathers information from the wiring hubs. This PC can communicate with all hubs, not just the one to which it is attached.



These devices include LAN wiring hubs, bridges, multiplexors, microwave radios, and modems. Their internal processors and programs gather statistical information and send out status reports to some intermediate level of software, usually running on a PC. If the network is not large and is composed of relatively homogeneous parts, these systems might provide all the analysis a manager needs.

The LAN operating systems in printer and file servers can also send alerts and notifications to higher-level management programs. At the highest level, management and control programs will accept alarms from any reporting device that can send them along in the right format; for instance, application programs can complain to management programs about files that they can't find or access. The reports from all these levels of hardware and software must be in some common format so that one top-level system can compile them and present them to users.

There are competing grand architectures for network management and control, marketed by companies such as IBM, DEC, Hewlett-Packard, and AT&T. At the same time, there is an attempt to standardize network management protocols and procedures within the International Standards Organization itself.

This review concentrates on the lowest-level smart reporting devices and the programs that gather their reports. Though these systems reside on the lowest level of the stack, they provide a great deal of information. These packages are uniquely independent of the LAN operating system software and soon will fit into most of the grand management-architecture schemes. If LAN control and management are important to you now, or if they will be in the next few years, you should invest at this level first. It's one LAN decision that you have to make early.

ALARMS AND ACRONYMS

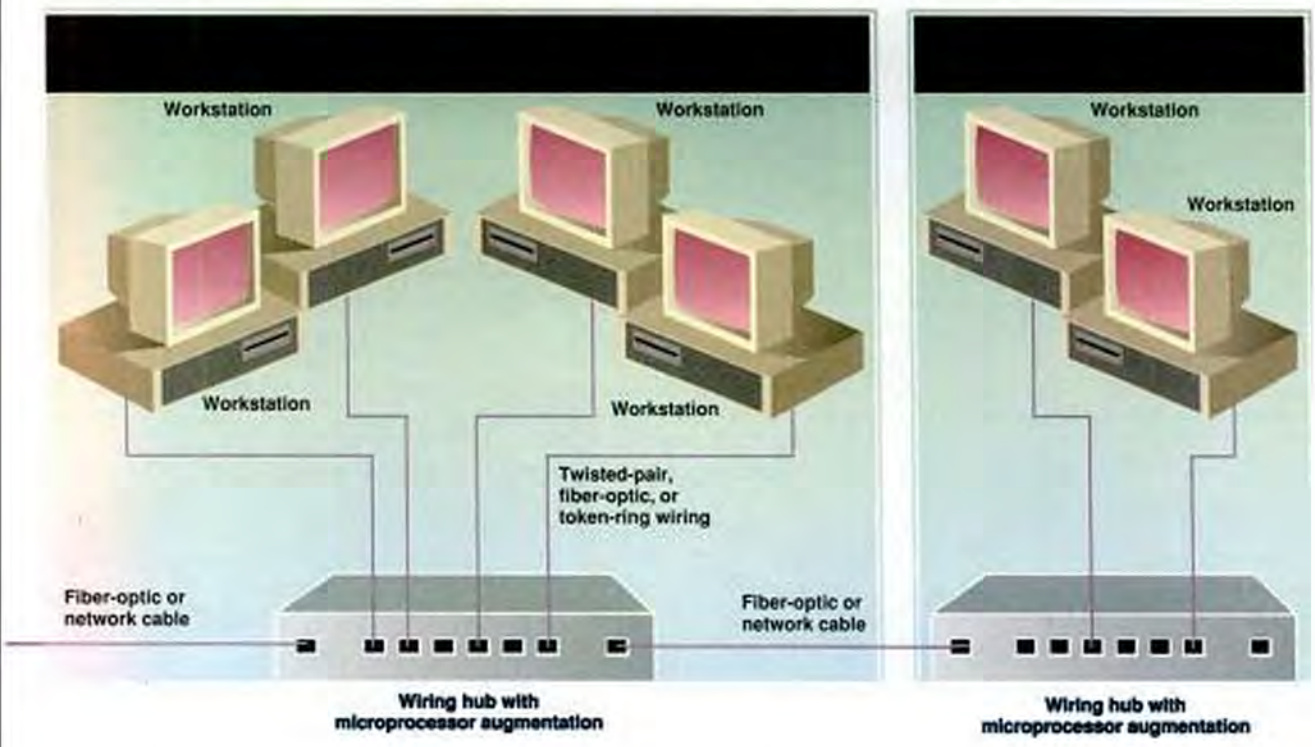
The whole network management and control industry has one common trait: reliance on the principle of performance alarms. When you use alarms, you're instructing the software to call your attention to any abnormal event. It's up to you to define the limits of abnormality—more than 30 consecutive Ethernet packet collisions, for example, or an unusually small or large number of packets sent within a specified period of time. The network management and control software packages' responses to alarm situations range from silently logging the event to frantically flashing symbols on the screen and beeping while sending error messages to a printer.

Of course, a blizzard of inevitably complicated acronyms surrounds the highest level of network management architecture. Picture these architectures as the underlying scheme you might use to plan a network management control center that looks like a small version of NASA's Mission Control. These architectures are particularly suited to big networks, which might need the higher level of reporting and the increased detail they can provide. However, big networks are made up of a lot of little networks with many nodes—most of them PCs. Each of the nodes in all of the little networks has to report to the big system. Like so many other things in the PC arena, there are several solutions: the ideal for which everyone hopes, a system that is working today in government and university networks, and IBM's own unique approach.

ALL ABOUT ISO CMIP

The management structure that everyone is hoping for comes in the form of an emerging open architecture called the Common Management Information Protocol, or CMIP (pronounced see-mip). The International Standards Organization (ISO) is cur-

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rently working on the CMIP proposal. Major companies such as Digital Equipment Corp., AT&T, Hewlett-Packard, and Northern Telecom say that they will release network products that follow the established CMIP protocols.

The ISO draft standard primarily defines the functions of network management software and explains how reports are formatted and transmitted. The standard also describes the format of the messages sent to devices trying to correct or isolate error conditions. The functions that the ISO model defines include the following types of network management: fault, configuration, performance, security, and accounting. The other models described below agree with these definitions in general terms.

Fault management includes detecting problems and taking steps to isolate them. Configuration management provides messages to describe active connections and equipment. It is closely tied to fault management, because the primary way to isolate network faults is to change configurations. Performance management includes counting things like packets, disk-access requests, and the number of times specific programs are used. Security management involves alerting managers to unauthorized access attempts at the cable, network, file server, and resource levels. Accounting management involves billing users for the applications and data that they access.

The announcements from Digital Equipment Corp. bill the company's planned CMIP-compatible network management system as the Enterprise Management Architecture. AT&T calls its system the Unified Network Management Architecture (UNMA). The first product released under AT&T's UNMA, and the first real CMIP product on the market, is the Accumaster Integrator.

CMIP is a great idea, but the protocol is still evolving. It will be a year or more before many practical products that support it hit the market.

IN THE MEANTIME

Since the need for a LAN control and reporting system has existed for a number of years, people have solved the problem in several ways. The control and reporting system used on-line today in many major networks is called the Simple Network Management Protocol (SNMP). SNMP was developed and is used by the same Federal government and university community that brought out TCP/IP and its suite of protocols (see "Building Workgroup Solutions: TCP/IP for Multiplatform Networking," *PC Magazine*, June 27, 1989). SNMP works well in the large defense and commercial networks that use TCP/IP, and there are plans to evolve SNMP products into CMIP products. Proteon, whose *TokenVIEW-4* product is reviewed here, also markets *OverVIEW*, a high-level data-gathering network management system for MS-DOS that gathers SNMP reports.

IBM's unique network management products debuted in early 1986. The overall system is called NetView, and the architecture relies on PCs running *NetView/PC* software to gather data on the network and to report to the *NetView* program running on a mainframe. Perhaps because the first version of *NetView/PC* required that a computer be dedicated to reporting on every network, or perhaps because NetView itself requires considerable mainframe resources, *NetView/PC* did not capture a large part of the market. IBM now markets a version of the *NetView/PC* software that requires OS/2 and that can collect data from several networks. IBM has also announced plans to evolve NetView to comply with CMIP sometime in the 1990s.

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BACK DOWN TO EARTH

Since most people don't need a network management system that NASA could use to control deep-space probes, we have excluded such systems from our review. We have also bypassed the statistical and security-related network management utilities contained in network operating systems like Novell's *NetWare* and Banyan's *VINES;* these utilities don't tell you much about the activities of remote printers, communications gateways, mail servers, database servers, routers, and other devices on the LAN. If you want a full picture of the activity and health of a network, you have to go to the lowest common denominator: the physical layer of network cabling.

The products we've looked at rely on a centralized wiring hub to monitor and report on the status of network nodes. From its central vantage point, a wiring hub sees every node and can measure the number and quality of packets that the node sends. The on-board processors in these hubs work with software running in a PC to report on and control—mainly by disconnecting—all network nodes. Although our tests showed that none of these programs were able to send alerts to high-level programs, that capability should be available in the future.

For larger networks, the per-node cost of LAN management software is very small.

These packages use a variety of different wiring schemes. Proteon's system works only with Token-Ring networks. The products from Cabletron Systems and Synoptics Communications use twisted-pair or fiber-optic wiring, or a combination of the two. Synoptics plans to expand its system to include Token-Ring and thin Ethernet by late 1989. If you want to run similar software on a Macintosh, Farallon Computing of Berkeley, California, markets *TrafficWatch,* which reports on and manages networks using Apple's LocalTalk architecture.

As soon as we set up these systems in the PC LAN Labs, it became clear that Synoptics has everyone beat in the areas of user interface and flexibility. Although its lack of a Token-Ring connection provides Proteon with a clear lead in that area, Synoptics is trying to close the gap quickly. The Synoptics software we saw does not forward alarms to higher-level programs, but it should be compatible with IBM's NetView by this fall.

COST FACTORS

It is difficult to break down the added incremental cost for network management capabilities in these systems. If you use the wiring hubs (or "concentrators," as they are sometimes referred to) from these companies, the hardware will include major elements of the network management features. Additionally, while the initial cost for software and hardware is usually several thousand dollars, that single cost is amortized over all of the nodes you now have and those that you will add in the future. Since larger networks usually benefit most from network management and control, the per-node cost is typically very small.

By themselves, these products provide all of the network management and control that many organizations will ever need. But if you think your network will grow with multiple servers, gateways, bridges, and wide area connections, you'll soon find yourself thinking about adding more layers of reporting. Looking for CMIP or SNMP compatibility in all of your network components is a smart idea, but starting to install reporting and control now at the lowest hardware layer is no less crucial.

NETWORK MANAGEMENT: A Short Glossary

CMIP Common Management Information Protocol. A structure for formatting messages and for transmitting information between reporting devices and data-collection programs. Developed by the International Standards Organization and designated as ISO 9596.

Concentrator See *wiring hub.*

EMA Enterprise Management Architecture. Digital Equipment Corp.'s company-specific architecture conforming to ISO's CMIP.

FDDI Fiber Distributed Data Interface. A specification for fiber-optic networks operating at 100 megabits per second. FDDI uses wiring hubs, and the hubs are prime candidates for network monitoring and control devices.

IEEE 802.3 10Base-T An evolving IEEE standard describing 10Mb-per-second twisted-pair Ethernet wiring. This wiring requires a wiring hub and is useful for installing network monitoring and control devices.

NetView IBM's company-specific network management and control architecture. This architecture relies heavily on mainframe data-collection programs but also incorporates PC-level products running under OS/2.

ONMS Open Network Management System. Digital Communications Associates' company-specific architecture conforming to ISO's CMIP.

OverVIEW Proteon's company-specific architecture conforming to SNMP.

SNMP Simple Network Management Protocol. A structure for formatting messages and for transmitting information between reporting devices and data-collection programs. Developed in collaboration by the Department of Defense, industry, and the academic community.

Token-Ring A wiring and signaling scheme sponsored by IBM and adopted by the IEEE as its specification 802.5. Token-Ring uses wiring hubs that serve as logical points for centralized management. IBM does not implement management and control through these hubs, but Proteon does through its ProNET-4 product line.

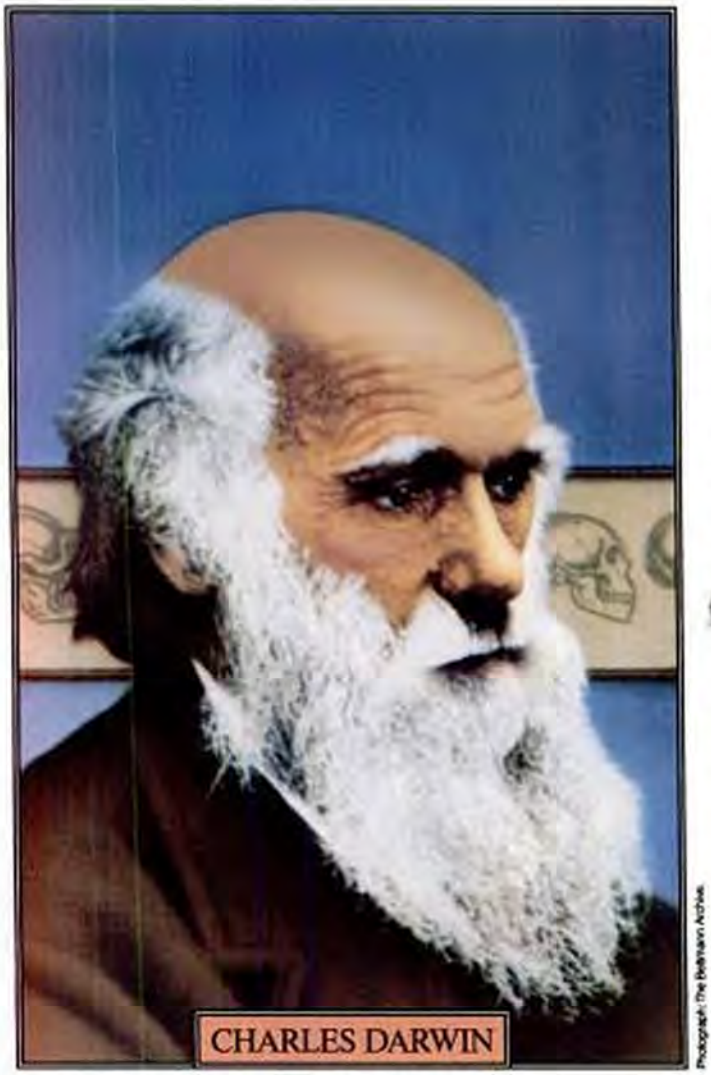
Twisted-pair Ethernet See *IEEE 802.3 10Base-T.*

UNMA Unified Network Management Architecture. AT&T's company-specific architecture conforming to ISO's CMIP.

Wiring hub A cabinet, usually mounted in a wiring closet, that holds connection modules for various kinds of cabling. The hub contains electronic circuits that retime and repeat the signals on the cable. The hub may also contain a microprocessor board that monitors and reports network activity.■

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We Redefined The Evolution Of 2400 bps Dial-Up Modem Performance.



Photograph: The Bettmann Archive.

Charles Robert Darwin, English naturalist, 1809-1882. His books *On the Origin of Species* and *The Descent of Man* established the principle of natural selection, and became the foundation of evolutionary theory for the next 100 years.

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Racal-Vadic's 2400VP set new standards for dial-up performance and reliability. Standards so high that PC Magazine naturally selected the 2400VP as **Editor's Choice.** InfoWorld agreed: "Considering its reliability, features, and performance, the 2400VP is our 2400 bps modem of choice." Byte adds, "The Racal-Vadic 2400VP boasts the best signal-to-noise ratio."

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G/X25 Gateway is a high-speed multiuser LAN gateway providing information sharing with remote mainframes, minicomputers, service bureaus, or remote X.25 PCs. The gateway also features 20 different terminal emulators.

G/Async Gateway provides multiuser asynchronous connections between a NetWare-based LAN and remote asynchronous devices. G/Async Gateway features support for up to 15 of the most popular asynchronous terminal emulation packages.

G/SNA Gateway is a multiuser LAN-to-IBM mainframe link. It features both 3270 and 3770 emulation, so network users can quickly and efficiently execute on-line inquiry and batch processing with the SNA mainframe.

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CIRCLE 146 ON READER SERVICE CARD

LattisNet Network Management System

Synoptics Communications has put a lot of effort into the development of LattisNet, a family of LAN connection devices that uses twisted-pair wiring or fiber-optic cabling and operates at 10 megabits per second. Along with AT&T, Hewlett-Packard, and other companies, Synoptics is in the forefront of the IEEE's work to develop the 10Base-T standard for fast twisted-pair networks.

LattisNet is a success in the market, with over 150,000 nodes installed in the last 2 years. One appeal of LattisNet is the detailed management and reporting capability provided in the *LattisNet Network Management System (LNMS)*. The *LNMS* runs in one dedicated PC under *Microsoft Windows* and receives status and performance data from several different models of network hubs, called concentrators. (Under a plan Synoptics calls the Network Utility Architecture, 4- and 16Mb Token-Ring connections and thin Ethernet connections will be added to the LattisNet product line late this year. The management software to report on and control these connection schemes is scheduled for release in early 1990.)

LattisNet concentrators are composed of several pieces of hardware; Synoptics provides a choice of cabinets, each containing a different number of slots and the appropriate power supplies. A single System 3000 Network Concentrator can connect up to 132 nodes. Smaller units provide economical connections for department-size networks or subnetworks at a price of approximately $130 to $150 per node.

SLIDE-IN CONNECTIONS

Each concentrator cabinet accepts the same family of 10- by 14- by 2-inch slide-in modules that provide connections for the nodes over twisted-pair or fiber-optic cable. These slide-in modules connect and translate between the different wiring and signaling schemes so that network planners can mix and match media to make custom-tailored systems. In addition, each module in the LattisNet system has an array of status lights that gives a visual representation of the present activity. Similar modules will integrate thin Ethernet cable into LattisNet concentrators by the end of the year. Connections for the 100Mb-per-second FDDI (Fiber Digital Data Interface) are planned for early 1990.

The heart of the LattisNet system is a device called the Network Management Module, which works in a concentrator and carries its own 80186 processor. The processor gathers data and sends packets to the board and to software running in the system management PC. Because the concentrator using the Network Management Module must maintain a connection to other concentrators and to the PC running *LNMS* when the network is down, the Network Management Module can also call the PC and other concentrators over a modem. You can buy the Network Management Module with either a built-in internal modem or with an RS-232 port for an external modem.

SCREEN GEMS

The display screen of the system management PC is certain to become a must-see stop on every VIP tour of your facility. Even if people don't understand the details of what they are looking at, the *LNMS* screens are impressive.

What's more, for the network manager and troubleshooter, the *LNMS* screens are valuable tools. The primary system display shows a diagram of the network; it portrays each LattisNet concentrator and every module and connection in it. The program doesn't even require that you enter the details of the network into a database to build the diagram. The software uses the network to interrogate each concentrator, gather its status on a second-by-second basis, and create the screen presentation from that current information base. If a person doing repairs on a concentrator across the campus changes a module or

FACT FILE
EDITOR'S CHOICE

LattisNet Network Management System
Synoptics Communications Inc., 501 E. Middlefield Rd., Mountain View, CA 94043; (800) USA-8023, (415) 691-1100.
List Price: Console Control Adapter (hardware and software), $4,195; transceiver, $155; network interface cards using LattisNet on-board transceiver chip, $395–$995.
Requires: 512K RAM, IBM PC AT or compatible, *Microsoft Windows 286* or *Windows 386*, Synoptics System 3000 Network Concentrator, DOS 3.1 or later.
In Short: The Synoptics Communications system delivers spectacular screen displays and detailed analysis of network activity. The software is integrated with the LattisNet hardware, but LattisNet offers twisted-pair and fiber-optic connections today and will include Token-Ring, thin Ethernet, and FDDI in the coming months.

CIRCLE 404 ON READER SERVICE CARD



With over 150,000 nodes installed in the last two years, LattisNet owes much of its success to impressive screens, intelligent troubleshooting, and a clear and flexible path for growth, all for about $130 to $150 per node.

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What better way to run Novell's 386 NetWare.

Novell's new 386 NetWare® will do for networking what gunpowder did for negotiating leverage. Provided you've got a 386 machine that's designed to be 100 percent compatible with it.

Not to worry.

Samsung's LAN hardware was co-designed by Novell.® Which should put any compatibility concerns to rest. That's why the Samsung/Novell co-label is on our 386AE Fileserver and our PCterminal/286 LAN workstation.



NETWORKING vs. NOTWORKING.

Both the Samsung 386AE and PCterminal/286 have been tested exhaustively by Novell for compatibility with popular networking hardware and NetWare products. In fact, no other LAN hardware has ever undergone such extensive testing.

But then Samsung and Novell didn't set out to design just another make-do desktop computer.

Samsung's 386AE Fileserver, for example, was designed from the bus up to be a high-performance fileserver, starting with its Novell-developed BIOS. It also sports eight expansion slots for the inevitable inventory of interface and controller cards. Plus an oversize power supply capable of driving the requisite 100 megabyte-plus hard disk, tape backup system, etc. And it includes 4 megabytes of high-speed RAM for disk caching.

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To maintain NetWare compatibility throughout

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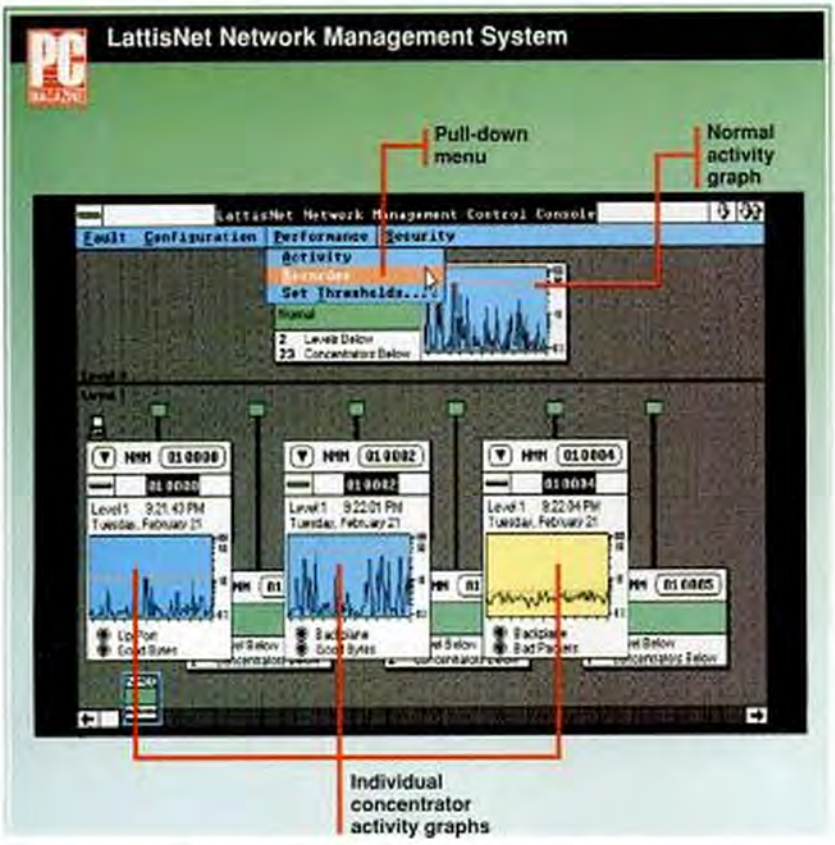


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The main screen of Synoptics Communications' *LattisNet Network Management System* includes a histogram depicting activity through a concentrator and icons showing the attached concentrators. Pull-down menus provide a way to call for more detailed information on any concentrator—or on any node attached to one.

disconnects a cable to one node, you will see the change on-screen within 5 seconds. To add English names to each node, you can supplement the database the program creates, but the program does most of the real work.

An eye-catching part of the screen presentation is a histogram showing activities going through each concentrator. This marching display is particularly useful for pinpointing very busy sections of the network that may need more connections or an intelligent bridge to isolate them from the rest of the LAN.

While the histogram is intriguing, other screens are spectacular. If you use a mouse or the keyboard to place the cursor over a particular concentrator on the on-screen diagram of the network and then select it, a complete diagram of the concentrator with all its modules is created, including a second-by-second update of the status lights on each module. If you make a similar cursor choice on a single port of the concentrator, you can select displays showing the number of good, misaligned, undersized, late, and colliding packets. You can display the activity of several nodes at the same time, so you can do sophisticated things like checking the flow of data between a workstation and a gateway.

LONG-TERM ANALYSIS

The screen display gives you a very complete picture of the present status of the network and its subelements. For longer-term analysis, *LNMS* provides the ability to collect raw statistical data as well as the programming necessary to create a predefined series of reports. The reports include half a dozen pie and bar charts showing performance and out-of-tolerance operation. These reports are created as ASCII files so that you can pass them on to more-sophisticated database programs. Synoptics Communications also provides many standardized reports.

In the area of control, none of these media-level systems can do anything more than disconnect a node from the network, but *LNMS* at least gives you the option of doing so politely. You can disconnect a node after a notification message or without notification, or you can arrange for automatic disconnection if certain criteria—such as a dozen packet collisions in a row—are met.

> The media-level systems under review can disconnect a node. *LNMS* at least can do so politely.

The one area in which Synoptics does not lead the competition is upward reporting. Just like the other systems reviewed, Synoptics' software didn't report events to any of the higher-level connection programs. However, *LNMS* should be able to report to NetView by this fall. The company is also waiting for the final definition of the CMIP standard, which its product should support by early 1990.

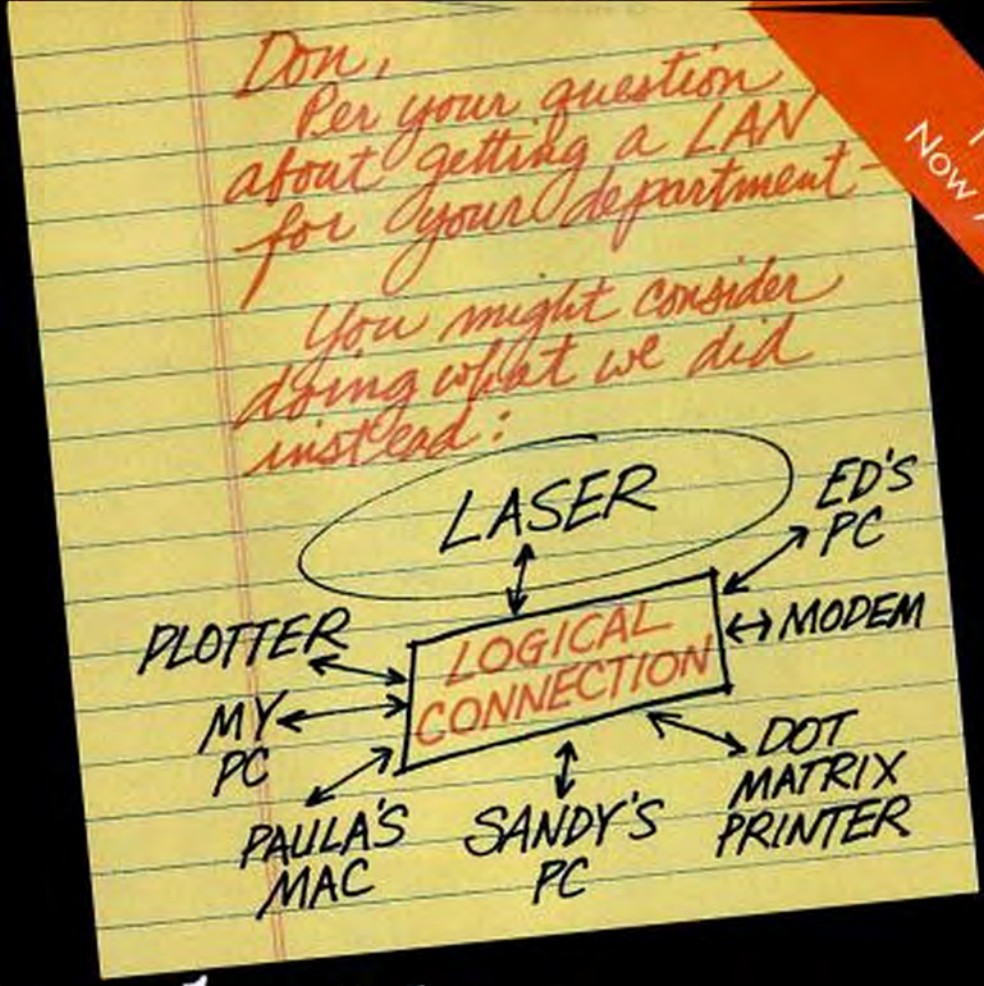
The Synoptics LattisNet architecture provides a clear and flexible path for growth. The software gives spectacular views of the network and the activity down to the level of each node. Synoptics has a strong base in *LNMS;* the product's evolution should be interesting to watch.

Remote LANView-PC

Remote LANView, from Cabletron Systems, is one of the few software products we have ever evaluated that doesn't have to run on or even directly connect to a PC. You can connect a terminal compatible with DEC's VT220 directly to Cabletron's MMAC (MultiMedia Access Center) and use the internal microprocessor and program in the MMAC to view and control

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PC MAGAZINE EDITORS' CHOICE 1/26/88

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And because of LANtastic's tiny RAM requirements, you can run its network operating system in base memory and still have plenty left over for your programs.

Best of all, the LANtastic Network Operating System is available with 2 Mbps adapters ($249/node), Ethernet adapters ($349/node), in a serial and parallel port version, and in an adapter-independent version that runs on other manufacturers' adapter cards.

PC MAGAZINE EDITOR'S CHOICE LANtastic March 29, 1988

No wonder PC Magazine gave their prestigious Editor's Choice Award to LANtastic over Novell ELS and TOPS. And Byte Magazine wrote: "LANtastic is . . . a lot of LAN bang for the buck."

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Cabletron Systems' *Remote LANView-PC* relies more on alarms than statistics to report on the status of network activity but will still provide many basic management and control functions at a low cost.

the activity of that hub. Of course, if you don't want to buy a DEC-compatible terminal, you *can* use a PC to control the activities of a single MMAC. However, if you want to monitor and control the activities of up to 40 MMACs in a network, you need to run Cabletron's $1,995 *Remote LANView-PC* software on a 286- or 386-based PC.

The Cabletron network system is designed around twisted-pair Ethernet cabling. This system, like Synoptics Communications' LattisNet, uses transceivers that attach to the rear of almost any Ethernet adapter and convert the standard Ethernet transceiver connection to twisted-pair. While you can use any one of the many types of PC Ethernet cards in the nodes, the computer running the *Remote LANView-PC* software must have a 3Com 3C503 EtherLink II adapter from 3Com Corp. installed. A hard disk is optional but recommended, and the machine should be equipped with 512K RAM and an EGA monitor.

The Cabletron architecture provides connections for both twisted-pair Ethernet and fiber-optic cables in the same concentrator. The company markets several different concentrators and connections modules so that you can create economical wiring schemes. The high-end MMAC 8 hosts up to 84 twisted-pair or fiber-optic connections. The MMAC 3 is sized for 24 such connections. The average price per connection is around $380, plus the cost of an Ethernet adapter card.

Cabletron's various concentrators and connectors let you create economical wiring schemes.

The screens created by *LANView-PC* are tabular instead of graphic, probably because Cabletron Systems' designers are oriented toward mainframe computers and attached terminals. The screens show an efficient set of yes/no options and parameters, but they are a far cry from Synoptics' spectacular displays.

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ANALYZERS VS. MANAGERS: An Important Distinction

by Frank J. Derfler, Jr.

Some people think of protocol analyzers, like Network General's well-known *Sniffer*, as LAN management systems. However, *PC Magazine* classifies these devices as tools for system developers, not LAN managers. Protocol analyzers that capture and decode packets provide some of the same information available through management and control systems, but you have to work much harder to get that information *and* you lack the big-picture view that you get with management and control systems. In addition, since the management and control systems that operate at the network cable level don't decode packets, they present no risk to the security of data or passwords.

Protocol analyzers have a role in organizations where users develop sophisticated software and network hardware, but management and control systems have a role in almost every network. People who use protocol analyzers in place of network management and control systems are using a telescope to view a football game from the sidelines. They can read the quarterback's lips, but they miss a lot of the action. ■

ETHERNET COMMUNICATION

The processors in the MMACs and the monitoring PCs communicate over Ethernet. In the event that the main cable should fail, there is no backup connection mode available. *Remote LANView-PC* polls the MMACs according to their Ethernet node addresses and, depending on the network activity, can take 20 to 30 seconds or more to query an MMAC and retrieve the current data.

In contrast to the other programs we reviewed, *Remote LANView-PC* relies more on alarms than on statistics. While Proteon's *TokenVIEW-4* and Synoptics's *LNMS* give you some idea of the activity level and operational status of the network in real time, *Remote LANView-PC* focuses more on reporting by exception. You manage the network on an MMAC-by-MMAC basis; there is no way—except through an after-the-fact analysis of log records—to see an overview of network status and activity.

The software would be improved if it could better differentiate among the types of events that fall into the error category. The error-packet count can result from a number of things, such as collisions and undersized or oversized packets. It isn't extremely difficult to offer such differentiation, and a manager would certainly benefit from knowing whether a problem is the result of a collision or of a less common event.

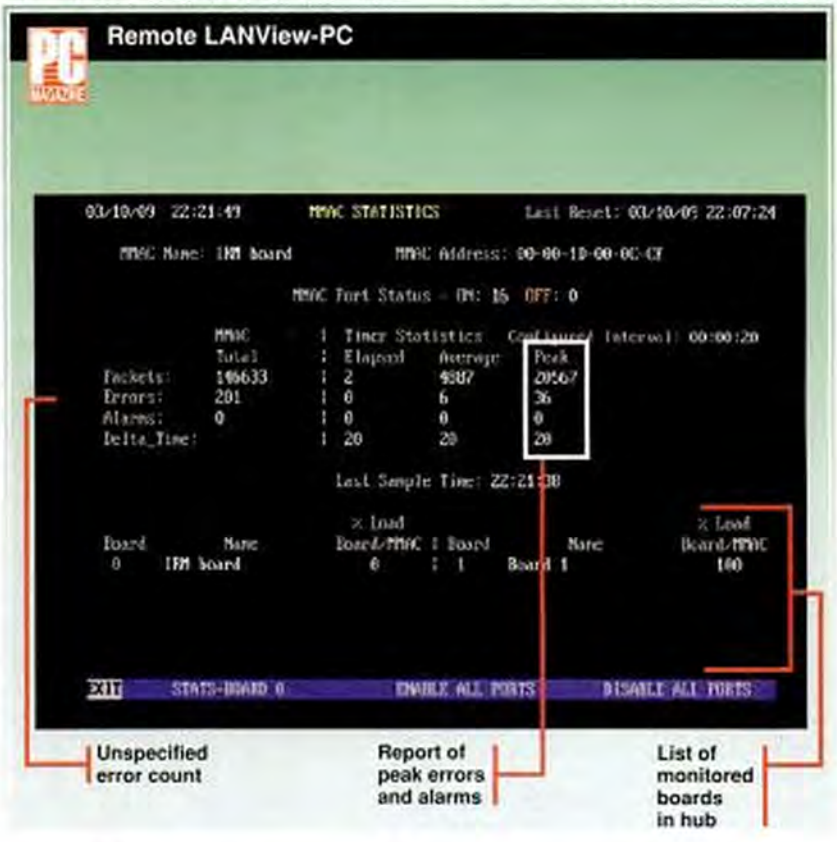
On the positive side, it doesn't take much work to set up *Remote LANView-PC*. You use a single menu to establish parameters, such as how often you want the PC to update its status and how many times it should retry failed network connections. On the negative side, the primary output of this system is an ASCII log file; the program doesn't provide a way to create specialized reports from the data in the file.

Remote LANView-PC satisfies the need

FACT FILE

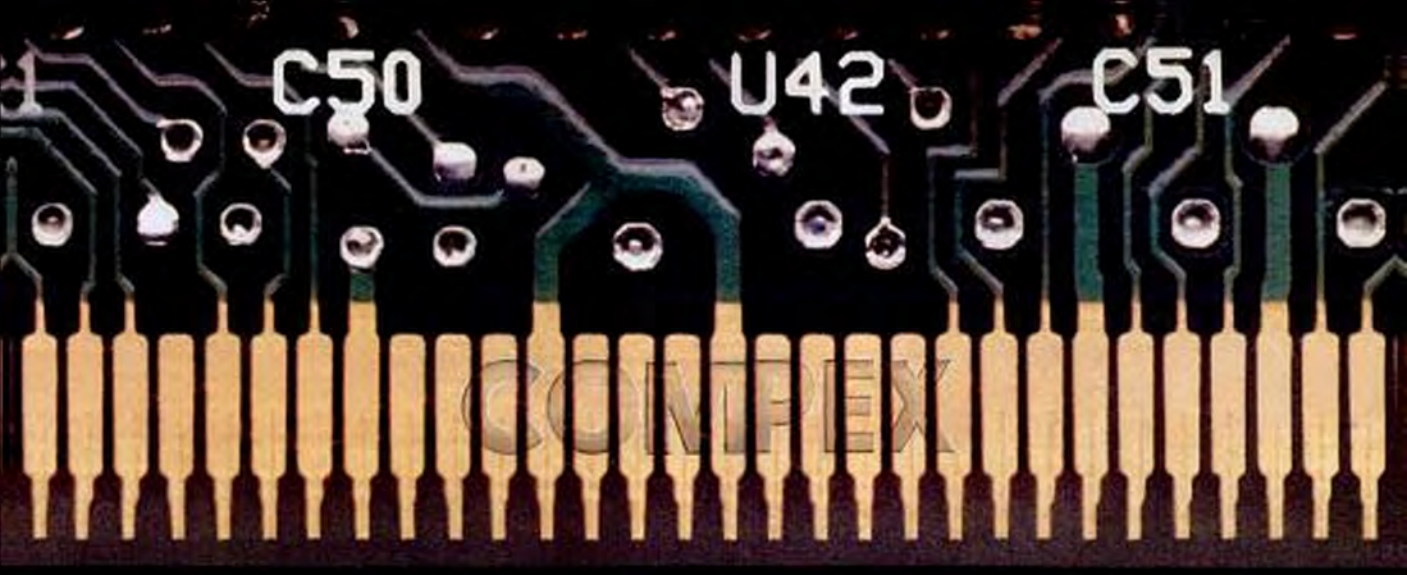
Remote LANView-PC
Cabletron Systems, 10 Main St., Rochester, NH 03867; (603) 332-9400.
List Price: $1,995
Requires: 512K RAM, IBM PC AT or compatible, EGA video adapter, 3Com Corp.'s 3C503 EtherLink II adapter, DOS 3.1 or later.
In Short: A LAN management system with mainframe-system flavor. You can control and receive reports from up to 40 access centers, but the software lacks an overview of the network.

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This *Remote LANView-PC* screen shows statistics for a specific port on a Cabletron Multi Media Access Center (MMAC) in a tabular rather than graphic format. Statistics and alarms are shown on the same screen.

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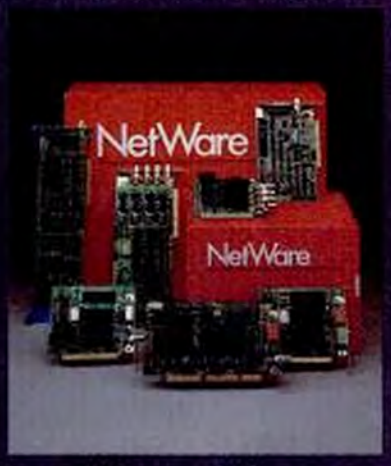
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PC WEEK "For the first time, one product outranked its competitors in every product attribute surveyed." March 27, 1989

PC MAGAZINE "...the impressively fast MaynStream would be an excellent choice for backing up your data." May 31, 1988

PC WORLD "PC World tested four tape backup units and tagged Maynard Electronics' as the best backup system based on a combination of speed, convenience, and value...one year later (it) performs just as quickly and efficiently..." September 1987

TECH PC "...a top quality package that offers a clean software interface along with good performance..." April 1989

INFO WORLD "...not only the fastest and quietest of the entire group, it's less expensive... On the test bench, (it) ran like Secretariat." August 3, 1987

LAN "Maynard...excels with its MaynStream backup software." September, 1987

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for basic management and control functions in twisted-pair and fiber-optic networks. Its ability to attach a low-cost terminal to a wiring hub and get full network control without dedicating a PC to the task will appeal to many cost-conscious LAN managers.

TokenVIEW-4

Network management and control tools are nice to have in Ethernet networks, but they are almost a necessity for large Token-Ring networks. Ethernet stations are like independent radio transmitters and receivers: if one station fails, it seldom disrupts the entire network. Each active Token-Ring node, however, is a critical part of the network: if one adapter board loses the ability to receive or retransmit tokens, the entire ring fails. Either you walk down the hall to a wiring closet and unplug nodes one by one until the network comes back to life, or you purchase Proteon's *TokenVIEW-4* software, sit back, survey the network on a screen, and take fault-isolation actions with a mouse.

TokenVIEW-4 is a renamed version of the company's original *Advanced Network Manager* software. *Advanced Network Manager* was one of the first media-level management and control systems available for PC-based networks. The current version works with Proteon's ProNET-4 network hardware, which is compatible with IBM's Token-Ring hardware; if you manage a pure Token-Ring installation, this product is a powerful tool. You can use Token-Ring cards from any vendor (including IBM, 3Com, Madge, and Racore) in the network nodes, along with the ProNET-4 wiring hubs, to take full advantage of the management system.

The ProNET-4 p2710 Intelligent Wire Center follows the IBM pattern of providing connections for eight nodes in each hub. Each processor-equipped wire center retails for $995, but it can collect data from and manage other $895 Proteon wire centers that lack full microprocessor augmentation. The *TokenVIEW-4* software package sells for $1,995. A complete network of over 24 nodes has a level price of approximately $200 per node, plus the cost of the adapter card in each node.

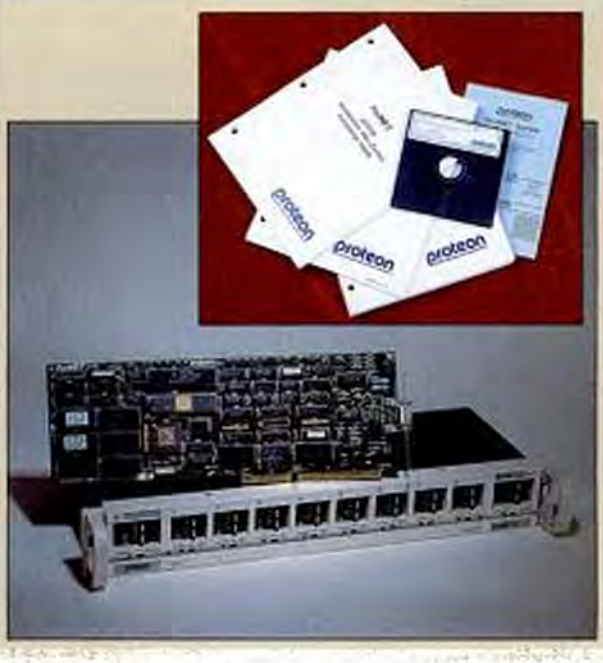
TokenVIEW-4 is a great application for an old XT-class machine—it can run on any PC with 160K of RAM, a hard disk, a serial port, and an EGA monitor. You also

NETWORK MANAGEMENT: SUMMARY OF FEATURES

(Products listed in alphabetical order)

	PC LattisNet Network Management System	Remote LANView-PC	PC TokenVIEW-4
NETWORK VIEW SHOWS:			
Pictorial diagram of network	●	○	○
Network status, good or bad	●	○	●
Peak load	●	●	○
Average load	●	●	○
Current load	●	●	○
Load information as a graph	●	○	○
WORKSTATION VIEW SHOWS:			
Events for individual nodes	●	●	●
Peak load	●	●	○
Average load	●	●	○
Current load	●	●	○
Load information as a graph	●	○	○
MISCELLANEOUS			
Displays traffic error rates	●	●	●
Sorts by error type	●	○	●
Administrator can limit access to authorized nodes	○	○	●
Preformatted reports are available within program	○	○	●

PC — Editor's Choice ● — Yes ○ — No



In a Token-Ring network, if one adapter fails, either you go to the wiring closet and unplug nodes one by one to find it or you buy *TokenVIEW-4*. The product can outfit a 24-node network—even one equipped with XTs—for about $200 per node.

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T300: *6.4 lbs, 4.77MHz 80C88, 512KB RAM expandable to 1.2MB. MS-DOS in ROM. 720KB 3½" diskette drive. Built-in RGB, parallel, serial and external drive ports.*



P341SL: Wide carriage (up to 270CPI.). 216/72 cps, advanced paper handling, 4 part forms.



T1200FB: 9.8 pounds, 9.54MHz 80C86, 1MB RAM. 2 720KB 3½" floppy drives, removable/ rechargeable battery pack.



ExpressWriter 301: 4 lbs, letter-quality 24-dot print head, 60 cps, Toshiba/Qume and Epson LQ emulations, 5 resident fonts.



T3300e: 12MHz 80286, internal IBM slot, 20MB hard disk, gas plasma display, 1MB RAM expands to 5MB, 1.44MB 3½" diskette drive.



T5100: 16MHz 80386 microprocessor, 40 or 100MB hard disk, 2MB RAM expandable to 4MB. 14.6 lbs. Built-in EGA display with high resolution gas plasma screen.



P351SX: 360/120 cps, 24-pin letter quality, color option. Toshiba/Qume and IBM emulations standard, Epson & Diablo emulations optional.

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great minds don't think alike.



T1600: 11.6 lbs. Battery-powered 12MHz 286, 20MB hard disk, 1.44MB floppy. 1MB RAM expands to 5MB, backlit EGA LCD, removable/rechargeable battery packs.



T5200: 20MHz 80386 processor, 2 internal IBM compatible expansion slots, 40 or 100MB hard disk, VGA display with external VGA monitor port, 2MB RAM expandable to 8MB.



T3200: 12MHz 286, 2 IBM compatible slots, 40MB hard disk, 1.44MB floppy, 1MB RAM expands to 4MB, EGA screen.



PageLaser6: 6 ppm, 512KB standard memory. Emulations: HP LaserJet Series II, IBM Proprinter XL24. 2 HP LaserJet compatible font slots, multiple purpose tray. 4,000 prints per month. 35 pounds.



ExpressWriter 321: 24-pin dot matrix, 180 cps draft/60 cps letter quality, 3 resident emulations (Toshiba/Qume, Epson LQ, IBM Proprinter), 16K buffer, 5 resident fonts plus card slots, 11 lbs.

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P321SL/SLC (color): 216/72 cps, 24-pin letter quality, up to 360 x 360 DPI graphics. Toshiba/Qume and IBM emulations standard, Epson and Diablo emulations optional. 32KB print buffer, front panel controls, advanced paper handling.

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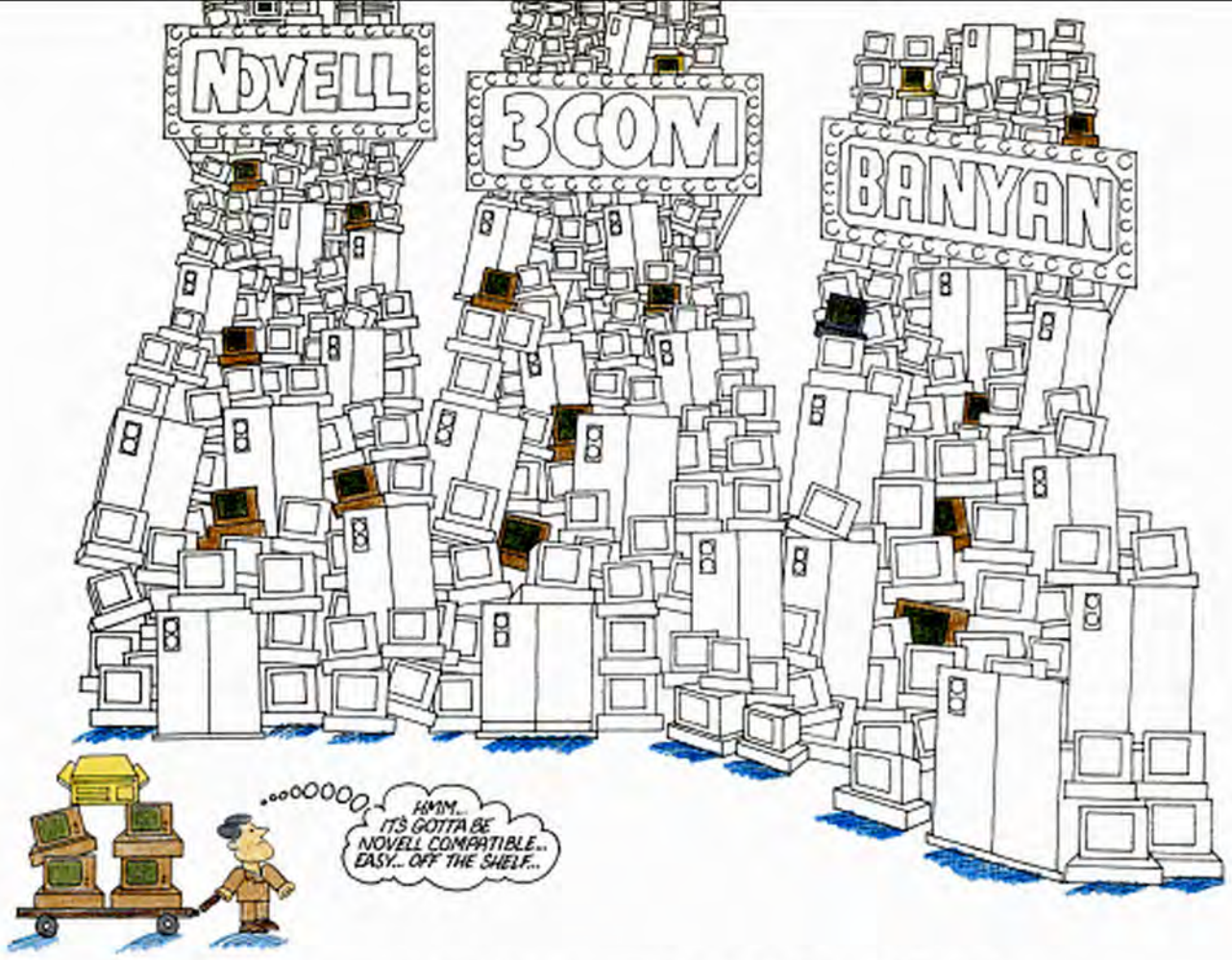
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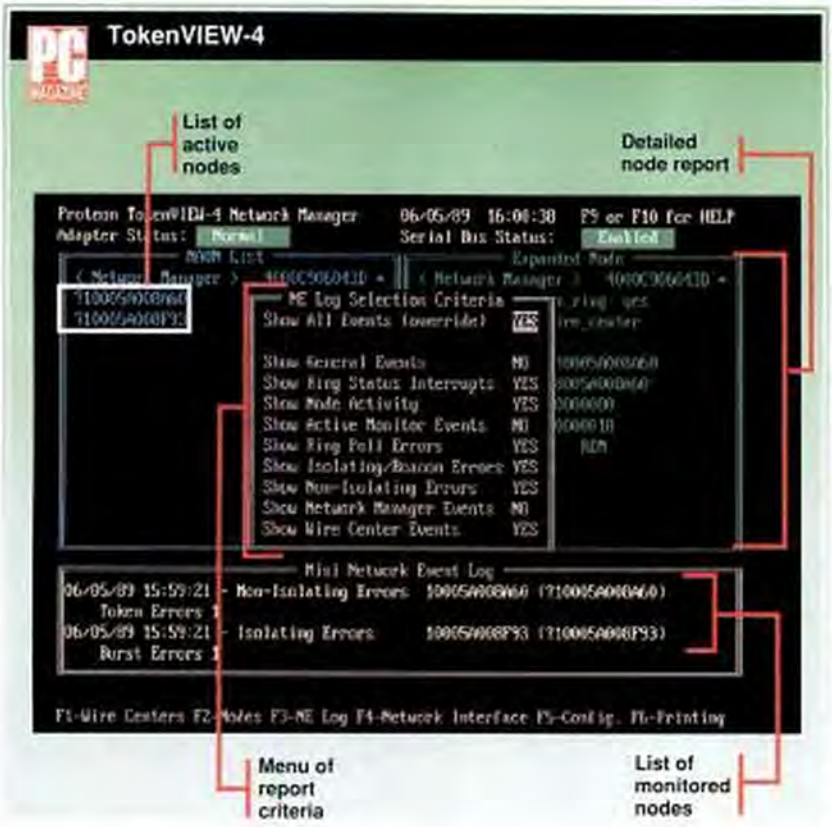
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Proteon's *TokenVIEW-4* software presents information in tabular format describing the activity of the Intelligent Wire Centers and their attached nodes.

The "mini event log" at the bottom of the screen keeps the network manager informed of selected network events.

need a Proteon ProNET-4 LAN adapter card in the PC; the card needs a special PROM (programmable ROM, included in the *TokenVIEW-4* package) to address the software.

If you run the ProNET-4 boards with standard IRQ and memory address settings, the task of installing the software consists of copying the files into the correct subdirectory. If you change the addressing of the ProNET-4 boards, then you will have to go through some menus to reconfigure *TokenVIEW-4*.

The computer running the network management and control software connects to the Intelligent Wire Centers through a separate twisted-pair cable. The twisted-pair wire runs in a daisy-chain to each Intelligent Wire Center and provides the communications path between the processors in the intelligent hubs. This network for the hubs gives the software a path to control the wire centers even if the Token-Ring network fails.

WHAT YOU SEE

The *TokenVIEW-4* screen displays aren't as striking as the ones created in Synoptics' *LNMS*, but they provide a good graphical picture of the wire centers and attached devices. The interface uses monochrome screens with pull-down windows and works well with a mouse or other pointing device.

You have to do a lot of database entry to set up the Proteon software, but it is automated enough to recognize new nodes and help with updates. *TokenVIEW-4* can also update itself with information about new Intelligent Wire Centers attached to the twisted-pair-wire bus—just go to the menu and select Look for New Wire Centers.

Because the token-passing activities in Token-Ring adapters are more complex than cable-sharing actions in Ethernet networks, Token-Ring adapters for PCs must have more on-board processing power than typical Ethernet adapters. They also pass along more information about the node's activities, as well as details such as the identity of the next node in the ring. This information becomes a valuable troubleshooting tool if the network dies, as *TokenVIEW-4* collects much of the data reported by the Token-Ring adapters and displays it on request.

SECURE AND ALERT

Proteon's software has better network security features than Synoptics' *LNMS*. *TokenVIEW-4* allows you to prohibit unknown nodes from entering the network. While it doesn't stop a technically sophisticated person from tapping the network to copy data flowing through it, it does prevent someone using a protocol analyzer from attaching to an open port and capturing passwords and data.

You can configure *TokenVIEW-4* to alert you, through the screen display, to a wide variety of events on the network. Proteon lists nine major categories of events, and each major category selection leads to other decisions about the levels or types of events to report. You can set alerts for token errors on the ring, the activity levels of certain nodes, and many other parameters. When the software detects an event you selected, it posts a notice on the screen and to an ASCII log file.

FACT FILE
EDITOR'S CHOICE

TokenVIEW-4
Proteon Inc., 2 Technology Dr., Westborough, MA 01581; (800) 545-RING, (508) 898-2800.
List Price: $1,995, including software and ROM for Proteon adapter card; Intelligent Wire Center, $995.
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In Short: *TokenVIEW-4* provides network managers with a comprehensive set of analysis and management tools for Token-Ring networks. You can use any of the several compatible Token-Ring adapters in the nodes, but the network must use Proteon's Intelligent Wire Centers. There is no reporting to SNMP or CMIP at present, but it is logical to assume that this program will accommodate one or both of these in the future.

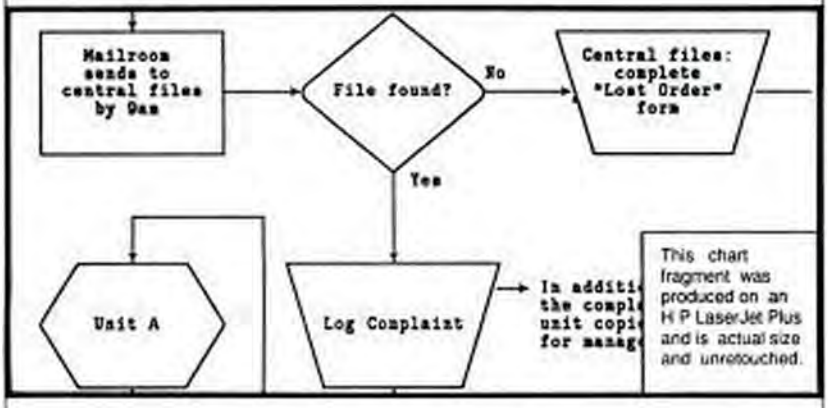
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EDITOR'S CHOICE

- **LattisNet Network Management System**
- **TokenVIEW-4**

We have made two recommendations in this area because of the differences between systems that work on Token-Ring networks and those that work on Ethernet-based networks.

If you are installing a Token-Ring system, we strongly recommend installing Proteon's ProNET-4 and *TokenVIEW-4* systems. It is likely that when Synoptics Communications integrates Token-Ring technology into its LattisNet system, Synoptics will give Proteon strong competition, but for now Proteon is the best.

In the overall area of management and control software, Synoptics' *LattisNet Network Management System* is certainly the leader. Its sound methods of analysis, impressive interfaces, and comprehensive approach to network analysis make it an easy choice.

The software gives you the tools to print out several instant status reports, but it doesn't provide capabilities to create reports from sorted log-file data. However, you can import the log-file data into almost any database program and create your own report formats.

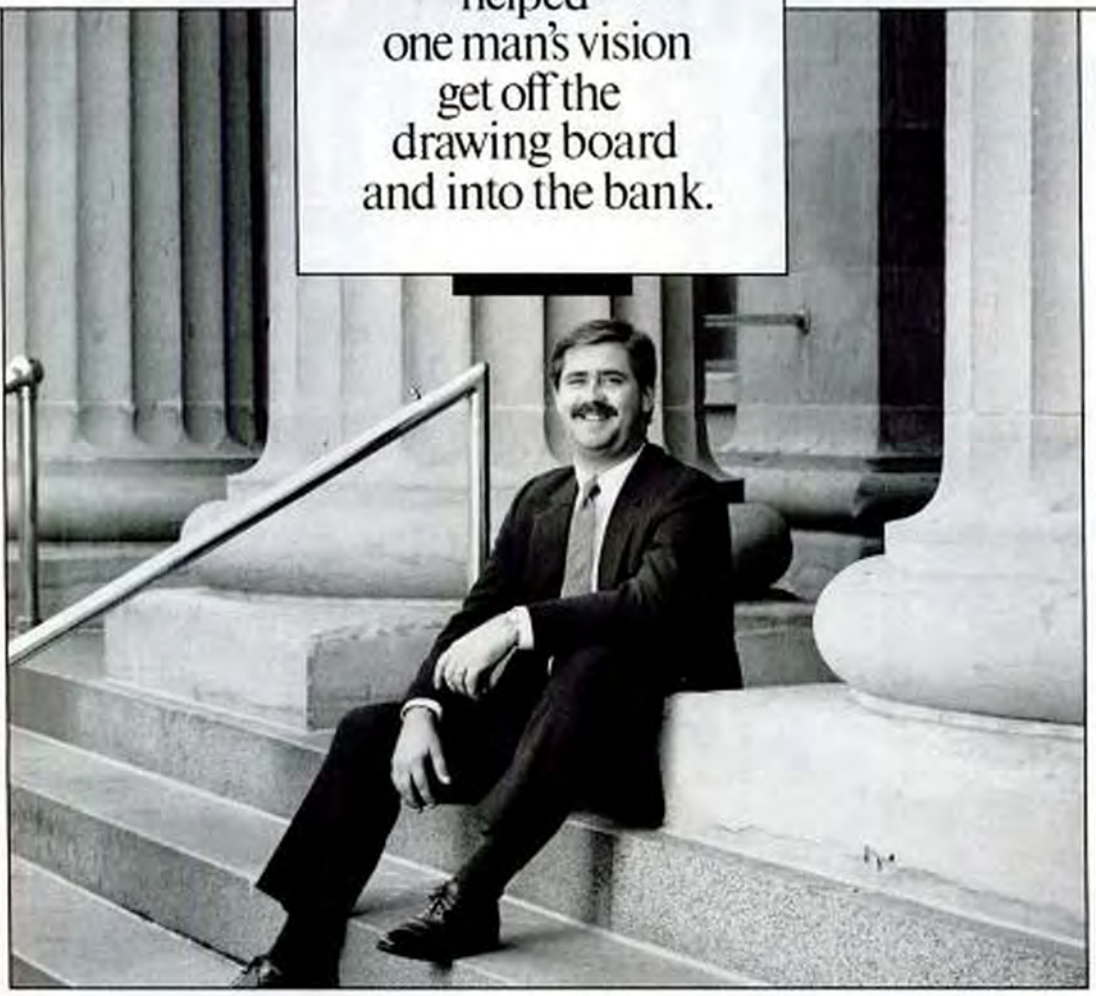
Proteon markets *OverVIEW*, a higher-level software package that accepts information in SNMP format. Marketing literature for *OverVIEW* also promises eventual CMIP compatibility. Proteon representatives wouldn't say when *TokenVIEW-4* would be compatible with *OverVIEW*, but the need for the connection is obvious. It is possible that, like everyone else, Proteon is waiting for the full CMIP specifications before choosing a development path.

Any network manager planning to install a new Token-Ring network or to expand on an old one will benefit from Proteon's Intelligent Wire Centers and *TokenVIEW-4* software. The system can provide faster recoveries and better management of shared resources than any other current Token-Ring alternative. ■

Frank J. Derfler, Jr., is workgroup systems editor of PC Magazine.

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CIRCLE 378 ON READER SERVICE CARD

by
Barry Simon

Lab Notes

Providing Program Access to the Real DOS Environment

■ If you follow the rules, the programs you write can change only a transient copy of the environment. Here's a programmers' guide to environmental outlawry.

Most PC users have learned how to use the PROMPT command to remove the humorous greeting the office wag stuck into their DOS environment, and nearly everyone with a hard disk has used the PATH command to tell DOS which subdirectories to search for executable programs and batch files.

Power users who have enough memory to make use of a RAMdisk often copy COMMAND.COM to it as part of their AUTOEXEC.BAT boot-up procedure, and use

```
SET COMSPEC=d:\COMMAND.COM
```

to speed the processes of "shelling out" to DOS from application programs and reloading the transient portion of COMMAND.COM when needed. As discussed in Richard Hale Shaw's two-part PC Lab Notes of March 31 and April 14, 1987, you can also use the SET command to insert strings into the environment from a batch file or from the DOS command line, so programs can access these user-defined strings.

Programmers, however, want to do more than simply customize the initial DOS environment variables. They'd like to give their programs control over the environment, letting them modify items such as the system path and prompt. Unfortunately, programs do not have such access to the active environment. But where there's a will there's a way, and the aim of this Lab Notes is to show you how to do it. Let's start by examining the relation between three distinct DOS "environments."

THE THREE ENVIRONMENTS

DOS keeps a block in memory, the Master Environment Block, in which it stores the the current path, prompt, comspec, and so forth. This memory area is also affected by SET commands issued from the DOS prompt or through batch files. I will call this the *real* or *active environment*. If you follow the rules, this area is not accessible to executing programs.

Before a program loads, COMMAND.COM passes a copy of the active environment to it. I will call this copy the *program environment*. A program is given the address of this second environment block in a word at offset 2C of the program's PSP (program segment prefix). Legally, the program can access only this copy of the real environment. Any changes a program makes in its program environment block are transitory, however; when the program exits, that block is freed up.

The third environment, which I'll call the *root environment*, is the environment of the *initial* DOS shell that is set up when the system boots. For most people, the root environment is and remains identical to the active environment. But if you shell out of a program or run *DESQview* or *Carousel*, or if you explicitly run a shell of COMMAND.COM, then the root environment will be different from the active environment.

The distinction is important because it is the active environment, rather than the root, that gets passed (as a copy) to a program and is also used by DOS for the prompt and path. It is the active rather than the root environment that you want your programs to be able to find and access.

One traditional "folk method" of locating the environment uses the fact that certain interrupts point to the sector containing COMMAND.COM. By examining these interrupts you find COMMAND.COM, which in turn leads you to its environment. Unfortunately, however, even if you ignore the possibility that some other program might have stolen the interrupt that you are examining, this method locates the *root* COMMAND.COM and hence the root environment rather than the active environment that is your goal.

To illustrate the method I use instead, I've written a Turbo Pascal program, FINDENV.PAS, which is listed in Figure 1. This program locates the active environment and computes both the amount of space being used and the amount of space that is still available in the block. The code shown here is from a shareware program called BATUTIL, which will be released shortly by my firm, CTRLALT Associates. This program makes extensive use of the real environment to store information. Although its output is admittedly not very visually stimulating, the information supplied by FINDENV.PAS will be of interest to the many DOS programmers.

One interesting thing that you can do, once you've gained access to the real environment, is to create longer paths. The only reason for the current 128-character limit (actually 123 since PATH= takes up 5 of the 128 characters) is that it's the maximum number of characters DOS allows

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on its command line. If you can get a longer path into the environment, DOS doesn't mind at all! As a test of this, I've been running with a path of 232 characters for a number of months, and DOS has had no problem with it. Over the course of running dozens of programs, I've seen only two that were troubled by it: Flambeaux Software's *Techhelp* and an old obsolete version of Phil Katz's *PKXARC*.

DOS VERSION VARIATIONS

With the introduction of DOS 3.1, it became possible to control the size of the root environment from a CONFIG.SYS command. Previous versions of DOS set a default environment size of 160 bytes. To set the size of the root environment under DOS 3.1 and later, you use an argument such as

```
shell=C:\command.com /E:xxx /P
```

where *xxx* is a decimal number that represents the number of 16-byte paragraphs to be assigned to the environment (that is, the size of the environment is 16 times the number *xxx*).

With DOS 3.2 and later, *xxx* represents the actual number of bytes you want for the root environment.

You'd think that when a program or user creates a secondary shell for DOS, DOS would make sure that the environment used by the shell was at least as large as the one you asked for in the root. Unfortunately, DOS is not quite so well constructed. Instead, by default, it looks at how much of the environment is actually in use and rounds this up to a multiple of 16 bytes. With DOS 3.2 and later, you can set a shell with the command

```
command /e:xxx
```

and adjust the size of the environment. Alas, most application programs that make a shell to the operating system do not use this feature, so the active environment in the shell is very small.

If an inherited environment turns out to be too small, there is a kludge you can use to get around the problem. Before loading the program from which you want to shell, issue several commands of the form

```
set a=aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa
set b=aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa
```

Then, in the shell use

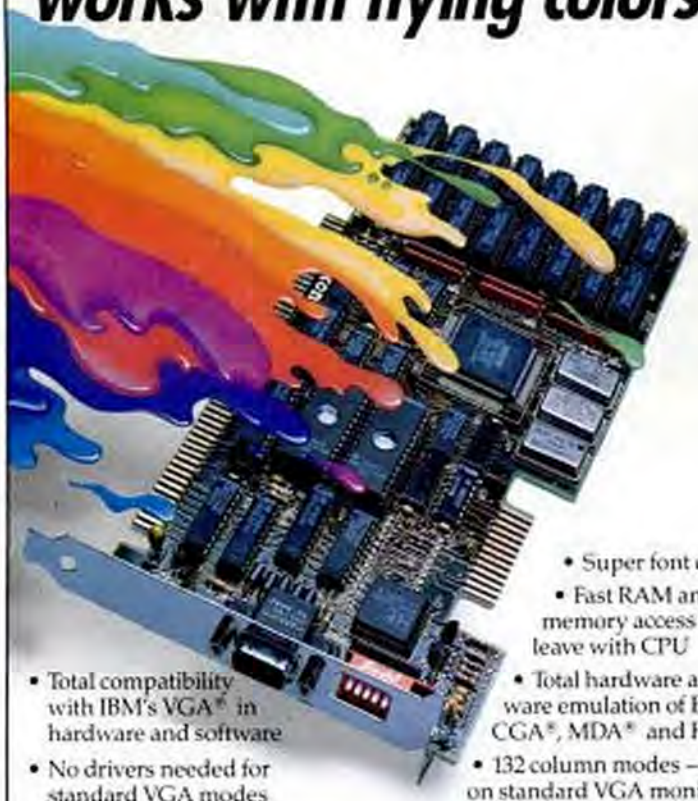
```
set a=
set b=
```

The space created by the bytes taken up by the initial SET commands will still be available after you remove the *a* and *b* variables, so you will end up with more usable space in the active environment than you otherwise would have.

LOCATING THE ACTIVE ENVIRONMENT

Two steps are necessary to locate the active environment. First, you must find the *active* copy of COMMAND.COM. Then you use it to find the active environment. The procedures for finding both COMMAND.COM and its environment are not officially documented. This means, of

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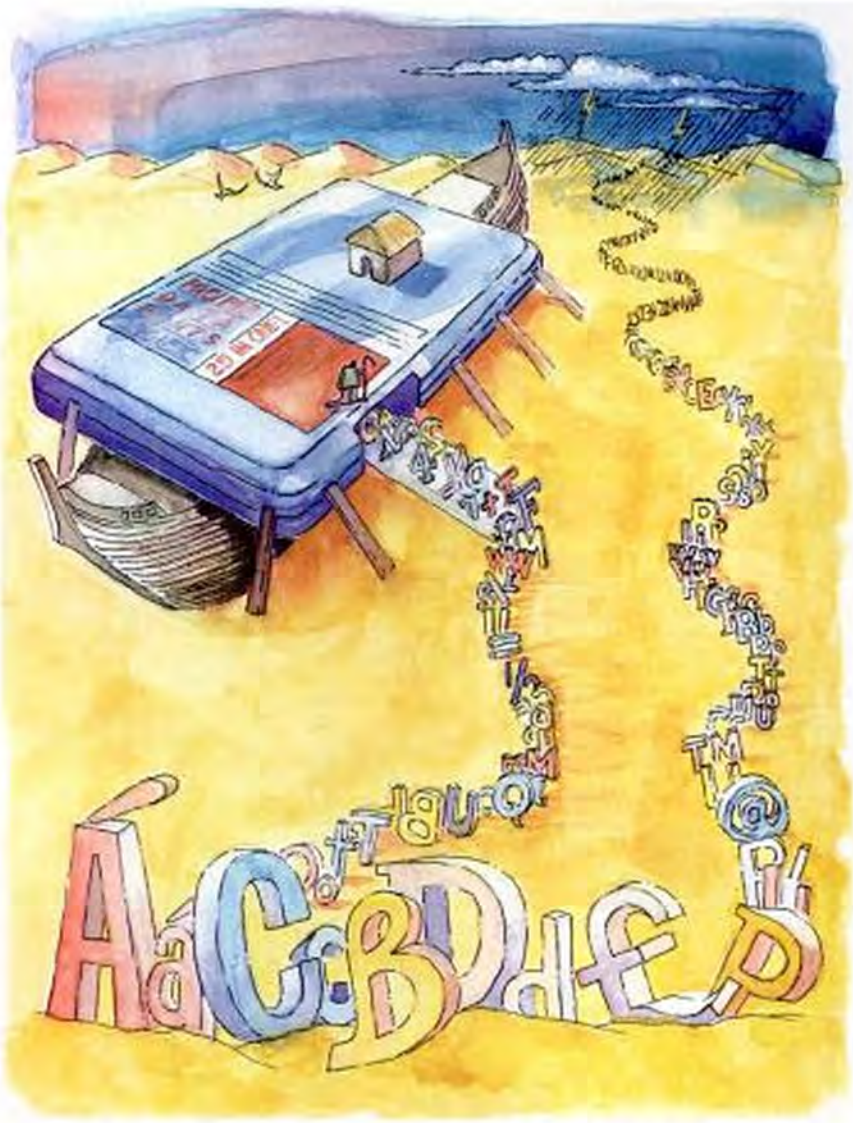
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Lab Notes

course, that there is a risk that they will not work when a new version of DOS is released. Indeed, the structure changed from DOS 3.1 to 3.2 and again from 3.2 to 3.3. Since you cannot assume that things will remain unchanged, the programs you write will obviously need to check for this. As always, there are potential dangers in using undocumented properties of the operating system.

Remember that the environment is really a memory block. Memory is broken into groups of paragraphs (a paragraph is 16 bytes), which are aligned at paragraph boundaries. These groups are called memory blocks. Each memory block contains a 16-byte header called the memory control block (MCB) for that particular block. Only the first 5 bytes out of 16 are used, of which the first 4 have an ID of the letter M. Z is used for the 5th byte. (The M and Z are the initials of Mark Zbikowski, one of the authors of DOS 2.0.) These two bytes are critical. If you use DEBUG to change the M in the MCB of one of your TSRs (an m, for example) and try to run a program,

FINDENV.PAS 1 of 2

```
(*** FINDENV.PAS -  A Program to Find the Real DOS Environment ***)

USES DOS;

VAR
  envseg : Word;                    {address of environment}
  envsize : Word;                   {absolute size of environment}
  envinuse : Word;                  {bytes in env up to first double 00}

  FUNCTION SpecialDOS : Boolean;    {true if DOS 3.2x}
  VAR
    regs : registers;
  BEGIN
    WITH regs DO BEGIN
      AH := $30;                    {Get MS-DOS version number}
      MsDos(regs);
      IF ((AL = 3) AND (AH > 19) AND (AH < 30)) THEN SpecialDOS := True
      ELSE SpecialDOS := False;
    END;
  END;

  FUNCTION getDOSPSP : Word;
  VAR
    tent, tent1 : Word;
  BEGIN
    tent := MemW[PrefixSeg:$16];
    WHILE True DO BEGIN
      tent1 := MemW[tent:$16];
      IF ((tent1 = 0) OR (tent1 = tent)) THEN BEGIN
        {this means we have DOS!}
        getDOSPSP := tent;
        Exit;
      END ELSE tent := tent1;
    END;
  END;

  PROCEDURE ComputeEnvInUse;
  VAR
    j : Word;
  BEGIN
    FOR j := 0 TO (envsize-3) DO
      IF MemW[envseg:j] = $0 THEN BEGIN {word 0 means two bytes}
        envinuse := j+2;
        Exit;
      END;
    envinuse := envsize;
  END;

  PROCEDURE getenv;
  VAR
    DOSPSP, temp : Word;
  BEGIN
    DOSPSP := getDOSPSP;
    temp := MemW[DOSPSP:$2C];
    IF ((temp <> 0) AND (NOT SpecialDOS)) THEN envseg := temp
    ELSE envseg := DOSPSP+MemW[DOSPSP-1:3]+1;
    envsize := 16*MemW[envseg-1:3];
    ComputeEnvInUse;
  END;
```

Figure 1: The source code listing for FINDENV.PAS, a program that locates the real DOS environment and reports its size and the current amount used.

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FINDENV.PAS 2 of 2

```
  FUNCTION HexDigit(b : Byte) : Char;
  BEGIN
    IF b < 10 THEN HexDigit := Char(Ord('0')+b)
    ELSE HexDigit := Char(Ord('A')-10+b);
  END;

  FUNCTION HexWord(w : Word) : STRING;
  BEGIN
    HexWord := HexDigit(w DIV $1000)+HexDigit((w MOD $1000) DIV $100)
    +HexDigit((w MOD $100) DIV $10)+HexDigit(w MOD $10);
  END;

BEGIN
  getenv;
  WriteLn('ENVREP. Copyright Ziff Communications Co., 1989');
  WriteLn('  Your active environment is at '+HexWord(envseg)+'H.');
  WriteLn('  The size of the environment is ', envsize, ' bytes');
  WriteLn('    of which ', envinuse, ' bytes are used');
  WriteLn('    leaving ', envsize-envinuse, ' bytes free.');
  WriteLn('  Have a good day.');
END.
```

DOS will decide your memory is corrupted and halt the system.

The 2nd and 3rd bytes of the MCB contain the segment of the owner of the memory block, that is, the PSP of the program that requested the block. It is stored in the usual way words are stored in Intel architecture: the segment 3GA4 would be stored as A4 in byte 2 and 3G in byte 3. (If your compiler understands words, it will normally do the translation for you automatically.) If a program deallocates memory located in the middle of the MCB chain, DOS changes bytes 2 and 3 in the MCB to zeros and will reuse that area for small things like the inherited environment of a program.

Bytes 4 and 5 of the MCB contain the number of 16-byte paragraphs in the memory block. Neither the MCB of that block nor the next one are included in the count, so the address of the next MCB is *yyyy*:0, where *yyyy* is the sum of the segment of the current MCB, the word at offset 5 of the MCB plus 1. DOS uses this method to trace through the chain of MCBs. It uses the undocumented DOS service 52h to find the first MCB. You call interrupt 21 with AH=52; on return, ES:(BX-2) forms a pointer to the first MCB.

HOW FINDENV WORKS

To find the active DOS environment, I use the fact that offset 16h of the PSP points to the parent of the current process, with the pointer being to *itself* if the parent program is COMMAND.COM. In essence, the procedure GetDOSPSP in the source code of FINDENV.PAS locates the active COMMAND.COM by chasing the pointer back until it points to itself.

The source code supplied here is meant for illustrative purposes and so ignores even the basics of defensive programming—a foolhardy omission for a real program. For production code, it would be a good idea to keep count of how many pointers you are accessing and to exit gracefully after, say, eight levels (I've never seen more than three levels needed). This will protect against someone adjusting the pointers into a loop! If your program is actually writing to the environment, defensive programming also requires that you compare what you think is the active environment and the program environment passed to you. They should have identical strings. If they don't, exit immediately: writing to the wrong place in memory can and will lead to dire consequences.

Having found the PSP of the active DOS, the FINDENV program can then locate the active environment, but the algorithm for doing so is DOS-version-dependent! Part of the information involves offset 2C in the PSP of the active DOS. If the active DOS is the root, the word at 2C is 0 and the active environment is the memory block after DOS.

But if the active DOS is not the root shell, then the situation is a little more complex. Keep in mind that COMMAND.COM is just a program, so that a DOS shell will have its own program environment placed by the loader of that copy of COMMAND.COM. For DOS 3.1 and earlier, this program environment is also used by the shell as the active DOS environment. For versions 3.2 and later, the shell instead places a memory block immediately following itself and does *not* use the program environment.

For DOS versions 3.2 and earlier, offset 2C points to the *program* environment. For versions 3.3 and later, offset 2C points to the *active* environment. Notice that while the placing of the active environment was changed with version 3.2, the address in 2C changed only in version 3.3. This is the reason behind the strange algorithm embodied in the sample source code: the block of the active environment is the next block in memory if offset 2C=0 or if the DOS version is 3.2; otherwise, the active environment is pointed to by 2C. The block of the active environment is found in the procedure Getenv.

Once the environment has been located, FINDENV uses the environment's structure to determine how much of it is being used. The strings are stored with a single ASCII zero terminating each string and with a double ASCII zero at the end of all strings. Thus a scan for a double 0 locates the end of the used part of the environment. An MCB calculation then finds the total length of the block and subtraction gives the amount free.

Having found the PSP of the active DOS, FINDENV can then locate the active environment.

Admittedly, the DOS world is like the Wild West: there are lots of outlaws around. Indeed, though our purpose is benign, our own attempt to extend program control over the active environment is in and of itself outlaw behavior. But despite this fact—perhaps even because it is *verboten*—it's a challenge that I'm sure many of my fellow programmers will want to take up. ■

Barry Simon is a professor of mathematics and theoretical physics at Caltech and vice president of the American Mathematical Society.

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CIRCLE 244 ON READER SERVICE CARD

by
Michael J. Mefford

Utilities

Easy Binary File Transfer Through ASCII Text Files

■ With DEBUGSCR you can send .COM, .EXE, and other binary files over MCI and other e-mail services.

Sending someone an MCI message is easy. Sending him a spreadsheet file is anything but. If you don't have specialized software like *Lotus Express*, MCI can't handle your spreadsheet at all. And modeming a binary file directly to another computer can become a humbling and exasperating experience. First, you and the recipient must arrange to the last detail for a common setup and transfer protocol, and then you must properly synchronize your send with his receive commands. If anything goes awry—which is often—something like stage fright often sets in, especially when it's a long distance call.

Why not do the obvious thing and get a copy of *Lotus Express* so that you can send binary files over MCI? Many people I know swear by it—but just as many swear *at* it and can't get it off their machines fast enough. It's a matter of personal style.

The practical problem with using *Express* is that both sender *and* receiver must use this program. *Lotus Express* employs MCI's proprietary Mail Link protocol for uploading and downloading binary files. Therefore, you must use *Express* to download a binary file uploaded with *Express*. Moreover, the specialized Mail Link protocol built into *Express* will work with MCI only, and not with any other e-mail service.

DEBUGSCR.COM, on the other hand, works with all e-mail services—including MCI. It also allows direct user-to-user transfers, if you wish. DEBUGSCR works by converting a binary file into an ordinary ASCII text file you can send without any transfer protocol. Its real beauty, however, is that it does not require the recipient to have a copy of DEBUGSCR to reconvert the text file to binary. All he needs is the ordinary DEBUG.COM that comes with DOS. (Be careful not to confuse the similar names used in this article: DEBUGSCR refers to the *PC Magazine* utility presented here; DEBUG refers to the DOS utility.)

The easiest way to get a copy of DEBUGSCR.COM is to download it from PC MagNet, as explained in the sidebar "DEBUGSCR by Modem." The assembly language source code, DEBUGSCR.ASM, is printed here and available from PC MagNet. If you prefer not to work with an assembler, DEBUGSCR.BAS, also listed here and on PC MagNet, will automatically create DEBUGSCR.COM when you run it once in BASIC.

USING DEBUGSCR

DEBUGSCR converts any PC file (up to 60K in length) into an ASCII text script file. The script file contains instructions that tell DEBUG how to re-create the original file. DEBUGSCR can even create a script file from text files, though it was designed to convert binary files, such as .EXEs, .COMs, or *Lotus 1-2-3* worksheets. (In point of fact, I first created DEBUGSCR so I could send copies of my programs to *PC Magazine*'s editors. It's worked so well we thought you might like it, too.) The script files created by DEBUGSCR can be easily transferred electronically as ordinary text files over MCI, CompuServe, or similar data services.

The syntax for DEBUGSCR.COM is

```
DEBUGSCR filespec [/N]
```

where *filespec* is the path and name of the (usually binary) file from which DEBUGSCR will create the script file. The script file will be put in the same directory and have the same filename, except that it will have an .SCR extension. Let's suppose that you have *PC Magazine*'s utility TOGGLE.COM, which reports—and lets you change—the state of your CapsLock, NumLock, and ScrollLock keys, stored in your PCMAG directory on drive C:. Entering

```
DEBUGSCR C:\PCMAG\NUMLOCK.COM
```

will create a script file called TOGGLE.SCR in the PCMAG directory. The created script file is shown in Figure 1 and is ready for immediate uploading. At the end of the script file there are instructions for the recipient on how to re-create the binary file.

If you wish, you can add to these instructions by editing the script file with your favorite word processor. You might, for example, want to add an explanation of how to use the utility if the binary file you are sending is a program. Just be *sure*, however, to save the edited script in ASCII text format.

If you regularly send to someone who knows how to re-create your binary files, on the other hand, you will probably want to suppress DEBUGSCR's message. The optional /N switch shown in the DEBUGSCR syntax line above allows you to do this.

You'll find that DEBUGSCR script files are approximately 3.75 times as large as their binary originals. This is not a seri-

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TOGGLE.SCR — COMPLETE LISTING

```
N TOGGLE.COM
E 0100 E9 BC 00 54 4F 47 47 4C 45 20 31 2E 30 20 28 63
E 0110 29 20 31 39 38 38 20 5A 69 66 66 20 43 6F 6D 6D
E 0120 75 6E 69 63 61 74 69 6F 6E 73 20 43 6F 2E 0D 0A
E 0130 50 43 20 4D 61 67 61 7A 69 6E 65 20 FE 20 4A 65
E 0140 66 66 20 50 72 6F 73 69 73 65 0D 0A 24 1A 0D 0A
E 0150 55 73 61 67 65 3A 20 20 54 4F 47 47 4C 45 20 5B
E 0160 2B 63 7C 2D 63 5D 20 5B 2B 6E 7C 2D 6E 5D 20 5B
E 0170 2B 73 7C 2D 73 5D 0D 0A 24 0D 0A 20 20 20 20 43
E 0180 61 70 73 4C 6F 63 6B 20 20 20 3A 20 20 24 20 20
E 0190 20 20 4E 75 6D 4C 6F 63 6B 20 20 20 20 3A 20 20
E 01A0 24 20 20 20 20 53 63 72 6F 6C 6C 4C 6F 63 6B 20
E 01B0 3A 20 20 24 4F 6E 0D 0A 24 4F 66 66 0D 0A 24 B8
E 01C0 40 00 8E C0 FC BE 81 00 AC 3C 20 74 FB 3C 0D 74
E 01D0 3F 3C 2B 74 10 3C 2D 74 0C B4 09 BA 4E 01 CD 21
E 01E0 B0 01 4C CD 21 AC 24 DF B4 10 3C 53 74 0C B4 20
E 01F0 3C 4E 74 06 B4 40 3C 43 75 DF 88 7C FE 2B 75 07
E 0200 26 08 26 17 00 EB C1 F6 D4 26 20 26 17 00 EB B8
E 0210 B4 09 BA 03 01 CD 21 B4 09 BA 79 01 CD 21 B4 40
E 0220 E8 1D 00 B4 09 BA 8E 01 CD 21 B4 20 E8 11 00 B4
E 0230 09 BA A1 01 CD 21 B4 10 E8 05 00 B8 00 4C CD 21
E 0240 BA 59 01 26 84 26 17 00 74 03 BA B4 01 B4 09 CD
E 0250 21 C3
RCX
0152
W
Q

      If you have downloaded this script file, remove
      any captured communications header and then enter

                DEBUG < filename

      where filename is the name of this script file.
```

Figure 1: This sample script file for *PC Magazine*'s short TOGGLE.COM utility was created by the DEBUGSCR program. DEBUGSCR automatically includes instructions for re-creating the binary file at the end of the script that it has created.

ous problem for short binary file transfers—for example, files of perhaps 20K or less. For larger files, you should use the *PC Magazine* utility 1STCLASS or *Lotus Express*. Indeed, you'll probably not be tempted to exceed DEBUGSCR's 60K input file limitation, for the script file output would be more than 240,000 bytes. And in that case, Federal Express is probably cheaper.

DEBUGSCR script files don't do checksums or include any other error-checking as do *Lotus Express* or Xmodem. It's really not necessary, however. When sending a script file, you can see if noise on the line is spoiling the transfer simply by monitoring the upload. If it doesn't go smoothly, the columns of the script will become irregular.

At the receiving end, before re-creating the original binary file, the script file recipient must edit out any captured communications header, such as the TO: header that prefaces MCI downloads. Any messages that appear at the end of the captured script can remain, however. When the script is processed by DEBUG, DEBUG returns to the DOS prompt when it sees the last instruction, Q for Quit. It never sees any remaining notes.

After removing the communications header (and saving in ASCII), the recipient then re-creates the original binary file simply by redirecting the script file to DE-

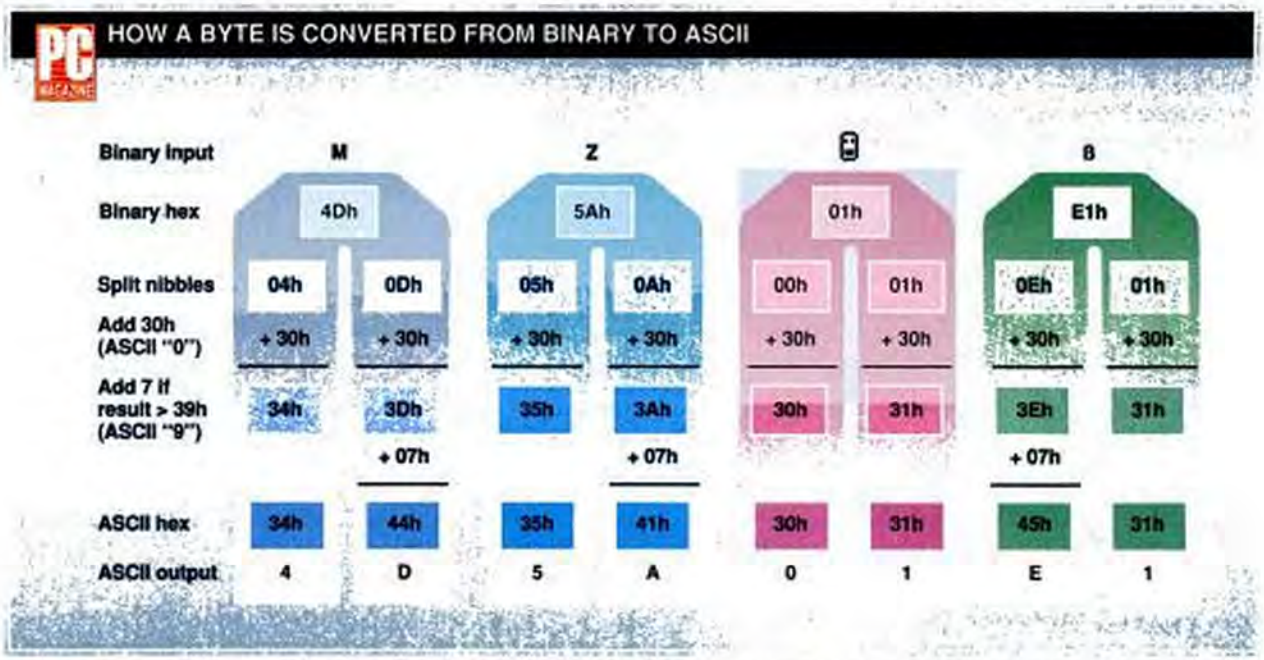


Figure 2: Converting the 4 bytes of this .EXE binary file example into ASCII hex is a two-step process. The value for 0 (30h) is added to each byte's nibbles and the results are placed in separate bytes. If the result is greater than 39h, an additional 7 is added to produce the hex numbers from A through F.

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DEBUGSCR.ASM


```
; Debugscr converts any disk file into a hexadecimal ASCII script text file.
; Unlike binary files like .EXEs, .COMs or 123 data files, the script file can
; then be sent via a data service like MCI or CIS as an ordinary text file.
; The recipient recreates the original binary file by redirecting the script
; file as Debug's input thus:
;
;               DEBUG < filename.SCR
;
; where filename.SCR is the name of script file created by DEBUGSCR.COM.

_TEXT           SEGMENT PUBLIC 'CODE'
                ASSUME  CS:_TEXT,DS:_TEXT,ES:_TEXT,SS:_TEXT
                ORG     100H
START:          JMP     MAIN

;               DATA AREA
;               ---------
SIGNATURE       DB      CR,SPACE,SPACE,SPACE,CR,LF
COPYRIGHT       DB      "DEBUGSCR 1.0 (C) 1989 Ziff Communications Co. ",CR,LF
PROGRAMMER      DB      "PC Magazine ",BOX," Michael J. Mefford",CR,LF,LF

DB              "Syntax:  DEBUGSCR filespec [/H]",CR,LF,LF
DB              "/H = No instruction messages in script",CR,LF,LF
DB              "filename.SCR will be created",CR,LF
DB              "To recreate file, Exfxx",CR,LF,LF

DB              TAB,    "DEBUG < filename.SCR",CR,LF,LF,"$",CTRL_Z

TAB             EQU     9
CR              EQU     13
LF              EQU     10
CTRL_Z          EQU     26
SPACE           EQU     32
BOX             EQU     254

FILESPEC_START  DW      ?
FILESPEC_END    DW      ?
FILENAME_START  DW      ?
FILENAME_LEN    DW      ?
DOT_ADDRESS     DW      ?

EXE_FLAG        DB      0                       ;Set if and EXE
                                                ; extension found.
MSG_FLAG        DB      0                       ;Set if no suppress script msg.
FILE_LENGTH     DW      ?
HANDLE          DW      ?
LINE_NO         DW      100H
CHAR_CT         DW      ?

FILE            DB      "File"
NOT_FOUND       DB      " not found",CR,LF,LF,"$"
DISK_ERROR      DB      "Disk error",CR,LF,LF,"$"
DOT_SCR         DB      ".SCR",0,"$"
EXE             DB      ".EXE",CR,LF
TOO_BIG         DB      "Input file too big; can't be more than 64K",CR,LF,LF,"$"
NOT_ENOUGH      DB      "Not enough memory; requires 64K",CR,LF,LF,"$"
CREATED         DB      "reated",CR,LF,LF,"$"
NCX             DB      " NCX",CR,LF
NQ              DB      " N",CR,LF
                DB      " Q",CR,LF,CR,LF

SCRIPT_END      DB  TAB, "If you have downloaded this script file, remove",CR,LF
                DB  TAB, "any captured communications header and then enter:",CR,LF
                DB  CR,LF,TAB,TAB,"DEBUG < filename",CR,LF,CR,LF
                DB  TAB,"Where filename is the name of this script file.",CR,LF
SCRIPT_END_LEN  EQU $ - SCRIPT_END

EXE_MSG     DB  CR,LF
            DB  TAB,"Note this is an EXE script.  Debug will not create",CR,LF
            DB  TAB,"a file with an EXE name extension.  You have to add",CR,LF
            DB  TAB,"the EXE extension yourself AFTER the file is created",CR,LF
            DB  TAB,"by Debug by entering the following at the DOS prompt",CR,LF
            DB  CR,LF

            DB  TAB,"RENAME "
EXE_MSG_LENGTH  EQU     $ - EXE_MSG

;               CODE AREA
;               ---------
MAIN            PROC    NEAR
                CLD
                MOV     DX,OFFSET SIGNATURE     ;Display copyright and syntax.
                CALL    PRINT_STRING

                MOV     BX,64 / 16 * 1024       ;Minimum 64K memory required.
                MOV     AH,4AH
                INT     21H
                MOV     DX,OFFSET NOT_ENOUGH
                JNC     CAPITALIZE
                JMP     ERROR_EXIT

CAPITALIZE:     MOV     SI,81H                  ;Capitalize the command line.
NEXT_CAP:       LODSB
                CMP     AL,CR
                JE      PARSE
                CMP     AL,"/"
                JNZ     CK_CAP
                MOV     BYTE PTR [SI - 1],CR
                LODSB
                AND     AL,5FH
                CMP     AL,"H"
                JNZ     PARSE
                MOV     MSG_FLAG,1
                JMP     SHORT PARSE

CK_CAP:         CMP     AL,"a"
                JB      NEXT_CAP
                CMP     AL,"z"
                JA      NEXT_CAP
                AND     BYTE PTR [SI - 1],5FH
                JMP     NEXT_CAP

PARSE:          MOV     SI,81H                  ;Parse the command line.
FIND_START:     LODSB                           ;Find first non-white space.
                CMP     AL,CR
                JNZ     CK_SPACE
                MOV     DX,OFFSET FILE          ;If no parameter, display
                JMP     ERROR_EXIT              ; error message.
CK_SPACE:       CMP     AL,SPACE
                JE      FIND_START

                DEC     SI                      ;Adjust.
                MOV     BP,SI                   ;BP = Filespec start.
                MOV     FILESPEC_START,BP       ;Save it.
                MOV     DX,SI                   ;DX = Filename start.
                XOR     CX,CX                   ;CX = dot flag.
FIND_END:       LODSB
                CMP     AL,":"                  ;If colon or backslash found,
                JZ      FOUND_PATH              ; it's a path specifier
                CMP     AL,"\"
                JNZ     CK_DOT
FOUND_PATH:     MOV     DX,SI                   ;Filename start.
CK_DOT:         CMP     AL,"."                  ;If dot, extension follows.
                JNZ     CK_END
                MOV     CX,SI
                DEC     CX                      ;Adjust.
CK_END:         CMP     AL,SPACE                ;Carriage return marks end of
                JA      FIND_END                ; command line.
                DEC     SI                      ;Adjust.
                MOV     BYTE PTR [SI],0         ;ASCIIZ the filespec.
                MOV     FILESPEC_END,SI         ;Save filespec end.
                MOV     FILENAME_START,DX       ;Save filename start.
                MOV     DOT_ADDRESS,CX          ;Save address of extension.

                MOV     DX,BP                   ;Retrieve filespec start.
                MOV     AX,3D00H                ;Open file for reading.
                INT     21H
                JNC     OPENED
                MOV     BYTE PTR [SI],"$"       ;If failed, display message.
                CALL    PRINT_STRING
                MOV     DX,OFFSET NOT_FOUND
                JMP     ERROR_EXIT

OPENED:         MOV     BX,AX                   ;Else, BX = filehandle.
                MOV     DX,OFFSET BUFFER        ;Point to input buffer.
                MOV     CX,(64 * 1024) + 1      ;Read 64K + 1.
                MOV     AH,3FH
                INT     21H
                JNC     CK_SIZE
                MOV     DX,OFFSET DISK_ERROR    ;If failed, disk error.
                JMP     ERROR_EXIT

CK_SIZE:        CMP     AX,CX                   ;Did we read 64K + 1.
                JNE     SAVE_SIZE
                MOV     DX,OFFSET TOO_BIG       ;If yes, too big.
                JMP     ERROR_EXIT

SAVE_SIZE:      MOV     FILE_LENGTH,AX          ;Else, save file size.
                MOV     AH,3EH                  ;Close input file.
                INT     21H

                MOV     BX,FILESPEC_END         ;Retrieve filespec end.
                MOV     SI,DOT_ADDRESS          ;Retrieve extension address.
                OR      BP,BP                   ;Is there an extension?
                JNZ     CK_EXE                  ;If yes, see if it's an EXE.
                MOV     BP,BX                   ;Else, filename end=
                                                ; filespec end.
                JMP     SHORT STORE_NAME

CK_EXE:         MOV     SI,BP                   ;Point to extension address.
                MOV     DI,OFFSET EXE           ;And ".EXE"
                MOV     CX,4
                REP     CMPSB
                JNE     STORE_NAME              ;If the extension is EXE then
                MOV     EXE_FLAG,1              ; special case.
                MOV     BX,BP                   ;filespec end=
                                                ; extension address.

STORE_NAME:     MOV     SI,FILENAME_START       ;Filename.
                MOV     CX,BX                   ;Calculate filename length.
                SUB     CX,SI
                MOV     FILENAME_LEN,CX         ;Save length.
                MOV     DI,OFFSET DTA + 3       ;Place name in DTA.
                REP     MOVSB

MAKE_SCRIPT:    MOV     SI,OFFSET DOT_SCR       ;Convert filespec to script
                MOV     DI,BP                   ; name by adding .SCR
                                                ; extension.
                MOV     CX,5
                REP     MOVSB

                MOV     DX,FILESPEC_START       ;Create a normal file with the
                XOR     CX,CX                   ; .SCR extension on it's name.
                MOV     AH,3CH
                INT     21H
                JNC     SAVE_HANDLE
                MOV     DX,OFFSET DISK_ERROR    ;If failed, disk error.
                JMP     ERROR_EXIT
SAVE_HANDLE:    MOV     HANDLE,AX               ;Else, save file handle.
```

DEBUGSCR.ASM: The assembly language source code for DEBUGSCR.COM, which turns binary files into an ASCII form that can be transmitted over MCI and subsequently reconverted to its original form using DOS's DEBUG.

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DEBUGSCR.ASM 2 of 2

```
                MOV     CX,FILENAME_LEN         ;Retrieve length of filename.
                ADD     CX,3                    ;Add 3 for space,"W",space.
                CALL    WRITE                   ;Write to disk.

;-----------------------------------------;
; This is the hexadecimal E loop.         ;
;-----------------------------------------;
                MOV     BP,FILE_LENGTH          ;Retrieve file length.
                MOV     SI,OFFSET BUFFER        ;Point to input file buffer.
NEXT_LINE:      MOV     DI,OFFSET DTA + 1       ;Point to write storage.
                MOV     CHAR_CT,3               ;Chars to write; start with 3.
                CALL    E                       ;Get the (E)nter address.
                MOV     CX,16                   ;16 numbers per line

NEXT_BYTE:      MOV     AL,SPACE                ;Space delimiter.
                STOSB
                INC     CHAR_CT                 ;Count it.
                LODSB                           ;Get a byte from input file.
                CALL    CONVERT                 ;Convert to ASCII hexadecimal.
                DEC     BP                      ;One less input character.
                JZ      END_FILE                ;If that last one, done.
                LOOP    NEXT_BYTE               ;Else, do 16 numbers/line.
                MOV     CX,CHAR_CT              ;Retrieve length of line.
                CALL    WRITE                   ;Write it to disk.
                JMP     SHORT NEXT_LINE         ;Next line.

END_FILE:       MOV     CX,CHAR_CT              ;Write the last line to disk.
                CALL    WRITE

                MOV     DX,OFFSET RCX           ;Add "RCX" line.
                MOV     CX,6
                CALL    DOS_WRITE
                MOV     AX,FILE_LENGTH          ;Retrieve length of file.
                PUSH    AX                      ;Save low half.
                MOV     AL,AH                   ;Convert high half to
                                                ; ASCII hex.
                MOV     DI,OFFSET DTA + 1
                CALL    CONVERT
                POP     AX                      ;Retrieve low half and convert
                CALL    CONVERT                 ; it also to ASCII hex.
                MOV     CX,5
                CALL    WRITE                   ;Write that line to disk.
                MOV     DX,OFFSET WQ            ;Write "W" and "Q".
                MOV     CX,10
                CALL    DOS_WRITE
                CMP     HEX_FLAG,1
                JZ      CLOSE_FILE
                MOV     DX,OFFSET SCRIPT_END    ;Finish up with instructions.
                MOV     CX,SCRIPT_END_LEN
                CALL    DOS_WRITE

                CMP     EXE_FLAG,1              ;Was there the special case of
                JNZ     CLOSE_FILE              ; and EXE extension.
                MOV     DX,OFFSET EXE_MSG       ;If so, done here.
                MOV     CX,EXE_MSG_LENGTH       ;Else, add EXE message
                                                ; to script.
                CALL    DOS_WRITE
                MOV     DX,FILENAME_START       ;Add REN filename.
                PUSH    DX
                MOV     CX,FILENAME_LEN
                PUSH    CX
                CALL    DOS_WRITE
                MOV     DX,OFFSET DTA           ;Add delimiting space.
                MOV     CX,1
                CALL    DOS_WRITE
                POP     CX
                POP     DX                      ;Add new name
                CALL    DOS_WRITE
                MOV     DX,OFFSET EXE           ; with the .EXE extension.
                MOV     CX,6
                CALL    DOS_WRITE

CLOSE_FILE:     MOV     BX,HANDLE               ;Close output file.
                MOV     AH,3EH
                INT     21H
                JC      WRITE_FAIL
                MOV     DX,FILESPEC_START       ;Retrieve output filespec.
                CALL    PRINT_STRING            ;Display it followed by
                MOV     DX,OFFSET CREATED       ; "created".
                CALL    PRINT_STRING
                XOR     AL,AL                   ;ErrorLevel = 0.
                JMP     SHORT EXIT              ;Done.

;-----------------------------------------;
WRITE_FAIL:     MOV     DX,OFFSET DISK_ERROR    ;Generic disk error message.
ERROR_EXIT:     CALL    PRINT_STRING
                MOV     AL,1                    ;ErrorLevel = 1.

EXIT:           MOV     AH,4CH                  ;Terminate.
                INT     21H
MAIN            ENDP

;********* SUBROUTINES *********;

DOS_WRITE:      MOV     AH,40H                  ;Write to file.
                INT     21H
                JC      WRITE_FAIL              ;Exit with message if failed.
                RET

;-----------------------------------------;
; INPUT: CX = count of chars to write.    ;
;-----------------------------------------;
WRITE:          MOV     DX,OFFSET DTA           ;Point to Disk
                                                ; Transfer Area.
                MOV     BX,HANDLE               ;Output filehandle.
                CALL    DOS_WRITE               ;Write DTA.
NEW_LINE:       MOV     BYTE PTR DTA + 1,CR     ;Add carriage return
                                                ; and linefeed
                MOV     BYTE PTR DTA + 2,LF
                MOV     DX,OFFSET DTA + 1
                MOV     CX,2
                CALL    DOS_WRITE
                RET

;-----------------------------------------;
E:              MOV     AL,"E"                  ;Store the "E"
                STOSB
                MOV     AL,SPACE                ; and space delimiter.
                STOSB
                MOV     AX,LINE_NO              ;Retrieve the line number.
                PUSH    AX
                XCHG    AL,AH
                CALL    CONVERT                 ;Convert high half to
                                                ; ASCII hex.
                POP     AX
                MOV     AX,LINE_NO
                CALL    CONVERT                 ;Convert the low half.
                ADD     LINE_NO,16              ;Next line number.
                RET

;-----------------------------------------------------;
; INPUT: AL = binary number; DI -> appropriate DTA address ;
;-----------------------------------------------------;
CONVERT:        PUSH    CX                      ;Preserve loop counter.
                MOV     DH,2                    ;Two ASCII
                                                ; hex bytes/binary byte.
                MOV     BL,AL                   ;Preserve binary number.
ROTATE:         MOV     CL,4
                ROL     BL,CL                   ;Rotate by four bits.
                MOV     AL,BL
                AND     AL,0FH                  ;Mask off high four bits.
                ADD     AL,"0"                  ;Convert to ASCII.
                CMP     AL,"9"                  ;If A-F, add 7.
                JBE     STORE_HEX
                ADD     AL,7
STORE_HEX:      STOSB                           ;Store in DTA.
                INC     CHAR_CT                 ;Increment count to write.
                DEC     DH                      ;Next half.
                JNZ     ROTATE
                POP     CX                      ;Restore loop counter.
                RET

;-----------------------------------------;
PRINT_STRING:   MOV     AH,9                    ;DOS print string.
                INT     21H
                RET

DTA             DB      SPACE,"E",SPACE
BUFFER          =       DTA + 188

_TEXT ENDS
END     START
```

BUG's input, for example:

```
DEBUG < filename
```

where *filename* is the name of the script file created by DEBUGSCR. Voilà!

EXCEPTIONAL CASES

Users of PC MagNet and the CompuServe Information Service have probably noticed that, unless specifically told otherwise, CIS will try to format uploaded messages in as few lines as possible. Short lines, such as the R, W, and Q commands at the end of the DEBUGSCR script file, normally would be put all on one line. This CIS-imposed formatting can be suppressed, however, by placing a space as the first character on a line. DEBUGSCR, therefore, indents each line of the script with a space, just in case you might want to upload to CIS. The space character is ignored by DEBUG.

Files with an .EXE extension provide one additional complication for DEBUGSCR to overcome. DEBUG won't write a file with an .EXE extension to disk. Without going into details, DEBUG does this to protect you from writing over .EXE header information. If you try to write an .EXE file from DEBUG, you'll get the eloquently laconic message

```
EXE and HEX files cannot be written
```

Fortunately, you can trick DEBUG into

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DEBUGSCR BY MODEM

The programs published in *PC Magazine* are available by modem from PC MagNet.

To download DEBUGSCR.COM, log on to PC MagNet. Enter GO UTILITIES or choose PC MAGAZINE UTILITIES from the top menu, then DIRECT UTILITY DOWNLOAD from the next. Enter the filename, then select the file from those presented. Answer (Y) to DO YOU WISH TO DOWNLOAD? Press Enter to see the transfer protocols. Choose a protocol and download the file.

To join PC MagNet, set your communications software for either 300 or 1,200 bits per second, 7 data bits, even parity, 1 stop bit, and full duplex. You can use any of more than 300 local access phone numbers, including: Boston, (617) 542-1796; New York, (212) 422-8820; Chicago, (312) 693-0330; or San Francisco, (415) 956-4191. To find the number nearest your dialing exchange after you have subscribed, or for 2,400-bps service, connect with PC MagNet and type GO PHONES. For Customer Service, call (800) 848-8990; in Ohio and outside the United States, call (614) 457-8650.

When you connect with PC MagNet, press Ctrl-C. At the HOST NAME PROMPT, enter CIS. At the USER ID prompt, enter 177000,5000. Enter PC*MAGNET at the PASSWORD prompt and Z10D8920 at the ENTER AGREEMENT NUMBER prompt.

You don't have to be a member of CompuServe to access PC MagNet. It costs $12.50 an hour for 1,200/2,400-bps service and $6 for 300-bps, via MasterCard, VISA, or American Express. These programs can be copied but are copyrighted and are made available only for noncommercial use. You may make copies for others as long as no charge is involved, but making copies for any commercial purpose is prohibited.

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DEBUGSCR COMMAND

Michael J. Mefford November 28, 1989 (Utilities)

Purpose: To convert binary files into ordinary ASCII text files, which can be transmitted over MCI Mail and similar services and reconverted to their original binary form using the DOS DEBUG command.

Format:

```
DEBUGSCR filespec [/N]
DEBUG < filename
```

Remarks: Use the first command shown above to create a DEBUGSCR script file from a binary file (.COM, .EXE, .WK1, for example) named in the *filespec*. An alternate drive and path can be specified. The script file is automatically given an .SCR extension and is placed in the same directory as the original file. The script file consists of an ASCII hex representation of the original binary values, together with the commands DEBUG needs to re-create the original file. The script file ends with appropriate instructions to the recipient. These instructions are ignored by DEBUG and can be suppressed altogether by using the optional /N switch.

The .SCR file can be edited with a word processor before transmission to append additional information, such as how to use the utility being sent. The .SCR file must then be resaved in pure ASCII form. Similarly, before reconverting the .SCR file with DEBUG.COM, the recipient must edit out any header prefixed to the file by the communications service (for example, the TO: heading added by MCI). After resaving in ASCII, the recipient simply uses the second command line shown above under FORMAT, supplying the desired final *filename*.

DEBUGSCR.COM can be downloaded from PC MagNet (see the "DEBUGSCR by Modem" sidebar). Also available from PC MagNet and printed in the article are DEBUGSCR.BAS and DEBUGSCR.ASM. DEBUGSCR.BAS will automatically create DEBUGSCR.COM when run once in BASIC. To assemble the program from its source code listing requires the use of a macro assembler (IBM or Microsoft, Version 2 or later) and the following commands:

```
MASM DEBUGSCR;
LINK DEBUGSCR;
EXE2BIN DEBUGSCR DEBUGSCR.COM
```

Note: DEBUGSCR will not work with files over 60K.

DEBUG.COM will not write a filename with an .EXE extension to disk. DEBUGSCR therefore strips this extension and appends a warning to the recipient that after using DEBUG he must rename the file to include its proper .EXE extension.

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writing an .EXE file in its entirety simply by renaming the file to omit the forbidden extension. DEBUGSCR uses this trick. If you tell it to create a script file from an .EXE file, DEBUGSCR strips the extension before placing it in the first line of the script. After the original file is re-created by DEBUG, however, the file must be renamed with its original, proper .EXE extension. To make sure this very important renaming step is not overlooked by the script file's recipient, DEBUGSCR puts a very prominent reminder instruction at the end of all .EXE scripts.

BINARY VERSUS TEXT

The difference between a binary file and a text file can be confusing. In its literal sense, *every* file is a binary file, since it is composed entirely of bytes of binary ones and zeros. In more customary usage, *binary* denotes all but strict ASCII text files. These include executable files, such as .EXE and .COM files, and data files, such as *1-2-3* and *dBASE* files. Binary files may *contain* some ASCII text strings, however, as messages or as a copyright notice.

The values of the bytes in a "text" file are meant to be interpreted using the standard ASCII table familiar to every *PC Magazine* reader. ASCII decimal values between 32 and 127 represent the alphanumeric and punctuation characters of our alphabet. Values below decimal 32 are called *control* characters, which include the carriage return and line-feed characters, which mark the end of a text line. Values in the range from decimal 128 to 255 are know as *high* or *extended* ASCII, and are not strictly standardized. This range is used for the IBM extended character set, which includes a foreign character subset and box drawing characters.

A byte that has a value of binary 01000001 has a value of 41 in hexadecimal notation and 65 in decimal; these are simply three ways of designating the same value. That value is interpreted as the capital letter A by the ASCII interpreter program built into your word processor. The *same* value, 41h, in the code section of .EXE or .COM file, would be interpreted by the CPU as the instruction `INC CX`, which tells the processor to increment the CX register. And in a spreadsheet data file, 41h would be interpreted literally, as the numeric value, 41h.

The real difference between a binary and text file, therefore, is how the bytes of a file are interpreted. ASCII text files are always interpreted as characters from the ASCII table. Binary files may be interpreted as some combination of machine codes, binary values, and ASCII text bytes.

Not all text files are ASCII text files, either. For example, a *WordPerfect* text file is actually a binary file. That's because *WordPerfect* (and most other word processors) mix in special codes along with the ASCII text. These special codes are understood only by that particular word processing program. There are codes for italics and boldface, codes for paragraphs, margins, and page lengths, and special bytes that tell the processor where the cursor was when the document was saved. Some of this information is stored in a binary section at the beginning of the document. One word processor usually can not understand the codes of another.

DEBUGSCR.BAS COMPLETE LISTING

```
100 REM - BASIC PROGRAM TO CREATE DEBUGSCR.COM
110 CLS:PRINT "Creating DEBUGSCR.COM": OPEN "DEBUGSCR.COM" AS #1 LEN = 1
120 FIELD #1, 1 AS A$: CHECKSUM#=0
130 FOR I = 1 TO    89
140  LINESUM#=0: LOCATE 2,3: PRINT "Countdown: "     89 - I ;
150  FOR J = 1 TO  16: READ BYTE$: BYTE = VAL("&H" + BYTE$)
160   CHECKSUM# = CHECKSUM# + BYTE: LINESUM# = LINESUM# + BYTE
170   IF (BYTE < 256) THEN LSET A$=CHR$(BYTE): PUT #1
180  NEXT J
190  READ LINETOT$: LINECHECK# = VAL("&H"+LINETOT$)
200  IF LINECHECK# = LINESUM# THEN GOTO 220
210  LOCATE 4,2: PRINT "Error in line #"  ;  260 +  10 * I: GOTO 260
220 NEXT I
230 CLOSE: READ FILETOT$ : FILECHECK# = VAL(FILETOT$)
240 IF CHECKSUM# <> FILECHECK# THEN GOTO 260
250 PRINT: PRINT "DEBUGSCR.COM created successfully": SYSTEM
260 PRINT: PRINT "DEBUGSCR.COM is not valid!": END
270 DATA E9, 37,  3,  D,  D, 2E, 20, 20,  D,  A, 44, 45, 42, 55, 47, 53, 43,   3A4
280 DATA 53, 20, 31, 2E, 30, 20, 28, 43, 29, 20, 31, 39, 39, 39, 20, 3A,  32A
290 DATA 69, 66, 66, 2E, 43, 6F, 6D, 70, 75, 6E, 69, 63, 61, 74, 69, 6F,  630
300 DATA 6E, 73, 20, 43, 6F, 2E, 20,  D,  A, 54, 43, 20, 4D, 61, 67, 61,  441
310 DATA 7A, 69, 6E, 65, 20, FE, 20, 20, 49, 63, 6D, 61, 65, 6C, 20, 4A,  611
320 DATA 2E, 20, 4D, 65, 66, 66, 6F, 72, 64,  D,  A, 53, 79, 6E, 74, 68,  489
330 DATA 61, 78, 3A, 20, 20, 44, 45, 42, 55, 47, 53, 43, 52, 49, 50, 54,  491
340 DATA 6C, 65, 73, 78, 65, 63, 20, 5B, 2F, 4E, 5D,  D,  A, 2F, 4E, 46,  467
350 DATA 20, 3D, 20, 4E, 6F, 20, 69, 6E, 73, 74, 72, 75, 63, 74, 69, 6F,  5AE
360 DATA 6E, 20, 69, 6E, 73, 73, 61, 67, 65, 73, 20, 69, 6E, 20, 73, 63,  503
370 DATA 72, 69, 78, 74,  D,  A,  A, 46, 69, 6C, 65, 6E, 61, 6D, 65, 2E,  56F
380 DATA 53, 43, 52, 20, 77, 69, 6C, 6C, 20, 62, 65, 20, 63, 72, 65, 61,  562
390 DATA 74, 65, 64,  D,  A, 54, 6F, 20, 72, 65, 63, 72, 65, 61, 74, 65,  592
400 DATA 20, 64, 69, 6C, 65, 20, 20, 45, 78, 74, 65, 72, 6E, 61, 6C, 20,  434
410 DATA 44, 45, 42, 55, 47, 20, 3C, 20, 66, 69, 6C, 65, 6E, 61, 6D, 65,  524
420 DATA 2E, 53, 43, 52,  D,  A,  A, 24, 1A,  0,  0,  0,  0,  0,  0,  0,  175
430 DATA  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  1,  0,  0,  0, 46, 69, 6C,  11C
440 DATA 65, 20, 6E, 6F, 74, 20, 66, 6F, 75, 6E, 64,  D,  A,  A, 24, 44,  498
450 DATA 69, 73, 6B, 20, 65, 72, 72, 6F, 72,  D,  A,  A, 24, 20, 53, 43,  4BA
460 DATA 52,  0, 24, 2E, 45, 59, 45,  D,  A, 49, 6E, 70, 75, 74, 20, 66,  433
470 DATA 69, 6C, 65, 20, 74, 6F, 6F, 20, 62, 69, 67, 3D, 20, 63, 61, 6E,  5B5
480 DATA 27, 74, 20, 62, 65, 20, 6D, 6F, 72, 65, 20, 74, 68, 61, 6E, 20,  560
490 DATA 36, 30, 4B,  D,  A,  A, 24, 4E, 6F, 74, 20, 65, 6E, 6F, 75, 67,  465
500 DATA 68, 20, 6D, 65, 6D, 6F, 72, 79, 3D, 20, 72, 65, 71, 75, 69, 72,  614
510 DATA 65, 73, 20, 36, 34, 4B,  D,  A,  A, 24, 63, 72, 65, 61, 74, 65,  466
520 DATA 64,  D,  A,  A, 24, 20, 52, 43, 50,  D,  A, 20, 57,  D,  A, 20,  27B
530 DATA 51,  D,  A,  D,  A,  9, 49, 66, 20, 79, 6F, 75, 20, 48, 61, 76,  413
540 DATA 65, 20, 64, 6F, 77, 6E, 6C, 6F, 61, 64, 65, 64, 20, 74, 68, 69,  6B8
550 DATA 73, 20, 73, 63, 72, 69, 70, 74, 20, 66, 69, 6C, 65, 2C, 20, 72,  5A6
560 DATA 65, 6D, 6F, 76, 65,  D,  A,  9, 61, 6E, 79, 20, 63, 61, 70, 74,  54C
570 DATA 75, 72, 65, 64, 20, 63, 6F, 6D, 40, 75, 6E, 69, 63, 61, 74, 69,  469
580 DATA 6F, 6E, 73, 20, 48, 65, 61, 64, 65, 72, 20, 61, 6E, 64, 20, 74,  5C9
590 DATA 65, 65, 6E, 20, 65, 6E, 74, 65, 72, 20,  A,  D,  A,  9,  9, 44,  3F9
600 DATA 45, 42, 55, 47, 20, 3C, 20, 66, 69, 6C, 65, 6E, 61, 6D, 65, 2E,  4ED
610 DATA  A,  D,  A,  9, 77, 68, 65, 72, 65, 20, 66, 69, 6C, 65, 6E, 61,  404
620 DATA 6D, 65, 20, 69, 73, 20, 74, 68, 65, 20, 6E, 61, 6D, 65, 20, 6F,  577
630 DATA 66, 20, 74, 68, 69, 73, 20, 73, 63, 72, 69, 70, 74, 20, 66, 69,  582
640 DATA 6C, 65, 2E,  D,  A,  D,  A,  9, 4E, 6F, 74, 65, 20, 74, 68, 69,  431
650 DATA 73, 20, 69, 73, 20, 61, 6E, 20, 45, 58, 45, 20, 73, 63, 72, 69,  535
660 DATA 70, 74, 2E, 20, 20, 44, 65, 62, 75, 67, 20, 77, 69, 6C, 6C, 20,  531
670 DATA 6E, 6F, 74, 20, 63, 72, 65, 61, 74, 65,  D,  A,  9, 61, 20, 44,  480
680 DATA 69, 6C, 65, 20, 77, 69, 74, 68, 20, 61, 6E, 20, 45, 58, 45, 20,  527
690 DATA 6E, 61, 6D, 65, 20, 69, 78, 74, 65, 6E, 73, 69, 6F, 6E, 2E, 20,  580
700 DATA 2B, 59, 6F, 75, 20, 68, 61, 76, 65, 20, 74, 6F, 20, 61, 64, 64,  569
710 DATA  D,  A,  9, 74, 68, 65, 20, 45, 58, 45, 20, 65, 78, 74, 65, 6E,  4A7
720 DATA 73, 69, 6F, 6E, 20, 79, 6F, 75, 72, 73, 65, 6C, 66, 20, 41, 46,  5F9
730 DATA 54, 45, 52, 20, 74, 68, 65, 20, 66, 69, 6C, 65, 20, 69, 73, 20,  528
740 DATA 63, 72, 65, 61, 74, 65, 64,  D,  A,  9, 63, 79, 20, 44, 65, 62,  4FE
750 DATA 75, 67, 20, 62, 79, 20, 45, 4E, 74, 65, 72, 69, 6E, 67, 20, 74,  587
760 DATA 68, 65, 20, 66, 6F, 6C, 6C, 6F, 77, 69, 6E, 67, 20, 65, 74, 20,  503
770 DATA 74, 68, 65, 20, 44, 4F, 53, 20, 70, 72, 6F, 6D, 70, 74,  D,  A,  529
780 DATA  D,  A,  9, 53, 45, 41, 4D, 45, 20, FC, BA,  3,  1, EB, 3F,  409
790 DATA  2, BD,  0, 1B, B4, 4A, CD, 21, BA, 67,  2, 73,  3, E9, C6,  1,  692
800 DATA BE, 81,  0, AC, 3C,  D, 74, 24, 3C, 2F, 75, 12, C4, 44, FF,  D,  504
810 DATA AC, 24, 5F, 3C, 4E, 75, 15, C6,  6,  4,  2,  1, EB,  E, 3C, 61,  4AC
820 DATA 72, E1, 3C, 7A, 77, DD, 80, 64, FF, 5F, EB, D7, BE, 81,  0, AC,  940
830 DATA 3C,  D, 75,  6, BA,  D,  2, E9, AC,  1, 3C, 2E, 74, F7, 4E, E9,  597
840 DATA EE, 69, EE, F9,  1, EB, D4, 33, C9, AC, 3C, 2E, 74,  4, 3C, 5C,  72E
850 DATA 75,  2, EB, D4, 3C, 2E, 75,  2, EB, CE, 49, 3C, 2E, 75, EA, EE,  6E7
860 DATA C6,  4,  0, B9, 3F, FB,  1, EB, FD,  1, B9,  E,  1,  2, EB,  5,  547
870 DATA D5, B0,  0, 3D, CD, 21, 73,  C, C6,  6, 24, EB, B2,  1, BA, 11,  688
880 DATA  2, E9, 42,  1, EB, D8, BA, E9,  6, B9,  1, FF, B4, 3F, CD, 21,  709
890 DATA 73,  6, BA, 1F,  2, E9, 2E,  1, 3B, C1, 75,  6, BA, 39,  2, E9,  901
900 DATA 24,  1, A3,  5,  2, B4, 3E, CD, 21, EB, 1E, F9,  1, EB, 2E,  1,  582
910 DATA  2,  B, ED, 75,  4, EB, EB, EB, 13, EB, F5, BF, 33,  2, B9,  4,  718
920 DATA  0, F3, A6, 75,  3, C6,  6,  3,  2,  1, EB, D9, EB, 36, FD,  1,  6FE
930 DATA EB, CD, 20, CE, B9,  E, FF,  1, BF, B8,  4, F3, A4, EB, 20,  2,  787
940 DATA EB, FD, B9,  4,  0, F3, A4, EB, 16, F9,  1, 33, C9, B4, 3C, CD,  832
950 DATA 21, 73,  6, BA, 1F,  2, E9, CD,  0, A3,  7,  2, EB,  E, FF,  1,  578
960 DATA 83, C1,  3, EB, B0,  0, EB, 2E,  5,  2, EB, E9,  6, B9, 96,  6,  687
970 DATA C7,  6,  B,  2,  3,  0, EB, DB,  0, B9, 18,  0, B8, 20, AA, 77,  5E2
980 DATA  6,  B,  2, AC, EB, E9,  0, 4D, 74,  3, 83, F9, EB,  E, B,  2,  504
990 DATA E9, A3,  0, EB, D0, EB,  E,  B,  2, EB, BA,  0, BA, 95,  2, B9,  788
1000 DATA  6,  0, E8, BA,  0, A1,  5,  2, 50, BA, C4, BF, 86,  6, E8, BF,  6E0
1010 DATA  0, 59, E8, 3B,  0, B9,  5,  0, E8, 7B,  0, BA, 5B,  2, B9,  A,  636
1020 DATA  0, E8, 6B,  0, 8B, 2E,  4,  2,  1, 74, 3D, BA, A5,  2, B9, 8F,  593
1030 DATA  0, E8, 5B,  0, 8B, 3E,  3,  2,  1, 75, 2D, BA, 55,  3, B9, 85,  559
1040 DATA  0, E8, 4B,  0, 8B, 16, FD,  1, 52, B8,  0, FF,  1, 51, E8, 3E,  634
1050 DATA  0, BA, 85,  6, B9,  1,  0, E9, 35,  0, 59, 5A, E8, 30,  0, BA,  5A1
1060 DATA 33,  2, B9,  6,  0, E8, 27,  0, B8, 1E,  7,  2, B4, 3E, CD, 21,  495
1070 DATA 72, 11, B8, 16, F9,  1, E9, 77,  0, BA, BA,  2, E9, 71,  0, 33,  64E
1080 DATA C0, E8,  0, BA, 1F,  2, E9, 67,  0, B9,  1, B4, 4C, CD, 21, B4,  730
1090 DATA 40, CD, 21, 72, EE, C3, BA, 85,  6, B8, 1E,  7,  2, E8, EF, FF,  91E
1100 DATA 0C,  6, B6,  6,  D, 0C,  6,  7,  A, BA, B6,  6, B9,  2,  0,  4C9
1110 DATA E8, DC, FF, C3, B8, 45, AA, B9, 20, AA, A1,  9,  2, 50, B6, C4,  885
1120 DATA E9,  D,  0,  5, B, A1,  9,  2, E8,  6,  0, B3,  6,  9,  2, 10, C3,  44E
1130 DATA 51, BA,  2,  9, BA, D0, B1,  4, D3, C3, 8A, C3, 24,  F,  4, 30,  46D
1140 DATA 3C, 39, 76,  3,  4,  7, AA, FF,  6,  9,  2, 4A, 75, E8, 59, C3,  577
1150 DATA B4,  9, CD, 21, C3, 20, 4E, 20,  0,  0,  0,  0,  0,  0,  0,  0,  2FC
1160 DATA 124351
```

DEBUGSCR.BAS: As an alternative to using a macro assembler, running this listing in BASIC will automatically create DEBUGSCR.COM.

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Every word processor, however, knows how to interpret an ASCII file, because ASCII is a globally accepted standard. That's why you are asked to save a document in pure ASCII form when the file is destined for another word processor or any generic use. In the process of saving the document in ASCII, the word processor strips all its special codes.

MCI AND BINARY

MCI assumes everything you send its way is an ASCII-interpreted character. When you upload a file, MCI also ignores all the control characters other than the carriage return, line-feed, and tab characters. If you try to upload a binary file and it has any of the other control characters, they will be stripped out of the transmission. A binary file will almost always have some bytes that look like ASCII control codes, so a binary file upload will be incomplete.

DEBUGSCR makes use of DEBUG's command set and ability to write binary files to disk.

The other part of the story is that e-mail services in general, and MCI in particular, will accept only the first 7 bits of a byte. The 8th bit is always assumed to be zero. A binary file invariably contains bytes that have the 8th bit "set" (that is, equal to one), but this "high bit" is ignored by MCI.

If you've ever tried to send a text file containing box drawing characters from the IBM Extended character set to 7-bit systems like MCI, you've probably noticed that you get M's and @'s and such instead of the desired line characters. This is because the 8th bit is not accepted and the 7 remaining bits are interpreted as a low ASCII character-set value. A high-ASCII vertical line character with a value of 179, for example, is received as a 51—the decimal value for the ASCII numeral 3 character. The reason *Lotus Express* can send 8-bit binary files is that it shifts MCI into a protocol that handles 8-bit data through proprietary codes.

HOW DEBUGSCR WORKS

DEBUGSCR makes use of DEBUG's command set and of its ability to write binary files to disk. As seen in Figure 1, the first DEBUG command in DEBUGSCR's script file is N for the Name of the file to be written to disk. Following the N command line comes the bulk of the script, which consists of a series of E (Enter) commands. The first number after the E command is the address offset in memory at which to start entering the hexadecimal byte values that are to follow. All numbers in DEBUG are in hexadecimal notation.

Up to 16 values follow the E address argument. Sixteen values per line is convenient when working with an 80-column display. More convenient still, since 16 decimal is 10 in hex, the next E address offset argument will always be an even 10h larger. DEBUG's E command is very similar to BASIC's POKE command. The DEBUGSCR script file uses the E command to place the values of the original binary file sequentially in memory.

Once an exact image of the original binary file has been poked into memory, DEBUG needs to know how many bytes to write to disk. This is done by loading the CX register with the size of the file. The RCX (Register CX) command displays the current value of the CX register, and the following line gives DEBUG the new value. In the example shown in Figure 1, this new value is 0152, because the TOGGLE .COM file is 0152h (338 decimal) bytes long. (Programmers will recognize that actually it's the BX:CX pair of registers that tells you the length of the file. DEBUGSCR is limited to files of less than 64K, however, which only require the CX register for this information. DEBUG initializes BX to zero.)

The W command then causes DEBUG to write the memory image to the filename specified by the earlier N command. If W is entered without an argument, the write starts at memory offset 100h. (That's why the first E command is at 100h.) The last command in the script is Quit, which returns control to the DOS prompt. If the file written was an .EXE file, it must now be renamed with the .EXE extension, as explained above. The warning message for this is shown at label EXE_MSG in the source code listing.

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BUGSCR script files lies in the fact that DEBUG understands the DOS < redirection command. The less-than sign tells DEBUG to get all its subsequent commands from the file named immediately after the <, just as if they had been typed in at the keyboard.

BINARY TO HEX ASCII

Figure 2 shows the steps involved in converting the first 4 bytes of a sample .EXE binary file into a hexadecimal ASCII script file. The binary file bytes have the values 4Dh, 5Ah, 01h, and E1h, which have an IBM-extended ASCII interpretation of M, Z, a happy face control character ( ), and a lowercase Greek beta ( ). Since the first two bytes fall within the standard alphanumeric section of the ASCII table, *they* could be successfully uploaded to MCI without change. The 01h control character, however, would be lost, and the 8th bit of the E1h byte would not be accepted and would end up as 61h, a lowercase *a*. Thus the need for conversion.

The first step in the process is to separate each byte into its hexadecimal halves, which are known as nibbles. Each nibble is placed in the lower half of a byte of its own, with the high nibble of the new byte set to zero. The value of 30h (which is the value for the ASCII character zero) is added to each of these bytes. This converts a hex value into an ASCII character representation. For example, in Figure 2 the original 04h value ends up as 34h, the value for the ASCII numeral 4 character.

This works fine for the values between 0 and 9. Another step must occur to handle hexadecimal values above 9. Hexadecimal notation uses the letters A through F for the decimal values 10 through 15. Since there are seven characters that separate the 9 and the capital A in the ASCII table, to complete the ASCII hex conversion, another 7 must be added to all first-stage conversions that end up above 39h. For example, adding 30h to the 0Dh half of the ASCII M results in 3Dh. Since this is above 39h, an additional 7 is added to its value to get the 44h, an ASCII D.

The ASCII results are the character representations of each nibble of the original binary file. Every resulting value falls between 0 and 9 and A and F, all of which are ASCII text characters that can be sent via MCI. DEBUGSCR then places a space character (ASCII 20h) in the script file in between each pair of ASCII nibbles. Each pair represents a single binary byte. When DEBUG gets the ASCII hex file it simply reverses the process to convert it back to the original binary values.

There are two reasons for converting into hex ASCII instead of decimal ASCII. The first is that hexadecimal values can always be represented by two ASCII bytes. The largest value a byte can have in hex is FF. That value is 255 in decimal, which requires 3 bytes instead of the 2 hex bytes. Hexadecimal, therefore, makes for smaller script files. (Incidentally, smaller listings are also the reason the BASIC data listings in this column are done in hex.) More importantly, hex is used because that's the number system DEBUG understands.

So now that you understand DEBUGSCR, give it a try the next time you need to send a binary file via e-mail. ■

Michael J. Mefford is a contributing editor of PC Magazine.

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by
Charles Petzold

Environments

Beyond the Consistent User Interface of the Presentation Manager

■ A programmer's creativity need not fall victim to standardized handling of menus and scroll bars. Here's an enhancement a lot of programmers should consider using.

The consistent user interface it provides is a major selling point for a graphical environment such as the OS/2 Presentation Manager. Code to handle the most common items in the user interface (menus, dialog boxes, text entry fields, scroll bars) is built right into the environment, making it available to every application. Thus, even a relatively small PM program can come with all the trappings of a sophisticated user interface.

The consistent user interface is a great advantage for users, as well. The menu system incorporated into most Presentation Manager programs provides a good illustration. The main menu bar always appears near the top of the program's window, right under the title bar. Submenus are often invoked by selecting items on the main menu bar. The use of the keyboard and mouse to choose items on the menu is entirely consistent among applications.

There are even published guidelines for structuring the user interface, so programmers can deliberately follow conventions established by existing applications. For example, programs that work with documents must have a menu option to open an existing document file. The conventions establish that the first item on the main menu bar should be "File." Selecting this item invokes a submenu that includes the item "Open." Users can select this option using the mouse or with three keystrokes: Alt, F, and O. That makes it easy for users to move from one PM program to another.

DO WE WANT THIS?

The whole idea of a consistent user interface scares some people. How can we be sure that the user interface chosen by the developers of the system is the best possible interface?

Well, we can't, of course. Such judgments *are* subjective, and if the best possible interface were obvious to everyone, we wouldn't have thousands of different user interfaces under DOS. What all these inconsistent interfaces really show, however, is that PC users seem able to get accustomed to almost anything. People often identify the best user interface with the one used by their favorite application. This is not because they originally chose the application for that style of user interface, but rather because the interface grew on them.

We are entering an era in which the same look and feel will be found in three major environments, under three major operating systems: *Microsoft Windows* under DOS, the Presentation Manager under OS/2, and OSF/Motif under Unix. Users will be able to move among these three environments without problems.

The PM user interface is also part of the CUA (Common User Access) component of IBM's SAA (Systems Application Architecture). This means that when IBM's minicomputer and mainframe applications begin moving to a graphical interface, they too will look and feel like the OS/2 Presentation Manager, *Windows*, and OSF/Motif. IBM has also defined a character-mode user interface in SAA that works very similarly to the graphical user interface.

Moreover, the general style of this user interface is common on other graphical environments, such as the Macintosh. Someone conversant with *Windows* or PM can sit down at a Mac and begin using it immediately. Even some character-mode programs under DOS have been adopting the SAA-style interface.

The key point here is consistency—even if the user interface of PM were terrible, it would still be useful, because it

POPMENU — **COMPLETE LISTING**

```
#-------------------
# POPMENU make file
#-------------------

popmenu.obj : popmenu.c popmenu.h
     cl -c -G2sw -W3 popmenu.c

popmenu.res : popmenu.rc popmenu.h
     rc -r popmenu

popmenu.exe : popmenu.obj popmenu.def
     link popmenu, /align:16, NUL, os2, popmenu
     rc popmenu.res

popmenu.exe : popmenu.res
     rc popmenu.res
```

Figure 1: The POPMENU Make file aids in the construction of POPMENU.EXE.

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would at least be consistent with everything else. Further, since the user interface code is built into the operating system, it's even possible for a later version of the operating system to improve it in some way, and (in effect) automatically improve all existing programs that use it.

Another fear that some people have is that a consistent user interface will lead to a bland uniformity among applications. In fact, however, this has certainly not been the case with applications for the Macintosh and *Windows*. Some of the programs for these environments have been among the most interesting and powerful ever developed. When you get right down to it, the environment implements only the most common and mundane aspects of the user interface. A program's real look, feel, and functionality encompasses much more than menus, dialog boxes, and scroll bars.

Finally, some people see no need for a consistent user interface. After all, it is common knowledge that in many corporations most PC users work with only one or two application programs, such as *Lotus 1-2-3* or *WordPerfect*. I contend, however, that the extreme differences among user interfaces in DOS applications are precisely what prevent people from using other programs and extending the productivity of their PCs.

When users can move from one application to another without completely reorienting their fingers and minds, they will do so—especially when they can use these applications synergistically. The Presentation Manager allows easy switching among applications and permits transferring data between them using the clipboard or DDE (Dynamic Data Exchange).

CREATIVE OPPORTUNITIES

Programmers are by no means locked into the PM look and feel. You might want to write a Presentation Manager program that embodies your own, unique user interface. If you so wish, there's nothing to stop you.

The most extreme approach of this kind would be to create a blank window that occupies the full screen in the Presentation Manager session. The program could draw whatever it wants on that window (including its own menus), and do all its own keyboard and mouse input processing. Indeed, the program could even ignore the mouse entirely and hide the mouse pointer.

I must observe, however, that historically this approach has been disastrous. In the early days of the Apple Macintosh, some developers attempted to port programs from other environments without adapting them to the Macintosh interface. Mac users almost unanimously rejected these applications. I think this indicates that users want a consistent user interface. Even though you are certainly not locked into the Presentation Manager look and feel, you ignore it at your own risk.

MENU EXTENSIONS

Of course, it is also possible to extend the user interface in some way. In one sense almost every application does this because it requires some user input beyond the menu, dialog boxes, and scroll bars. In a broader sense, however, suppose an application were to offer the user an alternative to the standard interface?

I have an example in mind—a new Presentation Manager application I've been looking at recently. I can't discuss the program itself; it's still in development as I write this column (in August). But I can discuss how the program extends its menu interface.

The application in question has a standard menu bar, of course, which works exactly the same as the menus found in other Presentation Manager programs. However, if you press the right mouse button on one of the client windows in this program, a pop-up menu appears at the mouse point-

POPMENU.C 1 of 2

```
/*-----------------------------------------------------------
   POPMENU.C -- Popup Menus for OS/2 Presentation Manager
                (c) 1989, Ziff Communications Co.
                PC Magazine * Charles Petzold, August 1989
  -----------------------------------------------------------*/

#define INCL_WIN
#include <os2.h>
#include "popmenu.h"

MRESULT EXPENTRY ClientWndProc (HWND, USHORT, MPARAM, MPARAM) ;
MRESULT EXPENTRY AboutDlgProc  (HWND, USHORT, MPARAM, MPARAM) ;

int main (void)
     {
     static CHAR  szClientClass[] = "PopMenu" ;
     static ULONG flFrameFlags = FCF_TITLEBAR     | FCF_SYSMENU |
                                 FCF_SIZEBORDER   | FCF_MINMAX  |
                                 FCF_SHELLPOSITION| FCF_TASKLIST |
                                 FCF_MENU ;
     HAB         hab ;
     HMQ         hmq ;
     HWND        hwndFrame, hwndClient ;
     QMSG        qmsg ;

     hab = WinInitialize (0) ;
     hmq = WinCreateMsgQueue (hab, DEFAULT_QUEUE_SIZE) ;

     WinRegisterClass (hab, szClientClass, ClientWndProc, 0L, 0) ;

     hwndFrame = WinCreateStdWindow (HWND_DESKTOP, WS_VISIBLE,
                                     &flFrameFlags, szClientClass, NULL,
                                     0L, NULL, ID_NORMAL, &hwndClient) ;

     while (WinGetMsg (hab, &qmsg, NULL, 0, 0))
          WinDispatchMsg (hab, &qmsg) ;

     WinDestroyWindow (hwndFrame) ;
     WinDestroyMsgQueue (hmq) ;
     WinTerminate (hab) ;
     return 0 ;
     }

MRESULT EXPENTRY ClientWndProc (HWND hwnd, USHORT msg,
                                MPARAM mp1, MPARAM mp2)
     {
     static HWND hwndMenuPopup ;
     HPS         hps ;
     POINTL      ptlMouse ;

     switch (msg)
          {
          case WM_CREATE:
               hwndMenuPopup = WinLoadMenu (hwnd, NULL, ID_POPUP) ;
```

Figure 2: The POPMENU.C file contains the source code for the program that extends the standard PM user interface by providing pop-up menus.

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POPMENU.C 2 of 2

```
            WinSetWindowPos (hwndMenuPopup, NULL,
                             0, 0, 0, 0, SWP_SIZE) ;
            WinSetParent (hwndMenuPopup, HWND_DESKTOP, FALSE) ;
            return 0 ;

        case WM_BUTTON2UP:
            WinQueryPointerPos (HWND_DESKTOP, &ptlMouse) ;
            ptlMouse.y += WinQuerySysValue (HWND_DESKTOP,
                                            SV_CYMENU) ;

            WinSetWindowPos (hwndMenuPopup, NULL,
                             (SHORT) ptlMouse.x, (SHORT) ptlMouse.y,
                             0, 0, SWP_MOVE) ;

            WinSendMsg (hwndMenuPopup, MM_SELECTITEM,
                        MPFROM2SHORT (IDM_POPUP, FALSE),
                        MPFROMSHORT (FALSE)) ;

            WinSetCapture (HWND_DESKTOP, hwndMenuPopup) ;
            return 0 ;

        case WM_COMMAND:
            switch (COMMANDMSG(&msg)->cmd)
                {
                case IDM_ABOUT:
                    WinDlgBox (HWND_DESKTOP, hwnd, AboutDlgProc,
                               NULL, IDD_ABOUT, NULL) ;
                    return 0 ;
                }
            break ;

        case WM_PAINT:

            hps = WinBeginPaint (hwnd, NULL, NULL) ;
            GpiErase (hps) ;
            WinEndPaint (hps) ;
            return 0 ;
        }
    return WinDefWindowProc (hwnd, msg, mp1, mp2) ;
    }

MRESULT EXPENTRY AboutDlgProc (HWND hwnd, USHORT msg,
                               MPARAM mp1, MPARAM mp2)

    {
    switch (msg)
        {
        case WM_COMMAND:
            switch (COMMANDMSG(&msg)->cmd)
                {
                case DID_OK:
                case DID_CANCEL:
                    WinDismissDlg (hwnd, TRUE) ;
                    return 0 ;
                }
            break ;
        }
    return WinDefDlgProc (hwnd, msg, mp1, mp2) ;
    }
```

er position. After you choose an item from that menu, the menu disappears. Although pop-up menus are found on some graphical user interfaces, they are certainly not part of the standard PM interface.

The more I used these pop-up menus, the more I liked them. If I happened to be doing something in the client window with the mouse, it was a lot easier just to press the right mouse button for the menu instead of moving the mouse to the normal menu at the top of the window. Because Presentation Manager applications rarely make use of the right mouse button anyway, giving the button this function makes a lot of sense.

The program seemed to be using the built-in Presentation Manager menu logic for the pop-up menus. I was intrigued, however, that the application's programmers had found some way to force the menu to appear not at the top of the window, but at a location based specifically on the mouse position.

Naturally, I couldn't resist attempting to reproduce this amazing feat in one of my own programs. The task turned out to be less complex than I had initially feared. In fact, it was remarkably easy, which indicates to me a high degree of generality in the PM user interface code. The pop-up menus that I developed don't work exactly the same as those in the application I'd been examining, but they are fairly close and certainly usable.

THE POPMENU PROGRAM

Figures 1 through 5 contain all the files needed to create POPMENU, a program that includes both a conventional Presentation Manager menu and a pop-up menu you can invoke by pressing the right mouse button from any point within the client window.

As usual, if you have the Microsoft C Compiler 5.1 and the OS/2 Programmers Toolkit (or Presentation Manager Softset) installed, you can create POPMENU.EXE by running

```
MAKE POPMENU
```

You can download all source code and POPMENU.EXE from PC MagNet. You will, of course, need OS/2 1.1 or later to run POPMENU.EXE.

POPMENU doesn't do much of anything except demonstrate the pop-up menu. The program shows many menu options, but it responds to only one of them—the "About PopMenu" option, which displays a dialog box.

The screen shot in Figure 6 shows the program's standard menu. The three top-level items (File, Edit, and Options) appear across the menu bar near the top of the program's window. As seen in Figure 6, the Options item has been selected to display a submenu descending from the main menu bar; the Speed option on that submenu has been selected to display another submenu to the right of the Speed option. The Presentation Manager's ability to use nested submenus is an advance beyond what *Microsoft Windows* offers. This enhancement turns out to be important in implementing the pop-up menu.

Figure 7 shows the pop-up menu in use. When you click the right mouse button in the client window, the three top-level items are arranged vertically in a small window. The upper-left corner of the window is at the mouse pointer position. You can then use the left mouse button to select items. As in Figure 6, I've selected the Options item, which shows a submenu to its right, and the Speed option, which puts another submenu to *its* right.

Unlike a normal Presentation Manager menu, this pop-up menu has no keyboard interface. You use the left mouse button to

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- ☐ 1-25
- ☐ 26-100
- ☐ Over 100

D. How many PCs does your company plan to purchase in the next 12 months?
- ☐ 1-25
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- ☐ Business owner

C. How many business PCs do you now have installed?
- ☐ 1-25
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D. How many PCs does your company plan to purchase in the next 12 months?
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select items; the right mouse button only invokes the pop-up menu itself. When you make a selection, the pop-up menu disappears. To dismiss the menu without making a selection, you press the left mouse button when its pointer is outside the pop-up menu's windows. The pop-up menu then disappears and the mouse click has no effect on the window below.

A TALE OF TWO TEMPLATES

Let's take a look at the source code to see how this enhancement of the standard interface is accomplished. First, direct your attention to POPMENU.RC. This is the resource script file, which contains templates for the program's normal and pop-up menus and for the dialog box, as well.

The template for the normal menu begins with the line

```
MENU ID_NORMAL
```

MENU is a keyword recognized by the resource compiler. ID_NORMAL identifies a constant defined in the POPMENU.H header file. The POPMENU.C program uses this constant to refer to the menu.

The normal menu is standard stuff. The template is organized with the usual hierarchy of menu items. All items that invoke submenus are indicated by the SUBMENU keyword. A SUBMENU statement must be followed by a pair of curly brackets that contain the items on the submenu. The MENUITEM keyword indicates an option that can be chosen by the user. The tildes (~) in the text strings indicate the letter that is underlined in the menu. This is the key-letter for the menu's keyboard interface. All the items the user can choose are followed by constant identifiers (these are defined in POPMENU.H) that begin with the prefix IDM (ID for a Menu item). The Presentation Manager uses these ID numbers to identify chosen menu items to the program.

The pop-up menu begins with the following line:

```
MENU ID_POPUP
```

Its organization is similar to that of the normal menu. Note, however, that it begins with a SUBMENU statement in which the rest of the menu is nested. If you were to

POPMENU.RC 1 of 2

```
/*----------------------------
   POPMENU.RC resource script
  ----------------------------*/

#include <os2.h>
#include "popmenu.h"

MENU ID_NORMAL
     {
     SUBMENU "~File",                -1
          {
          MENUITEM "~New",                IDM_NEW
          MENUITEM "~Open",               IDM_OPEN
          MENUITEM "~Save",               IDM_SAVE
          MENUITEM "Save ~As",            IDM_SAVEAS
          MENUITEM SEPARATOR
          MENUITEM "A~bout PopMenu...", IDM_ABOUT
          }
     SUBMENU "~Edit",                -1
          {
          MENUITEM "Cu~t",                IDM_CUT
          MENUITEM "~Copy",               IDM_COPY
          MENUITEM "~Paste",              IDM_PASTE
          MENUITEM "C~lear",              IDM_CLEAR
          }
     SUBMENU "~Options",             -1
          {
          SUBMENU "~Color",          -1
               {
               MENUITEM "~Red",           IDM_RED
               MENUITEM "~Green",         IDM_GREEN
               MENUITEM "~Blue",          IDM_BLUE
               }
          SUBMENU "~Size",           -1
               {
               MENUITEM "~Small",         IDM_SMALL
               MENUITEM "~Medium",        IDM_MEDIUM
               MENUITEM "~Large",         IDM_LARGE
               }
          SUBMENU "S~peed",          -1
               {
               MENUITEM "~Slow",          IDM_SLOW
               MENUITEM "~Medium",        IDM_MEDSPEED
               MENUITEM "~Fast",          IDM_FAST
               }
          }
     }

MENU ID_POPUP
     {
     SUBMENU "",                     IDM_POPUP
          {
          SUBMENU "File",                -1
               {
               MENUITEM "New",                IDM_NEW
               MENUITEM "Open",               IDM_OPEN
               MENUITEM "Save",               IDM_SAVE
               MENUITEM "Save As",            IDM_SAVEAS
               MENUITEM SEPARATOR
               MENUITEM "About PopMenu...",  IDM_ABOUT
               }
          SUBMENU "Edit",                -1
               {
               MENUITEM "Cut",                IDM_CUT
               MENUITEM "Copy",               IDM_COPY
               MENUITEM "Paste",              IDM_PASTE
               MENUITEM "Clear",              IDM_CLEAR
               }
          SUBMENU "Options",             -1
               {
               SUBMENU "Color",          -1
                    {
                    MENUITEM "Red",           IDM_RED
                    MENUITEM "Green",         IDM_GREEN
                    MENUITEM "Blue",          IDM_BLUE
                    }
               SUBMENU "Size",           -1
                    {
                    MENUITEM "Small",         IDM_SMALL
                    MENUITEM "Medium",        IDM_MEDIUM
                    MENUITEM "Large",         IDM_LARGE
                    }
```

Figure 3: The POPMENU.RC resource script contains templates for the menus and dialog box.

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POPMENU.RC 2 of 2

```
            SUBMENU "Speed",          -1
                {
                MENUITEM "Slow",          IDM_SLOW
                MENUITEM "Medium",        IDM_MEDSPEED
                MENUITEM "Fast",          IDM_FAST
                }
            }
        }

DLGTEMPLATE IDD_ABOUT
    {
    DIALOG "", 0, 32, 32, 200, 100,, FCF_DLGBORDER
        {
        CTEXT "PopMenu"                          -1, 10, 76, 180, 8
        CTEXT "PC Magazine, Vol. 8 No. 20"       -1, 10, 52, 180, 8
        CTEXT "(c) 1989, Ziff Communications Co." -1, 10, 42, 180, 8
        CTEXT "Programmed by Charles Petzold, 8/89" -1, 10, 32, 180, 8
        DEFPUSHBUTTON "OK"              DID_OK, 80, 8, 40, 16, WS_GROUP
        }
    }
```

use such a template for a program's normal menu, only one option would appear on the main menu bar; everything else would be in submenus. I have given this item a blank text string (as we will see, it is not displayed anyway) and the identifier IDM_POPUP.

I've also removed all the tildes from the text strings in this template, since there is no keyboard interface on the pop-up menu. Otherwise, everything is the same as in the normal menu template.

MENU OVERHEAD

Now let's turn to POPMENU.C, the C source code file. Including the normal menu in the program's window is easy; it involves only some data and code near the beginning of the main function. Specifically, all you need to do is include the FCF_MENU identifier with all the other FCF (frame creation flag) identifiers and to specify the menu identifier (ID_NORMAL) as the penultimate parameter to WinCreateStdWindow.

Whenever the user chooses an item from the menu, the client window receives a WM_COMMAND message. You'll notice in ClientWndProc (the window procedure for the client window), that POPMENU ignores all menu items except IDM_ABOUT, to which the program responds by displaying a dialog box.

The overhead for the pop-up menu begins when the client window is first created and receives a WM_CREATE message. The program calls WinLoadMenu with ID_POPUP as the last parameter, in order to load the menu template from the program's resources and turn the template into a menu window. The function returns a handle to the menu window, which is stored in the static variable hwndMenuPopup. The menu window now exists, but it is not visible, because it has horizontal and vertical dimensions of zero.

Just to be on the safe side, since the menu window is not documented as being created with a zero size, the WinSetWindowPos function is called to set the size to zero explicitly. (This particular function can accomplish quite a few tasks; it will be used later to set the position of the menu window.)

POPMENU.H COMPLETE LISTING

```
/*------------------------
   POPMENU.H header file
  ------------------------*/

#define ID_NORMAL          1
#define ID_POPUP           2

#define IDM_NEW            1
#define IDM_OPEN           2
#define IDM_SAVE           3
#define IDM_SAVEAS         4
#define IDM_ABOUT          5
#define IDM_CUT            6
#define IDM_COPY           7
#define IDM_PASTE          8
#define IDM_CLEAR          9
#define IDM_RED           10
#define IDM_GREEN         11
#define IDM_BLUE          12
#define IDM_SMALL         13
#define IDM_MEDIUM        14
#define IDM_LARGE         15
#define IDM_SLOW          16
#define IDM_MEDSPEED      17
#define IDM_FAST          18

#define IDM_POPUP         20

#define IDD_ABOUT          1
```

Figure 4: The POPMENU.H header file contains definitions of the constants required by both POPMENU.C and POPMENU.RC.

ANATOMY OF A MENU

Although we speak of a menu and of a menu window, menus are really collections of multiple windows. In the Presentation Manager, windows are always rectangular. One window is required for the horizontal menu bar. This is called the top-level menu. Each submenu requires its own window.

The WinLoadMenu function creates all the windows and returns the handle to the top-level menu window. In POPMENU, the function creates eight windows: the top-level menu window and one window for each of the seven submenus.

The top-level window is not visible, because it has zero dimensions. If this top-level menu window had a nonzero dimension, it would consist of a horizontal menu bar with only one item in it—the item indicated by the first SUBMENU statement in the template (which, in this case, happens to be a blank string).

The seven submenus are not visible either. Submenus are always initially made children of a special window known as HWND_OBJECT. The children of HWND_OBJECT are known as *object windows*, and object windows are not visible on the screen. To display a submenu, the top-level menu changes the parent of the submenu window from HWND_OBJECT to HWND_DESKTOP, the desktop

POPMENU.DEF COMPLETE LISTING

```
;------------------------------------
; POPMENU.DEF module definition file
;------------------------------------

NAME            POPMENU   WINDOWAPI

DESCRIPTION     'Popup Menu (c) 1989, Ziff Communications Co.'
PROTMODE
HEAPSIZE        1024
STACKSIZE       8192
EXPORTS         ClientWndProc
                AboutDlgProc
```

Figure 5: POPMENU.DEF holds information LINK uses in constructing POPMENU.EXE.

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window. (It can do this by calling WinSetParent.) This causes the submenu to become visible on the screen. When the top-level menu window wishes to hide the submenus again, it changes the parent back to HWND_OBJECT. This is all handled internally in the menu logic within the Presentation Manager.

The first parameter of the WinLoadMenu function is a window handle. I used hwnd, the handle to the client window. The WinLoadMenu function assigns this window as both the parent and the owner of the top-level menu window. The owner relationship is very important: when a user chooses an item from the menu, the menu window will send a WM_COMMAND message to its owner. Because we want the WM_COMMAND messages to come to the client window, the client window must be the owner of the top-level menu window.

You'll notice that the final step concludes WM_CREATE processing in POPMENU by calling WinSetParent to set the parent of the top-level menu window to HWND_DESKTOP. I do this because . . . well, because I couldn't get the program to work right otherwise! I confess I'm not quite sure *why* this is necessary, but it is.

INVOKING THE POP-UP

The pop-up menu must be invoked when the right mouse button is pressed and released. When the client window receives a WM_BUTTON2UP message, it first calls WinQueryPointerPos to obtain the coordinates of the mouse pointer relative to the lower-left corner of the screen. These coordinates are stored in a POINTL structure named ptlMouse. For reasons I'll explain shortly, the *y*-coordinate must be adjusted by adding a value obtained from the WinQuerySysValue function.

The program then calls WinSetWindowPos to set the position of the lower-left corner of the top-level menu window relative to the lower-left corner of its parent (the desktop window). This requires passing the two fields of the ptlMouse structure, along with the identifier SWP_MOVE, as parameters to the WinSetWindowPos function.

In the Presentation Manager, windows are always rectangular. One window, called the top-level menu, is responsible for the horizontal menu bar. Each submenu requires its own window.



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Nothing is yet visible on the screen. The top-level menu window still has a dimension of zero, and that will not change. We now need to force the top-level menu window to invoke the first pop-up window—the window, as seen in Figure 7, that contains the three items, File, Edit, and Options. This is done by simply sending a message named MM_SELECTITEM to the top-level menu window with a call to WinSendMsg. This procedure causes the menu to display the first submenu window.

This submenu window is positioned by the top-level menu window. The position of the submenu is set so that the top of the submenu window touches the bottom of the top-level menu window. Apparently, however, the top-level menu calculates this position by subtracting the standard height of menu bars from the top of the window. This doesn't work quite right because this top-level menu happens to have a zero height. That's why I first adjust the y field of the ptlMouse by adding the standard height of menu bars. (This information is available from WinQuerySysValue.) This adjustment causes the upper-right corner of the submenu to be positioned at the mouse pointer.

The final step required is to call WinSetCapture on behalf of the menu window in order to force all mouse input to go to the menu window. This ensures that the menu window will recognize when the left mouse button has been pressed outside the menu and will dismiss all the submenu windows.

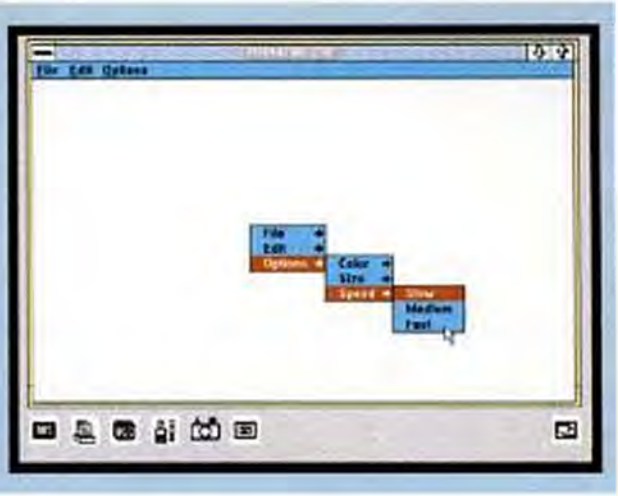


Figure 7: When you click the right mouse button in POPMENU's client window, a new window appears, with its upper-left corner at the mouse pointer position. The three top-level items are arranged vertically in this window. You can use the left mouse button to select items.

WinSetCapture ensures that the menu window will recognize when the left mouse button has been pressed outside the menu and will dismiss all the submenu windows.

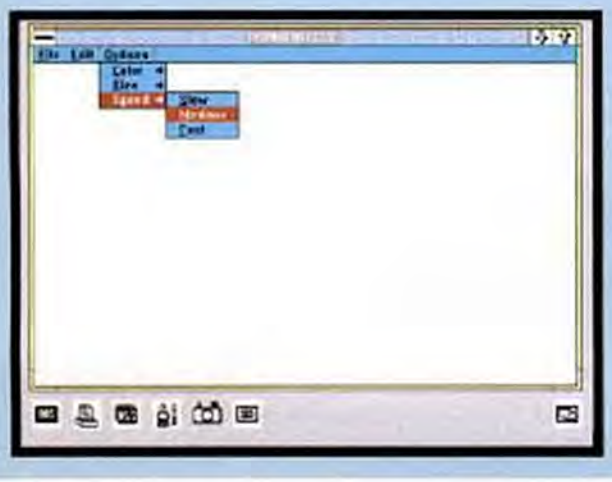


Figure 6: POPMENU's normal Presentation Manager menu.

And that's it! A total of eight Presentation Manager function calls (and very little ancillary code) is all that's required to implement pop-up menus.

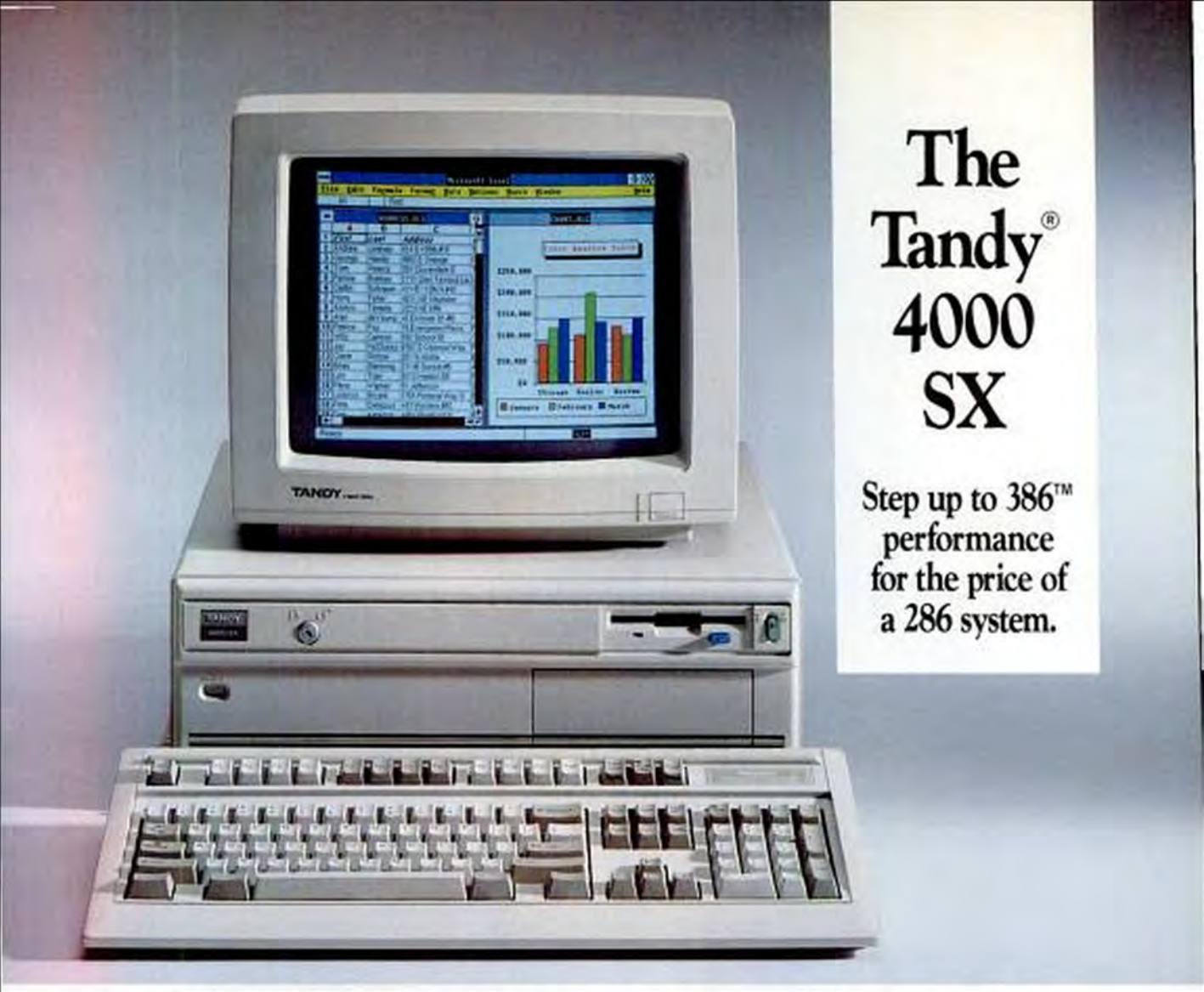
OBJECT ORIENTED?

I got the idea to attempt a pop-up menu after looking at an unreleased PM application that did something similar. This is a large application that creates several different types of standard windows. In some of these standard windows, the client window is separated into several rectangular areas by child windows. Each of these child windows is responsible for a different task. In such windows, the program implements several different pop-up menus. The pop-up menu you get depends on the child window in which the mouse pointer is positioned when you press the right button.

This technique seems to me to exemplify a rather object-oriented approach to menu design. Each child window has certain commands associated with it, and the pop-up menu need contain only those commands. Each child window is responsible for displaying data (and sometimes receiving user input) of a specific sort, so the pop-up menu lists only those commands that the particular child window understands. The main menu in these windows lists all the commands that all the windows understand.

For a program organized in this way, the pop-up menus make a lot of sense. Perhaps someday they will be explicitly supported in the Presentation Manager and will require only one function call rather than eight. That would be a very nice enhancement to the PM user interface. ■

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by
Ray Duncan

Power Programming

Arithmetic Routines For Your Computer Programs, Part 2

Last time, I discussed single- and double-precision integer arithmetic operations on the 80x86 family of processors. In this column, I want to generalize those techniques to cover integer addition, subtraction, and multiplication using any precision you might want or need in your programs. In the next installment, I'll talk a little more about multiplication and then address multiple-precision division.

Before beginning, however, a brief digression into the more-treacherous waters of data formats is in order.

■ This installment covers addition, subtraction, and multiplication, both in generalized C-like form and in full assembly language routines.

BIG-ENDIANS AND LITTLE-ENDIANS

When you program in a high-level language, you generally do not need (or want) to know how the component bytes of an arithmetic value are laid out in memory. If you program in an assembly language, on the other hand, an understanding of binary data formats is absolutely vital. If you are going to load an integer from memory into registers (or vice versa), you clearly need to know which end of the integer is which.

You may be surprised to hear that the world is divided into two hostile camps (wags have dubbed them the "Big-Endians" and the "Little-Endians") over this seemingly innocuous issue. The Big-Endians are committed to a data format that puts the most significant byte of an integer at the lowest memory address, the next most significant byte at the next-higher address, and so on. The Little-Endians, by contrast, are firm believers in a data format in which the least significant byte of the number is placed at the lowest memory address and the most significant byte at the highest memory address occupied by the number.

To make the difference in storage techniques more concrete, consider the 32-bit integer 12345678h, which is composed of four bytes. On a Little-Endian CPU, the four bytes would be layed out in memory thus:

```
78h 56h 34h 12h
```

with 78h occupying the lowest address and 12h the highest. On a Big-Endian CPU, on the other hand, again moving upward from the lowest to the highest address, the four bytes would be arranged in memory as follows:

```
12h 34h 56h 78h
```

Although there are many different examples of CPUs that use each of these data formats, the front lines in this silly little war are manned by the Intel 80x86 users on the side of the Little-Endians and by the Motorola 680x0 users on the side of the Big-Endians. When a Macintosh programmer meets a PC programmer, I'm often amazed at the intensity of the feelings aroused by this seemingly trivial issue.

Before you get involved in any such heated discussions yourself, just remember that these data formats are only conventions and that equally efficient CPUs can be built using either one. The Little-Endian approach, in which the significance of a byte ascends with its address, seems perfectly logical and intuitive to me, but I'll be the first to admit that hex dumps of memory are far easier to read and interpret on a Big-Endian machine. In any event, I'll be using the Little-Endian format exclusively in the arithmetic routines to be developed in this column, both for the sake of consistency and to make it easier to plug in the use of an 80x87 numeric coprocessor later.

Interestingly, the 80486 processor has a new instruction, called BSWAP, whose only purpose is to transform a 32-bit data value in a register from Big-Endian format to a Little-Endian format or back again. In other words, it performs the same function on 32-bit values as the XCHG instruction does on 16-bit values. For example, if you had a 32-bit value in register EAX, the instruction

```
BSWAP EAX
```

would be exactly equivalent to (but much faster than) the sequence

```
XCHG AH,AL
ROL  EAX,16
XCHG AH,AL
```

MULTIPLE-PRECISION ALGORITHMS

Whenever you need to perform addition, subtraction, multiplication, or division to a degree of precision beyond what your CPU's native machine instructions support, you are led directly to the so-called classical algorithms for these operations. The *classical algorithms* are the underpinnings of the stepwise, methodical procedures we all learned in grade school, using paper and pencil, for doing arithmetic on numbers with more than one digit. They are called *classical* because their history extends far back before the dawn of the

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computer age. In fact, as Donald Knuth points out, the word "algorithm" was used exclusively in this sense for several centuries, before it acquired its modern, more general meaning.

Figures 1 through 3 contain C-like pseudo-code that demonstrates the classical algorithms for addition, subtraction, and multiplication. (I'm deferring multiple-precision division to the next installment.) The pseudo-code shown is modeled on Knuth's MIX assembly language listings in *The Art of Computer Programming, Volume II: Seminumerical Algorithms* (section 4.3), a definitive work that should always be your ultimate recourse on these and related topics.

In Figures 1 through 3, u[] and v[] are arrays that hold arguments in base b, one digit per array element. The actual physical size of each array element is irrelevant, so long as it is large enough to hold a number of magnitude b−1. The value m represents the maximum number of digits in each argument, and the result is formed in array w[]. The variable k represents the "carry," which is set to the excess when the result of an operation does not fit into a single digit.

To illustrate how these arrays and variables are used, let's consider what happens when we add the very first digits of two multiple-precision numbers together. The value of the first result digit and the resulting carry are found as follows:

```
w[0] = (u[0] + v[0]) mod b
k    = (u[0] + v[0]) / b
```

Subsequent digits (1 through m−1) in the result are found in the same way, except that the previous value of k is included, as follows:

```
w[i] = (u[i] + v[i] + k) mod b
k    = (u[i] + v[i] + k) / b
```

One interesting aspect of these classical algorithms is that they apply equally well to numbers in any base whatever. You can choose to view your arguments and results as bit arrays (base 2), or you can group the bits together and work on octal numbers (base 8) or hexadecimal numbers (base 16); you can even allow the natural byte or word size of the CPU to be an individual "digit."

ADDITION PSEUDO-CODE — **COMPLETE LISTING**

```
int m;                      // number of digits
int i;                      // index variable
int b;                      // base
int k;                      // carry

array u[m], v[m];           // holds arguments
array w[m];                 // receives results

k = 0;                      // initialize carry

for(i = 0; i < m; i++);     // add digit by digit
{
    w[i] = (u[i] + v[i] + k) mod b
    k    = (u[i] + v[i] + k) / b
}
```

Figure 1: In this simplified, C-like pseudo-code for multiple-precision addition, both arguments and the result are assumed to be nonnegative. The carry k always takes the value 0 or 1.

SUBTRACTION PSEUDO-CODE — **COMPLETE LISTING**

```
int m;                      // number of digits
int i;                      // index variable
int b;                      // base
int k;                      // carry

array u[m], v[m];           // holds arguments
array w[m];                 // receives results

k = 0;                      // initialize carry

for(i = 0; i < m; i++);     // subtract digit by digit
{
    w[i] = (u[i] - v[i] + k) mod b
    k    = (u[i] - v[i] + k) / b
}
```

Figure 2: Multiple-precision subtraction in C-like pseudo-code. In this simplified presentation, both arguments and the result are assumed to be nonnegative, and the argument in array u[] is assumed to be greater than or equal to the argument in v[]. The carry k always takes the value 0 or −1.

MULTIPLICATION PSEUDO-CODE — **COMPLETE LISTING**

```
int m;                      // number of arg. digits
int i, j;                   // index variables
int b;                      // base
int k;                      // carry
int t;                      // scratch variable

array u[m], v[m];           // holds arguments
array w[m*2];               // receives product

for(i = 0; i < m*2; i++);   // initialize product
{
    w[i] = 0;
}

for(i = 0; i < m; i++);     // sum partial products
{
    k = 0;                  // initialize carry

    for(j = 0; j < m; j++); // find this partial product
    {
        t      = u[j] * v[i] + w[i+j] + k;
        w[i+j] = t mod b;   // digit of partial product
        k      = t / b;     // calculate carry
    }

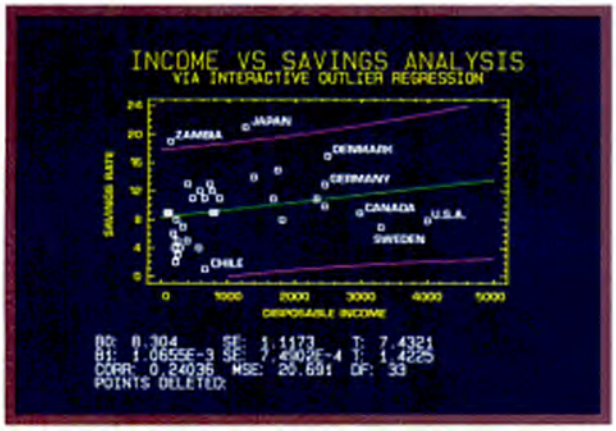
    w[i+m] = k;             // highest digit of
}                           // partial product
```

Figure 3: This C-like pseudo-code for multiple-precision multiplication exploits the CPU's native multiply instruction. The square of the base must be less than or equal to the largest product that can be generated by the hardware's unsigned multiply instruction. In this simplified presentation, both of the arguments and the result are assumed to be nonnegative, and both arguments are the same size. The value of the carry k always satisfies the condition 0 <= k < b, where b is the base.

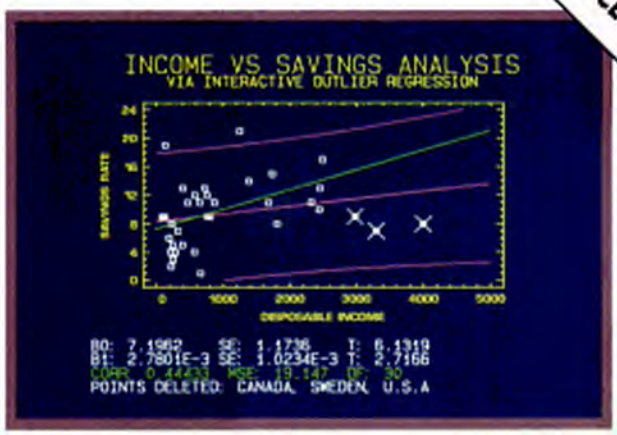
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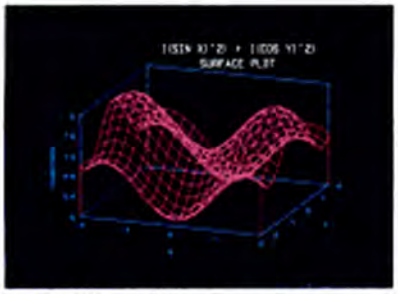
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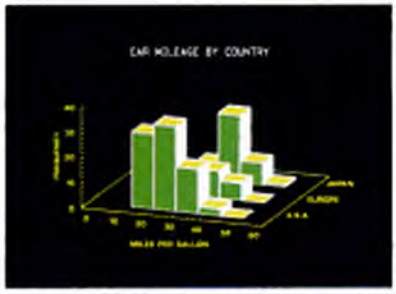
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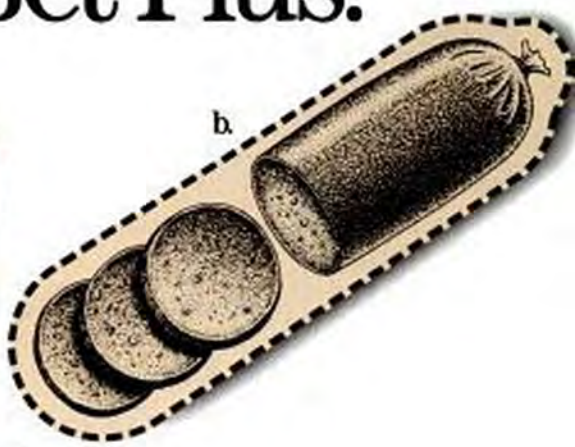
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a.



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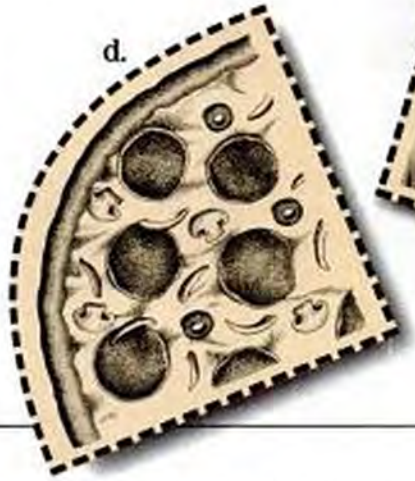


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The multiplication algorithm shown here differs slightly from the longhand technique you probably learned in school, in that the partial products are accumulated on the fly. When you perform long multiplication with pencil and paper, you normally find all the partial products first, then add them all up at the end of the calculation.

One particularly nice feature of this version of the multiplication algorithm is that it lets you use your CPU's native hardware multiply, if one is available. You need only pick a base such that the square of the base is less than or equal to 1 plus the largest product that can be generated by the CPU's unsigned multiply instruction. If no hardware multiply is available, of course, you simply fall back on base 2, in which case the algorithm degenerates into the

MPNEG.ASM — **COMPLETE LISTING**

```
        title   MPNEG.ASM Multiple-Precision 2's Complement
        page    55,132

; MPNEG.ASM     Multiple-Precision 2's Complement Routine
;               for Intel 8086, 8088, 80286, and
;               80386 in real mode/16-bit protected mode
;
; Copyright (C) 1989 Ziff Communications Co.
; PC Magazine * Ray Duncan
;
; Call with:    DS:SI   = address of argument
;               CX      = argument length in bytes
;               Assumes direction flag is clear at entry
;
; Returns:      ES:DI   = address of result
;
; Destroys:     Nothing

_TEXT   segment word public 'CODE'

        assume  cs:_TEXT

        public  mpneg
mpneg   proc    near

        mov     di,si                   ; save address of result
        push    cx                      ; save two copies of
        push    cx                      ; argument length

mpneg1: not     byte ptr [si]           ; 1's complement this digit
        inc     si                      ; advance through argument
        loop    mpneg1                  ; until all digits inverted

        pop     cx                      ; retrieve length of argument
        mov     si,di                   ; retrieve first-byte-address
        stc                             ; set carry to add 1

mpneg2: adc     byte ptr [si],0         ; add 1 to 1's complement
        inc     si                      ; to get 2's complement
        loop    mpneg2                  ; until all digits finished

        pop     cx                      ; restore operand length
        mov     si,di                   ; restore argument address
        ret                             ; back to caller

mpneg   endp

_TEXT   ends

        end
```

Figure 4: MPNEG.ASM is a general-purpose two's complement routine that changes the sign of multiple-precision integers.

MPADD.ASM — **COMPLETE LISTING**

```
        title   MPADD.ASM Multiple-Precision Integer Addition
        page    55,132

; MPADD.ASM     Multiple-Precision Integer Addition
;               for Intel 8086, 8088, 80286, and
;               80386 in real mode/16-bit protected mode
;
; Copyright (C) 1989 Ziff Communications Co.
; PC Magazine * Ray Duncan
;
; Call with:    DS:SI   = address of source operand
;               ES:DI   = address of destination operand
;               CX      = operand length in bytes
;               Assumes direction flag is clear at entry
;
; Returns:      ES:DI   = address of result
;
; Destroys:     AL, CX, SI (other registers preserved)

_TEXT   segment word public 'CODE'

        assume  cs:_TEXT

        public  mpadd
mpadd   proc    near

        push    di                      ; save address of result
        clc                             ; carry initially clear

mpadd1: lodsb                           ; next byte from source
        adc     byte ptr es:[di],al     ; accumulate sum
        inc     di
        loop    mpadd1                  ; until all bytes processed

        pop     di                      ; restore address of result
        ret                             ; back to caller

mpadd   endp

_TEXT   ends

        end
```

Figure 5: MPADD.ASM is a general-purpose addition routine for multiple-precision integers.

MPSUB.ASM — **COMPLETE LISTING**

```
        title   MPSUB.ASM Multiple-Precision Integer Subtraction
        page    55,132

; MPSUB.ASM     Multiple-Precision Integer Subtraction
;               for Intel 8086, 8088, 80286, and
;               80386 in real mode/16-bit protected mode
;
; Copyright (C) 1989 Ziff Communications Co.
; PC Magazine * Ray Duncan
;
; Call with:    DS:SI   = address of source operand
;               ES:DI   = address of destination operand
;               CX      = operand length in bytes
;               Assumes direction flag is clear at entry
;
; Returns:      ES:DI   = address of result (destination - source)
;
; Destroys:     AL, CX, SI (other registers preserved)

_TEXT   segment word public 'CODE'

        assume  cs:_TEXT

        public  mpsub
mpsub   proc    near

        push    di                      ; save address of result
        clc                             ; carry initially clear

mpsub1: lodsb                           ; next byte from source
        sbb     byte ptr es:[di],al     ; subtract from destination
        inc     di
        loop    mpsub1                  ; until all bytes processed

        pop     di                      ; restore address of result
        ret                             ; back to caller

mpsub   endp

_TEXT   ends

        end
```

Figure 6: MPSUB.ASM is a general-purpose subtraction routine for multiple-precision integers.

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MPMUL1.ASM — COMPLETE LISTING

```
        title   MPMUL1.ASM Multiple-Precision Unsigned Multiply
        page    55,132

; MPMUL1.ASM    Multiple-Precision Unsigned Multiply
;               for Intel 8086, 8088, 80286, and
;               80386 in real mode/16-bit protected mode
;
; Copyright (C) 1989 Ziff Davis Communications
; PC Magazine * Ray Duncan
;
; Call with:    DS:SI   = address of source operand
;               ES:DI   = address of destination operand
;               CX      = operand length in bytes
;
;               Assumes direction flag is clear at entry
;               Assumes DS = ES <> SS
;               Assumes CX <= 255
;
; Returns:      ES:DI   = address of product
;
;               NOTE: Buffer for destination operand must be
;               twice as long as the actual operand, because
;               it will receive a double-precision result.
;
; Destroys:     AX (other registers preserved)
;
; Usage:        DS:SI = u[0] base address source operand
;               ES:BP = v[0] base address destination operand
;               ES:DI = w[0] base address of product
;               BX    = i    index for outer loop
;               CX    = j    index for inner loop
;               DH    = m    operand length in bytes
;               DL    = k    remainder of partial products

_TEXT   segment word public 'CODE'

        assume  cs:_TEXT

        public  mpmul1
mpmul1  proc    near

        push    bx                      ; save registers
        push    dx
        push    bp
        sub     sp,cx                   ; make buffer on stack
        mov     bp,sp                   ; for destination operand
        mov     dh,cl                   ; save operand length (m)

        push    cx
        push    si                      ; copy destination operand
        push    di                      ; to temporary storage in
        push    es                      ; stack frame, because result
        push    ss                      ; will be built in destination
        pop     es                      ; operand's buffer
        mov     si,di
        mov     di,bp
        rep     movsb
        pop     es
        pop     di
        pop     si
        pop     cx

        push    di                      ; initialize destination buffer
        xor     ax,ax                   ; to receive result (it better be
        rep     stosw                   ; twice the size of the operands)
        pop     di

        xor     bx,bx                   ; i = 0

mpmul11: xor    dl,dl                   ; k = 0
        xor     cx,cx                   ; j = 0

mpmul12: xchg   bx,cx
        mov     al,[si+bx]              ; get u[j]
        xchg    bx,cx

        xchg    bp,di
        mov     ah,es:[di+bx]           ; get v[i]
        xchg    bp,di

        mul     ah                      ; t = u[j] * v[i]
        add     al,dl                   ;     + k
        adc     ah,0
        add     bx,cx
        add     al,[bx+di]              ;     + w[i+j]
        adc     ah,0
        mov     [bx+di],al              ; w[i+j] = t mod b
        mov     dl,ah                   ; k      = t / b
        sub     bx,cx                   ; restore i
        inc     cx                      ; j++
        cmp     cl,dh                   ; j = m?
        jne     mpmul12                 ; no, repeat inner loop

        push    bx
        add     bl,dh                   ; w[i+m] = k
        adc     bh,0
        mov     [di+bx],ah
        pop     bx

        inc     bx                      ; i++
        cmp     bl,dh                   ; i = m?
        jne     mpmul11                 ; no, repeat outer loop

        add     sp,bx                   ; discard operand buffer
        pop     bp                      ; restore registers
        pop     dx
        pop     bx
        ret                             ; back to caller

mpmul1  endp

_TEXT   ends

        end
```

Figure 7: MPMUL1.ASM is a general-purpose unsigned multiplication routine for multiple-precision integers.

MPIMUL.ASM — COMPLETE LISTING

```
        title   MPIMUL.ASM Multiple-Precision Signed Multiply
        page    55,132

; MPIMUL.ASM    Multiple-Precision Signed Multiply
;               for Intel 8086, 8088, 80286, and
;               80386 in real mode/16-bit protected mode.
;               Requires MPMUL.ASM (multiple-precision
;               2's complement) and MPMUL1.ASM (multiple-
;               precision unsigned integer multiply).
;
; Copyright (C) 1989 Ziff Davis Communications
; PC Magazine * Ray Duncan
;
; Call with:    DS:SI   = address of source operand
;               ES:DI   = address of destination operand
;               CX      = operand length in bytes
;
;               Assumes direction flag is clear at entry
;               Assumes DS = ES <> SS
;               Assumes CX <= 255
;
; Returns:      ES:DI   = address of product
;
;               NOTE: Buffer for destination operand must be
;               twice as long as the actual operand, because
;               it will receive a double-precision result.
;
; Destroys:     AX (other registers preserved)

_TEXT   segment word public 'CODE'

        extrn   mpmul1:near
        extrn   mpneg:near

        assume  cs:_TEXT

        public  mpimul
mpimul  proc    near

        push    bx                      ; save registers
        mov     bx,cx                   ; take Exclusive-OR of
        mov     al,[si+bx-1]            ; signs of operands
        xor     al,[di+bx-1]
        pushf                           ; save sign of result

        test    byte ptr [si+bx-1],80h  ; source operand negative?
        jz      mpim1                   ; no, jump

        push    di                      ; yes, flip sign of
        call    mpneg                   ; source operand
        pop     di

mpim1:  test    byte ptr [di+bx-1],80h  ; destination operand negative?
        jz      mpim2                   ; no, jump
        push    si                      ; yes, flip sign of
        mov     si,di                   ; destination operand
        call    mpneg
        pop     si

mpim2:  call    mpmul1                  ; perform unsigned multiply

        popf                            ; retrieve sign of result
        jns     mpim3                   ; jump, result is positive

        push    si                      ; operand signs were not
        push    cx                      ; same, make result negative
        mov     si,di
        shl     cx,1
        call    mpneg
        pop     cx
        pop     si

mpim3:  pop     bx                      ; restore register
        ret                             ; back to caller

mpimul  endp

_TEXT   ends

        end
```

Figure 8: MPIMUL.ASM is a general-purpose signed multiplication routine for multiple-precision integers.

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more familiar shift-and-add method of multiplication.

MULTIPLE-PRECISION ROUTINES

Figures 4 through 8 are the source listings of the first multiple-precision integer arithmetic modules in our Power Programming library, which are as follows:

MPNEG	Change sign of a multiple-precision integer
MPADD	Multiple-precision integer addition
MPSUB	Multiple-precision integer subtraction
MPMUL1	Multiple-precision unsigned integer multiplication
MPIMUL	Multiple-precision signed integer multiplication

The logic of the addition, subtraction, and multiplication routines follows the flow of the pseudo-code listings quite closely. The change-sign procedure employs the familiar trick of taking the one's complement of the entire integer, then adding 1.

The calling sequence for these various multiple-precision routines is documented in their source-code listings. In general, CX is used to pass the length of the arguments, which are assumed always to be the same size. DS:SI points to one argument and ES:DI points to the other. The DS:SI argument is referred to as the *source* and the ES:DI argument as the *destination*, which preserves symmetry with operand usage in the CPU's native ADD and SUB instructions.

The result of the operation always replaces the destination argument, and the address of the result is returned in ES:DI. One warning is in order: when calling the multiple-precision multiply routines, you must make certain that the buffer that holds the destination argument is twice as large as the argument itself so that it will be able to hold the product of the two arguments.

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- FLEXIBLE RANGE NAMES: Developing Excel worksheets is easy when you use relative range names.
- SEARCHING STRINGS: 1-2-3's @FIND function can quickly locate substrings within a string.
- A SHORTCUT FOR ASSIGNING CELL FORMATS: Use these Excel key combinations to assign date and time formats in a single setup.
- PLOTTING POINTS IN 1-2-3 GRAPHS: Choose the wrong ASCII character to plot a graph and it may be rendered inaccurately.
- CONVERTING LABELS INTO VALUES: Here's a handy way to change columns of numeric, date, and time labels into values.

FLEXIBLE RANGE NAMES

To name a range in *Microsoft Excel*, you issue the Define Name... command, type the range name into the Name: text box, and type the address of the range to which you want the name to refer, prefaced by an = (equals sign), into the Refers to: text box.

Typically, you use absolute references when assigning a name to a range so that it will always refer to the same range. For example, if the Name: text box contains the name Test and the Refers to: text box contains the formula =$A$1:$B$2, the name Test will refer specifically to these four cells when you click OK. Consequently, entering a function such as =SUM(Test) will always return the sum of the values in cells A1, A2, B1, and B2; similarly, *Excel* always will highlight these four cells if you do the following: issue the Goto... command, specify Test, and click OK.

You can also use relative references to define a range. However, you probably won't get the results that you expect. Instead of assigning a name to the range that you specify, *Excel* will create a variable range—one that refers to different cells, depending upon where the cell pointer is when you reference it.

Let's suppose that while cell A1 is the active cell, you pull down the Formula menu, select the Define Name... command, type Temp into the Name: text box, type the formula =A2:A3 into the Refers to: text box, and then click OK. If you enter the formula =SUM(Temp) into cell A1, it will sum the values in cells A2 and A3. If you enter the same formula into cell B5, however, it will sum the values in cells B6 and B7. Similarly, if you issue the Goto... command, select the name Temp, and click OK, *Excel* will highlight cells A2 and A3.

Tim Langrave
Louisville, Kentucky

PC MAGNUM Although many people will view this behavior as a hazard, it actually comes in handy in certain situations. In the course of developing an *Excel* worksheet, you'll often need to highlight the active cell plus the four cells to its right. To make this process easier, create a relative named range: issue the Define Name... command, type a name (for example, RIGHT4) into the Name: text box, and type a relative reference to the range that begins with the active cell and extends four cells to the right into the Refers to: text box. For example, if cell A1 were the active cell, you would type =A1:E1. Finally, click OK.

Once you have defined this name, it's easy to extend the highlight from an active cell to the cell four cells to its right. Simply issue the Goto... command (the F5 key provides the easiest way to do this), select the name that you assigned to the range (in this case, RIGHT4), and press Enter.

SEARCHING STRINGS

Lotus 1-2-3's @FIND function locates a substring within a string. The form of this function is

```
@FIND(substring,string,offset)
```

where *substring* is the group of characters that you want to find, *string* is the group of characters that you want to find the substring within, and *offset* is where the search should begin relative to the beginning of the string. If *1-2-3* locates the substring in the portion of the string it searches, the @FIND function will return the offset of the first character of that occurrence. If the searched portion does not contain the substring, the @FIND function will return the value ERR.

When a substring occurs more than once within a string, it is easy to determine the position of its first occurrence: simply use an @FIND function with an offset argument of 0. Let's suppose that cell A1 contains the label *'abracadabra*. To locate the first occurrence of *a*, you'd use the function

```
@FIND("a",A1,0)
```

The result of this function—0—indicates that the first occurrence of *a* is as the first letter in the word.

To find subsequent occurrences of a substring, nest one @FIND function within another. The function

```
@FIND("a",A1,@FIND("a",A1,0)+1)
```

will find the second occurrence of the letter *a*. Since this word begins with the letter *a*, the formula @FIND("a",A1,0)+1 returns the value 1—the offset of the character immediately to the right of the first occurrence of the letter *a* in the label. Thus, the main @FIND function begins searching with the

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second character in the label and returns the value 3—the offset of the second occurrence of the letter a within the label.

In order to find the third occurrence of this substring, you would use a formula that adds 1 to the function that returns the previous occurrence of the string as your offset argument. The formula would be as follows:

```
@FIND("a",A1,@FIND("a",A1,@FIND("a
",A1,0)+1)+1)
```

This would return the value 5. Similarly, you'd use any one of the three following @ find functions:

```
@FIND("a",A1,@FIND("a",A1,@FIND("a
",A1,@FIND("a",A1,0)+1)+1)+1)
```

```
@FIND("a",A1,@FIND("a",A1,@FIND("a
",A1,@FIND("a",A1,@FIND("a",A1,0)+
1)+1)+1)+1)
```

```
@FIND("a",A1,@FIND("a",A1,@FIND("a
",A1,@FIND("a",A1,@FIND("a",A1,@FI
ND("a",A1,0)+1)+1)+1)+1)+1)
```

to find the fourth, fifth, and sixth occurrences, which would return the values 7, 10, and ERR, respectively.

Daniel Swigart
Denver, Colorado

Mr. Swigart's technique does a good job of finding a numbered occurrence of a substring within a string. But what if you are trying to find the final occurrence of a substring? The macro shown in Figure 1 describes just how you can do this.

The first two statements in this macro ask you to point to the cell that contains the label that you want to search and to assign the name STRING to that cell. The third statement asks you to specify the string that you want to locate and enters your response into the cell named SUBSTRING (B12).

The fourth statement sets up a loop that *1-2-3* will execute as many times as there are characters in the string, less the number of characters in the substring. The cell named COUNT (B13) serves as the counter for the loop. Initially, the value in COUNT will be the difference between the length of the string and the length of the substring. However, it will decrease by 1 at the beginning of each subsequent pass through the loop.

The single statement in the loop uses an @FIND function to search for the substring within the string, starting at the position specified by the COUNT statement. Consequently, the search will begin near the end of the string but will include one more character during each pass through the loop.

1-2-3 will continue to make passes through the loop until it finds an occurrence of the substring or until it has searched the entire string. In either case, *1-2-3* will break from the loop and recalculate the string formula

```
B6:  +"{Let "&@CELLPOINTER
     ("address")&",@IF
     (COUNT<0,@ERR,COUNT)}"
```

in cell B6. The result of this particular formula is a {Let} statement that commands the *Lotus 1-2-3* program to enter the result of the following function:

```
@IF(COUNT<0,@ERR,COUNT)
```

into the current cell. If *1-2-3* has searched the entire string without finding an occurrence of the substring, COUNT will contain the value −1 and this function will return the value ERR. If *1-2-3* has located an occurrence of the substring, the value in COUNT will be the offset of that value relative to the beginning of the string.

A SHORTCUT FOR ASSIGNING CELL FORMATS

Microsoft Excel displays the results of date-producing formulas or functions in the General format unless you have previously assigned a format to that cell. To display an entry as a recognizable date, for example, you must assign a date format to the cell. To do this, you typically pull down the Format menu, select Number..., select the format, and click OK.

Fortunately, there is an easier way. Before you enter a date-producing formula or function into a cell, press Ctrl-; (semicolon) and hit Enter. This enters the serial value of the current date into the active cell. More importantly, however, it assigns the m/d/yy format to this cell. Now, when you enter a date-producing formula or function into this cell, *Excel* will replace the serial date value in the active cell with this formula or function. However, the format of the cell will remain. Consequently, *Excel* displays the result of the formula or function in the m/d/yy format.

Peggy Zeilman
New York, New York

You can use a variation of this technique to assign the hh:mm AM/PM format to a cell. Prior to entering a formula or function that returns a serial time value, press Ctrl-Shift-; (semicolon). *Excel* will enter the serial value of the current time into the active cell and, more importantly, assign that cell the hh:mm AM/PM format. Now, when you subsequently enter a time-producing formula or function into that cell, *Excel* displays the result of that formula in the hh:mm AM/PM format.

PLOTTING POINTS IN 1-2-3 GRAPHS

In the January 17, 1989, Spreadsheet Clinic, you described a method of marking data points on a graph with alternative symbols by using the /Graph Options Data-Labels

SUBSTRING MACRO — **COMPLETE LISTING**

```
      A          B          C          D          E          F          G          H
1   \f         {GetLabel "Press [Enter], then point to the label...",NULL}
2              /rncSTRING~(?)~
3              {GetLabel "String to find? ",SUBSTRING}
4              {for COUNT,@LENGTH(STRING)-@LENGTH
               (SUBSTRING),0,-1,LOOP}
5              {Recalc NEXT}
6   NEXT       {Let $C$7,@IF(COUNT<0,@ERR,COUNT)}~
7
8   LOOP       {If @NOT#@ISERR(@FIND
               (SUBSTRING,STRING,COUNT))}{ForBreak}
9
10
11  NULL
12  SUBSTRING
13  COUNT
14
```

Figure 1: This macro locates the final occurrence of a substring within a string.

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command. To demonstrate this technique, you used the period.

Unfortunately, when *Lotus 1-2-3* centers a data label at a point on a graph, it vertically centers a normal full-height character box (that is, capital letters). Lowercase letters and other characters (such as the period) that are not centered in a normal character box are plotted slightly below the actual data point. The result is an erroneous graph.

In many situations, this small plotting error is acceptable. In other cases, it makes a difference. Therefore, as a general rule, lowercase letters and periods should not be used as centered data labels to mark data points.

Rod S. March
Fairbanks, Alaska

This is correct. If you want to mark the data points on a *1-2-3* graph with a dot, use LICS character 183. This character is a dot, similar to a period. Unlike the period, however, LICS character 183 is centered vertically within the normal character box. To generate this character, press Alt-F1, type ', and then press . (period).

CONVERTING LABELS INTO VALUES

Most people use *Lotus 1-2-3*'s /Data Parse command to break information, imported from another program, into separate entries. But it also comes in handy for converting columns of numeric labels into values.

To do this, move the cell pointer to the first entry in the column of labels that you want to convert. Then, issue the /Data Parse Format-Line Create command. This inserts a row into the worksheet and enters a format line into the current cell. Since the first character in the cell that the cell pointer was on when you issued the command was a number, the format line will begin with the letter *V*. This character will be followed by multiple occurrences of the character >—as many as there are characters in the value, less 1.

If the value in the cell just below the cell that contains the format line is not the longest label in the column, choose Edit from the /Data Parse Format-Line menu, press End, hit Ins, type as many >'s as are required to make the format line as long as the longest label in the column, and press Enter on your keyboard.

Next, select Input-Column from the /Data Parse menu, highlight the single-column range that begins with the cell that contains the format line and extends downward to include all of the labels that you want to convert to values, and press Enter. Choose Output-Range, highlight all but the topmost cell of the range that you just highlighted, and hit Enter again.

Select Go from the /Data Parse menu and *1-2-3* will convert the numeric labels in the range that you selected into values. Quit to return to READY mode and use /Worksheet Delete Row to delete the row that contains the format line.

Byron G. Lee
Winston-Salem, North Carolina

You also can use the /Data Parse command to convert date labels into serial date values and to convert time labels into serial time values. When converting date labels, make sure that the format line begins with the letter *D;* when converting time labels, make sure the format line begins with the letter *T*. In order for this technique to work for date labels, they must be in one of the following five formats:

```
dd-mmm-yy
dd-mmm
mmm-yy
mm/dd/yy
mm/dd
```

Time labels must be in one of these four formats:

```
hh:mm:ss AM/PM
hh:mm AM/PM
hh:mm:ss
hh:mm
```

Unfortunately, this technique will not convert values into labels. To do this, you should use the @STRING function or the {Contents} command.

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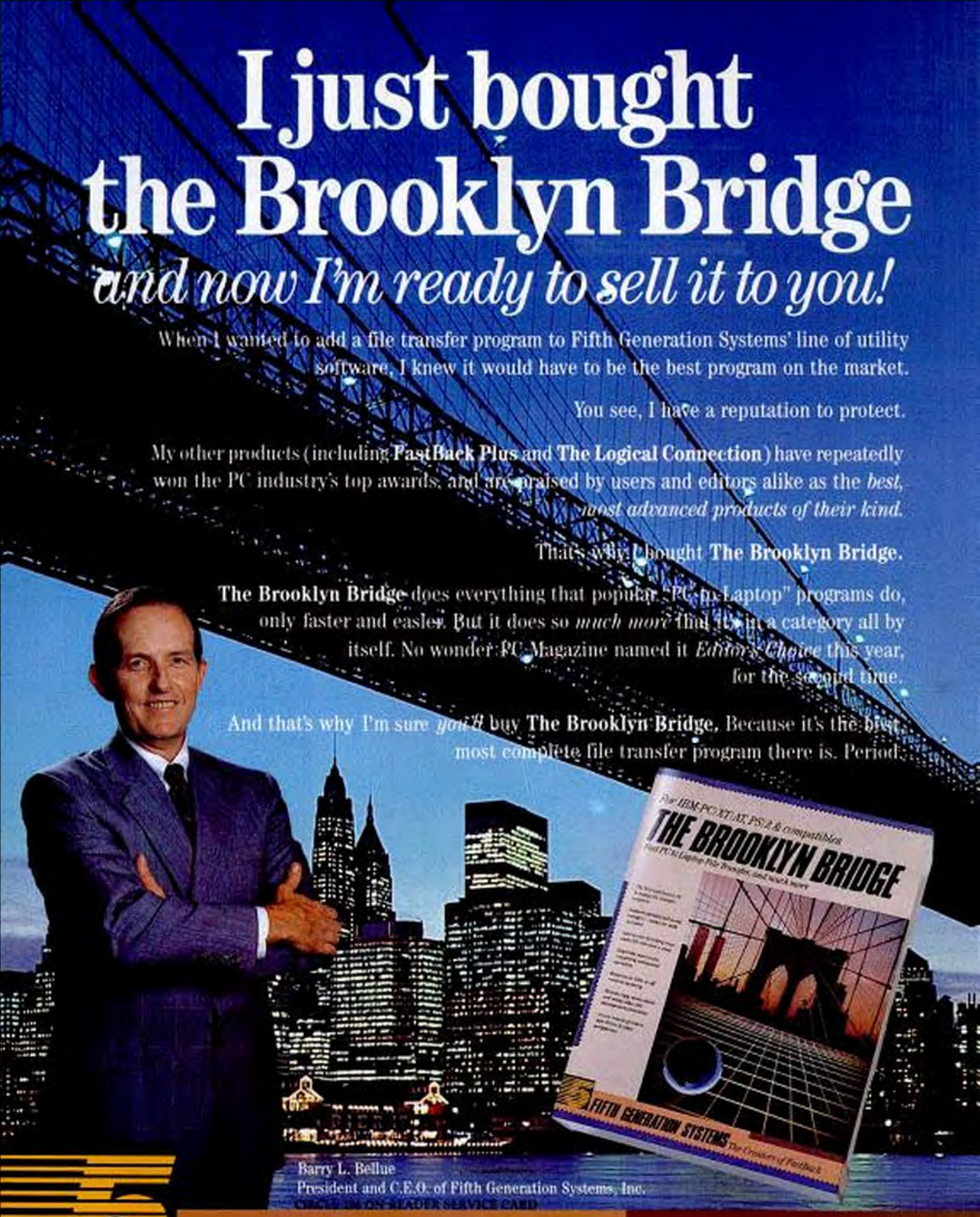
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by
Neil J. Rubenking

User-to-User

SUSPENDING BATCH FILE EXECUTION

DOS offers only the PAUSE command to suspend batch file execution. PAUSE requires user input for an operation to continue, so it is well suited to displaying warnings before potentially ruinous commands are executed. Sometimes, however, you don't want or need user intervention.

DELAY.BAT (Figure 1) temporarily halts batch file execution and, after a short time, lets it continue. The length of time that a message is displayed depends on two factors: the number of entities in the set defined by the FOR..IN..DO parentheses, and the speed at which the particular computer can execute the DIR command. My UTIL directory has many files, which makes it a prime candidate for DELAY.BAT. The NUL device receives the redirected output from the DIR command, preventing output to the screen.

You can use DELAY.BAT to display user-friendly information, such as notes before infrequently used procedures. You can insert these lines wherever you desire in your batch file, or you may create a more extensive version and call it as a separate batch file.

Two other operating-system commands, TYPE and COPY, could also be used in this manner to produce a delay in batch file execution.

Michael Ross
Carlsbad, California

DELAY.BAT COMPLETE LISTING

```
::::::::::By Michael Ross::::::::::

ECHO OFF
FOR %%p IN (a b c d e f g h i j k
 l m n o p) DO DIR C:\UTIL > NUL

::::::::::::::::::::::::::::::::::
```

Figure 1: These batch lines will suspend your batch file for a short while.

- **SUSPENDING BATCH FILE EXECUTION: Halt and restart your batch files without user input.**
- **RENAMING SUBDIRECTORIES: Tiny RED.COM will rename subdirectories for you, even in DOS 2.0.**
- **SAVING DISK SPACE: Shrink your batch files by setting environment variables to common words or phrases.**
- **CURSOR CONTROL: A tiny program that sets the shape of your cursor and solves a problem with some monochrome displays.**

Some batch programs can benefit from a command that suspends operation for a short while but doesn't require user intervention. However, I don't approve of using DIR, TYPE, or COPY to create the delay. In effect, this method uses your hard disk as a "friction brake" for your batch files! The exact delay time will vary wildly, depending on the speed of the system and possibly on any disk-caching software installed.

I created a tiny program, WAIT-10.COM, to address this problem. The DEBUG script that will create this program is shown in Figure 2. Type it in exactly as shown. Don't forget the blank before the W and after the Q. Then enter the following command

```
DEBUG < WAIT10.SCR
```

WAIT10 watches the timer-tick count that DOS keeps in low memory. This count increases by one about 18.2 times per second. All WAIT10 does is add 18.2 times 10 (182, or B6 in hexadecimal) to the current count and wait for the tick count to be greater than that amount. WAIT10 looks only at the lower 2 bytes of the 4-byte tick count, so there's a chance that the low part of the count could overflow and start again at 0. Each hour there's a 10-second period in which this could happen. But don't worry—WAIT10 takes that into account.

If you want a longer wait, you can just use a FOR loop to add 10-second increments. For example, to add a delay of 1 minute, use

```
FOR %%v IN (1 2 3 4 5 6) DO WAIT10
```

in your batch file.

You may wish to modify WAIT-10.SCR to use a basic unit other than 10 seconds. Multiply the number of seconds you want by 18.2, and round off any fraction. Convert that number to hexadecimal, then replace the number B6 with the number you derived. Now subtract that number from hexadecimal 10000h and replace the number FF4A with the result of that subtraction. Do this carefully, because an arithmetic error could produce a program that will wait for an hour or more!

WAIT10.SCR COMPLETE LISTING

```
NWAIT10.COM
RCX
21
A 100
MOV     AX,0040
MOV     DS,AX
MOV     BX,[006C]
CMP     BX,FF4A
JB      0116
CMP     WORD PTR [006C],+00
JLE     010F
ADD     BX,0286
CMP     BX,[006C]
JA      011A
RET

N
Q
```

Figure 2: This script creates WAIT10.COM. Use it in a batch file for a 10-second delay.

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RENAMING SUBDIRECTORIES

One of the little annoyances inherent in DOS is its inability to rename subdirectories. I created RED.COM to overcome this shortcoming.

RED stands for REname Directory. Like RENAME, RED takes two arguments, the old directory name followed by the new one. Neither name can include a path. For example, the command

```
RED WP WORDPRO
```

changes the name of the WP directory to WORDPRO. Figure 3 contains a DEBUG script that will create RED.COM. Copy everything—except the comments—to a file called RED.SCR. Then type

```
DEBUG < RED.SCR
```

This will create a file called RED.COM. Now you should be REDy to rename those directories.

Geoff Friesen
Dauphin, Manitoba, Canada

You may wonder how RED.COM, 61 bytes in size, can perform the same task as *PC Magazine*'s own RENDIR.COM, which weighs in at 1,139 bytes. The answer is that the two programs are *not* actually performing the same tasks. RED uses older DOS functions that work through an Extended File Control Block and cannot handle pathnames. You can use RED only on a subdirectory of the current directory.

Note, though, that because it uses "old-fashioned" functions, RED will work in any version of DOS back to 2.0, while RENDIR works only in DOS 3.0 and later. Some of its 1,139 bytes are devoted to checking that the DOS version being used is at least 3.0, and halting with an error message if it is not.

RED has only one message, "Unable to rename directory." If for any reason RED can't do its job, that's the message you'll get. After a successful rename, RED says nothing at all.

RED.SCR — COMPLETE LISTING

```
A 100
MOV DX,55       ; Address of extended file control block #1
MOV DI,DX
MOV AX,FF       ; Signature for XFCB
STOSW
INC AX
STOSW
STOSW
MOV AL,10       ; Directory attribute
STOSB
MOV AH,17       ; Rename file function code
INT 21
OR AL,AL        ; Error?
JE 11E
MOV DX,11F      ; Address of error message
MOV AH,9        ; Display string function code
INT 21
RET
DB "Unable to rename directory.",0D,0A,"$"

RCX
3D

NRED.COM
W
Q
```

Figure 3: Redirect this file into DEBUG to produce RED.COM, a utility that renames subdirectories.

SAVING DISK SPACE

If your hard disk's cluster size is 2K (a common size), the tiniest file will take up at least 2K of disk space, and a file even 1 byte longer will use 4K. Condensing a number of short batch files into a single master file is one way to regain disk space. However, this usually involves using a utility that modifies ERRORLEVEL based on keyboard input, checking a number of IF ERRORLEVEL statements and finally branching to the appropriate section of the batch file. A complicated batch file with several checks and branches can quickly exceed the 2K boundary.

Substituting a short environment variable in place of a commonly used command, such as ERRORLEVEL, will reduce the size of a batch file. For example, place the command

```
SET e=ERRORLEVEL
```

early in a batch file and replace every subsequent occurrence of the word ERRORLEVEL with %e%. This SET command adds 17 bytes to a batch file; every substitution will shorten the batch file by 7 bytes. Thus, for a batch file with ten occurrences of the word ERRORLEVEL, the length will be reduced by a total of 53 bytes. [Making a 3-byte substitution—%e%—for the 10-character ERRORLEVEL saves 7 bytes for each occurrence of the word ERRORLEVEL, or a savings of 70 bytes if the substitution is made ten times. If the 17 bytes necessary for the initial SET statement are subtracted from the 70-byte savings, the net amount saved is 53 bytes.—*Ed.*] This could save you as much as 2,000 bytes of disk space.

William L. Maynard
Bowie, Maryland

ABBREV.BAT — COMPLETE LISTING

```
SET e=IF ERRORLEVEL
SET f=FOR %%v IN
SET i=IF EXIST
SET x=IF NOT EXIST
SET o=ECHO OFF
SET n=GOTO end
SET c=COMMAND /C
```

Figure 4: After running this batch file, you can replace various batch commands with one-letter abbreviations.

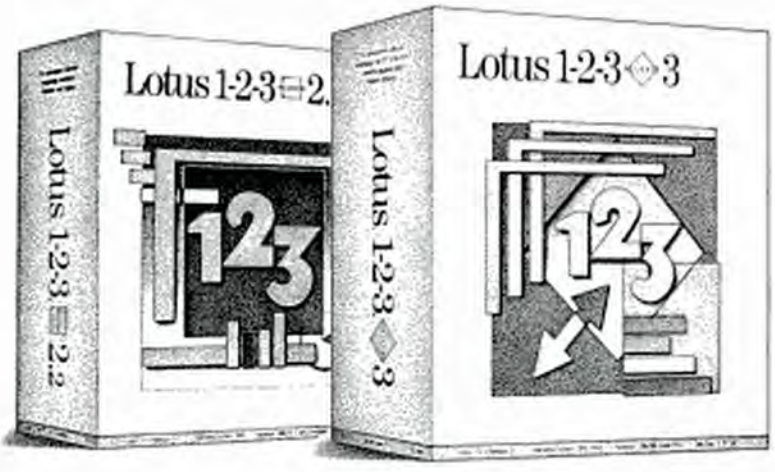
SHORT.BAT — COMPLETE LISTING

```
ECHO ON
CHOOSE
IF ERRORLEVEL 2 GOTO files
IF ERRORLEVEL 1 GOTO runbatch
GOTO END
:files
IF EXIST *.BAT FOR %%v IN (*.BAT) DO TYPE %%v
GOTO End
:runbatch
FOR %%v IN (DUM*.BAT) DO COMMAND /C %%v
:End
```

Figure 5: This batch file doesn't do anything useful—it just uses some common batch commands.

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User-to-User

Shrinking batch files like this makes them harder to read. But if you're the only one who *needs* to read them, this may not be a problem. If the command you're abbreviating is a common one, why not move the SET command from the individual batch file to your AUTOEXEC. Once the abbreviations are in the environment, any batch file can use them. The batch file in Figure 4 sets abbreviations that I'd find useful myself.

Figure 5 selects one of two actions using the imaginary program CHOOSE. Figure 6 shows the same batch file as it would look if the environment variables shown in Figure 4 had been created.

SHORT2.BAT COMPLETE LISTING

```
%o%
CHOOSE
%e% 2 GOTO files
%e% 1 GOTO runbatch
%n%
:files
%i% *.BAT %f% (*.BAT) DO TYPE %%v
%n%
:runbatch
%f% (DUM*.BAT) DO %o% %%v
:End
```

Figure 6: Since this batch file uses the abbreviations in Figure 4, it takes up less disk space.

Using these variables knocks off 30 percent of the file size. Note that unless the shrinking brings your file below a cluster-size boundary, it serves no purpose. But if you're already working at saving space by combining many batch files into one, this can help reduce its size even further.

CURSOR CONTROL

I find that various programs alter the appearance of the cursor on my monochrome display and fail to restore it upon exiting. Depending upon the program, my cursor can be left as a box, rectangle, or line, the latter often blinking right in the middle of a character display position.

CURSOR.SCR COMPLETE LISTING

```
A 100
MOV AH,01
MOV CH,0C
MOV CL,0D
INT 10
INT 20

RCX
9
N CURSOR.COM
W
Q
```

Figure 7: The DEBUG script for CURSOR.COM, which simply restores the cursor when a program has wiped it out.

CURSOR.COM redefines the cursor as a blinking line at the bottom of a character display position. You can create CURSOR.COM by redirecting CURSOR.SCR, shown in Figure 7, into DEBUG:

```
DEBUG < CURSOR.SCR
```

If you have a preference for another cursor style, you can easily alter the starting and ending scan lines of the cursor using DEBUG. Remember to include the blank line before RCX and after the final Q.

A monochrome display adapter can display a cursor of up to 14 lines, numbered from 0 at the top to 13 (0D in hex) at the bottom. A CGA can display an 8-scan-line cursor, numbered from 0 at the top to 7 at the bottom. Experimenting with the values at the starting and ending scan lines of the cursor in CURSOR.SCR will vary the appearance of the cursor.

Andrew C. Coyne
Somerville, New Jersey

Some monochrome systems have a cursor problem when they're first turned on. On the screen, the cursor properly occupies the 13th and 14th scan lines. However, the BIOS data area contains the numbers 6 and 7. Hence, if a program properly queries the BIOS about the current cursor shape, and then restores it on exit, it will produce a cursor that's incorrectly shaped. Running CURSOR.COM in AUTOEXEC.BAT will fix this problem.

MCURSOR.BAT COMPLETE LISTING

```
ECHO OFF
IF "%2"=="" GOTO BadParams
FOR %%v IN (0 1 2 3 4 5 6 7 8 9 A B C D a b c d) DO IF %%v==%1 GOTO OK1
GOTO BadParams
:OK1
FOR %%v IN (0 1 2 3 4 5 6 7 8 9 A B C D a b c d) DO IF %%v==%2 GOTO OK2
GOTO BadParams
:OK2
ECHO Creating DEBUG script to set cursor lines to %1 and %2
ECHO A 100 > CURSOR.$$$
ECHO MOV AH,01 >> CURSOR.$$$
ECHO MOV CH,0%1 >> CURSOR.$$$
ECHO MOV CL,0%2 >> CURSOR.$$$
ECHO INT 10 >> CURSOR.$$$
ECHO INT 20 >> CURSOR.$$$
REM Using MORE in the next line gets an extra
REM blank line before G, which is necessary to
REM end the Assemble mode.
ECHO G | MORE >> CURSOR.$$$
ECHO Q >> CURSOR.$$$
ECHO Now RUNNING the DEBUG script
DEBUG < CURSOR.$$$ > NUL
DEL CURSOR.$$$
GOTO End
:BadParams
ECHO SYNTAX: "MCURSOR top bot", where top and bot are hex numbers
ECHO 0-9 or A-D.
:End
```

Figure 8: MCURSOR.BAT lets you experiment with different cursor shapes.

To make it easier for you to play with cursor shapes, I've written MCURSOR.BAT, shown in Figure 8. Just pass the top and bottom scan lines you want to use as parameters to MCURSOR. To get a box cursor, set the top line to 0 and the bottom line to the maximum—D on a monochrome system, 7 on a color. For really strange results, set the top line *lower* than the bottom. MCURSOR D 0 gives a "split-level" cursor (on a color system use 7 and 0). If you find a cursor shape you especially like, you can edit CURSOR.SCR to create a version of CURSOR.COM that will produce that shape. MCURSOR refuses parameters other than 0–9 and A–D, but it's up to you to remember to use only 0–7 if you have a color monitor.

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edited by
Craig L. Stark

Power User

SIMULATING DEFAULTS

Microsoft Word uses Courier for the default font on an HP LaserJet II printer. Microsoft technical support insists that you can't reset the default to something else, such as a Letter Gothic cartridge font. However, you can get the same effect with style sheets.

Word tries to attach a style sheet to every document and uses the file NORMAL.STY unless told otherwise. Therefore, the settings in NORMAL.STY affect *Word*'s default settings.

To change NORMAL.STY's default settings, press Esc-G to load *Word* and enter the Gallery. (If you don't already have a NORMAL.STY on your disk, the gallery will be empty. In this case, you will have to create a Standard Paragraph before you can format it. To do this, press Esc to enter the menu and choose Insert; name the paragraph SP for Standard Paragraph; tab to the Usage field and press P for Paragraph; tab to the Variant field and press F1 to highlight Standard; and hit return.) Highlight the Standard Paragraph style, choose Format Character, and then use the menus in order to pick the font name and size you want as the default.

Finally, use the Transfer Save option to save the style sheet as NORMAL.STY, and choose Exit to go back to *Word*'s editing screen. *Word* now automatically attaches NORMAL.STY to all your files. And the new standard paragraph will be the default for all text that does not have another style or direct formatting applied to it.

Frank Laughlin
Santa Monica, California

- **SIMULATING DEFAULTS:** Style sheets are the perfect way to work around Word's formatting defaults.
- **SIZING UP WORDPERFECT:** Version 5.0 is big, but with some care you can still run it from floppy disks.
- **SEARCH COMMENTS FOR TEXT:** This pair of macros operates on a document so that you can find text strings within its comments.
- **TESTING DATE FIELDS:** dBASE III users must be careful when testing for an empty date field.

Style sheets are probably the most overlooked feature in *Word*. Yet they are the first place you should look when doing anything related to formatting. As a variation on this idea, let's consider *Word*'s default margins. The normal default for left and right margins is 1.25 inches on each side. But for many purposes 1 inch on each side is preferable. In this case, too, the easiest solution is to put your preferred defaults in a style sheet. Go to Gallery, hit Insert, and create a Division entry using the Standard option for the Variant field. Then change the margins to 1 inch using the Format menu, and save the style sheet.

For the record, there is at least one other way to change the default font in *Word*, though it is not as straightforward as using style sheets. If you use MAKEPRD to convert your printer driver to a text file, you'll find that the file includes font descriptions, each of which starts with

```
{Fn
```

where *n* represents the font number. To find the font name that corresponds with the number, search for }F. This marker ends the font description and is usually several screens later. You'll find the font name, labeled FontName, just above the end marker.

Some experimentation with the driver for my Canon LPB-8II showed that *Word* will always take the font labeled {F0 as the default. To change the default from Courier to Swiss (the Canon equivalent of Helvetica), I only had to change the Swiss font number to 0 and the Courier font number to 2 (or some other number that isn't being used). Then, of course, I'd have to convert the text file back to .PRD format with MAKEPRD.

Not so incidentally, if you choose to experiment with MAKEPRD, it's a good idea to make a copy of the .PRD file first so that you have something to go back to if you don't like the results. MAKEPRD and the .PRD format are fully documented in the *Microsoft Word Printer Information* manual.—*M. David Stone*

SIZING UP WORDPERFECT

The student newspaper at Seattle Pacific University wanted to install *WordPerfect*, Version 5.0, on dual-floppy-disk-drive computers. The installation went fine—until I tried to install the HP LaserJet Plus printer driver. Since newspapers use more fonts than just Courier, the printer driver was too large for the minimal space left on the second program disk. However, there was plenty of room on the first program disk. Unfortunately, to run *WordPerfect* 5.0 on a dual floppy system, the first disk must be replaced with the second one.

I found a way to get around this. Simply install *WordPerfect* as instructed and add a small RAMdisk on the first *WordPerfect* program disk as a part of the bootup procedure. I found 32K a safe amount to begin with; however, you may need more, depending on the size and number of printer drivers you have.

Start *WordPerfect* as instructed, press Shift-F1 (Setup), select Location of Auxiliary Files, Printer Files, and type C:\ to indicate the RAMdisk. Install the printer driver(s) as instructed and exit *WordPerfect* (F7). Copy the printer driver(s) from C:\ to the first program disk and have your AUTOEXEC.BAT file copy those files back to

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WP5.BAT — COMPLETE LISTING

```
ECHO off
REM *** AUTOEXEC.BAT for WordPerfect 5.0 and 2 Floppy System ***
PATH = C:\;A:\;
CLS
ECHO Copying Printer Drivers to RAMdrive C:
COPY *.PRS C:
CLS
ECHO Please insert a DATA DISK in Drive B:
ECHO.
PAUSE
CLS
ECHO Loading WordPerfect 5.0
B:
A:wp
```

Figure 1: This batch file avoids the space crunch when you install *WordPerfect* 5.0 on floppy disks.

the RAMdisk during future bootup, as shown in Figure 1.

Adam L. Marin
Seattle, Washington

Imagine you're installing *WordPerfect* for the first time. You create your work disks, fire it up, and start installing printers. Then you run out of disk space. Discouraging indeed!

The author suggests loading the printer drivers to the RAMdisk from AUTOEXEC.BAT. However, this implies that the *WordPerfect* disk is bootable, with the system files on it. There are two good reasons *not* to make the *WordPerfect* disk bootable. First, the system files take a fair chunk of disk space. Second, when you have a floppy-disk–based system, it's safer to always boot from a single write-protected boot disk. It lessens the possibility of a virus attack.

> There are two good reasons *not* to make the *WordPerfect* disk bootable.

If you create a nonbootable *WordPerfect* disk, you can give the batch file in Figure 1 any name you like. You could even call it AUTOEXEC.BAT, but you'd have to type AUTOEXEC at the DOS prompt to run it. A better name might be WP5.BAT.
—Neil J. Rubenking

SEARCH COMMENTS FOR TEXT

WordPerfect 5.0 will search for document comment codes, but not for text within comments. Sometimes it's useful to search for text within a comment, especially when a comment has been used as a self-documenting signpost to guide the operation of a macro. The macros SHOW_COM.WPM (Figure 2) and HIDE_COM.WPM (Figure 3) act as a pair. SHOW_COM changes all comments within a document into document text, allowing searches for text within the comments. HIDE_COM changes all comments that were converted into document text back into comments.

To search for text within comments, invoke SHOW_COM.WPM, which searches for document comment codes. When it locates one, it goes into the comment and marks it as a comment with æ (ASCII character 145) at the beginning and Æ (ASCII character 146) at the end. To enter these characters, hold down the Alt key while pressing the number 145 or 146 on the number pad (the numbers on the top row will not work). When you release the Alt key, the character will appear. The macro then exits the comment and converts it into document text. SHOW_COM searches again for document comment codes and repeats the process of marking and converting text until there are no more comment codes.

After running SHOW_COM, search for text as usual. When you finish your search, reverse the process, using HIDE_COM.WPM. It searches for æ and, when it finds one, moves the cursor one character to the left and starts a block of highlight. It then searches for an Æ character and extends the block to include all the text that formed the comment. HIDE_COM then converts the blocked text into a comment, deletes the æ and Æ characters, and searches for another æ character. This searching and converting continues until no more æ characters remain.

The use of æ and Æ ASCII characters to mark the beginning and end of comments is purely arbitrary. You can use any character or string of characters that's never used in your documents. However, you should note that if a string of characters is substituted, SHOW_COM must be modified to include every character in the string in the block of text to be converted to a comment. HIDE_COM must also be modified so that it deletes every character in the string after converting text from document form to comment form.

I have not shown the steps for creating SHOW_COM.WPM and HIDE_COM.WPM, since creating the macros is an involved process. However, you can create them step by step with *WordPerfect*'s macro editor, using the Ctrl-PgUp key combination to create the {PAUSE}, {ON NOT FOUND}, and {GO} commands.

Jock K. Chung
Washington, D.C.

SHOW_COM.WPM

```
{DISPLAY OFF}{Home}{Home}{Home}{Up}
{LABEL}SEARCH~
{Home}{Search}{Text In/Out}{Search}
{ON NOT FOUND}{GO}END~~
{Text In/Out}ce
æ
{Home}{Home}{Down}Æ
{Exit}{Text In/Out}ot
{GO}SEARCH~
{LABEL}END
```

Figure 2: SHOW_COM.WPM turns comments into ordinary text, leaving markers at the start and end.

HIDE_COM.WPM

```
{DISPLAY OFF}{Home}{Home}
{Up}
{LABEL}SEARCH~
{Home}{Search}æ{Search}
{ON NOT FOUND}{GO}END~~
{Left}{Block}
{Search}Æ{Search}
{Text In/Out}y
{Text In/Out}ce
{Del}{Home}{Home}
{Down}{Backspace}
{Exit}
{GO}SEARCH~
{LABEL}END~
```

Figure 3: HIDE_COM.WPM checks for markers and turns the included text back into a comment.

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Power User

After you've used SHOW_COM, you're in a vulnerable position. If you accidentally delete one of the marker characters, you may find that big chunks of your document disappear into comments when you call HIDE_COM. You should SHOW the comments, perform any searches you want to make, and when you have finished, HIDE the comments again right away.

The text doesn't explain entirely how to substitute text strings such as *BEGIN* and *END* for the single-character markers. Changing SHOW_COM is easy—just replace the single characters with the marker strings. In HIDE_COM, you also replace the single characters, but there's more. Find the {Left} code and replace it with as many {Left}'s as there are characters in the startmarker. Likewise duplicate the {Del} code. Then replace the single {Backspace} with as many {Backspace}'s as there are letters in the endmarker. That does it. Note that a marker like

```
{Enter}**BEGIN**{Enter}
```

would make the comment stand out from the rest of the text.—*Neil J. Rubenking*

TESTING DATE FIELDS

Both *dBASE III* and *III Plus* can silently fool your program when they try to evaluate a nuldate field (for example, one in which no entry was made). To see what happens, try entering:

```
nuldate = CTOD("")
? DATE() = nuldate
```

or

```
nuldate = CTOD("")
? DATE() <> nuldate
```

from the dot prompt. Both return .F.

Something is clearly wrong if nuldate is neither equal to nor different from today's date. This means that a program testing whether a date has been entered is likely to be misled and branch off in the wrong direction.

The solution presents another oddity. From the dot prompt enter either:

```
? DATE() - nuldate
```

or this statement

```
? nuldate - DATE()
```

Both will return a 0. Illogical as this result is, at least it's consistent: any date subtraction involving a nuldate will yield 0 as its result. So this is a reliable way to test whether a real date has been entered.

Tom Lawford
Washington, D.C.

Mr. Lawford has identified a potentially serious glitch in the *dBASE III* program and has produced a simple work-around to this problem. Fortunately, the problem does not exist in either *FoxBASE* or *Clipper*, and it has been fixed in *dBASE IV*.

A technical service representative at Ashton-Tate proved very helpful. He suggested converting the date to a character string first and then testing if the character string is empty (rather than comparing the nuldate as a date). For example,

To change SHOW_COM, replace single characters with marker strings.

```
? DTOC(nul)>" "
```

This returns .F., and works in all *dBASE* language programs. In addition, if you wish to require that a date be entered in a data entry situation, he suggested adding a RANGE clause as part of the GET statement.—*Brad Stark*

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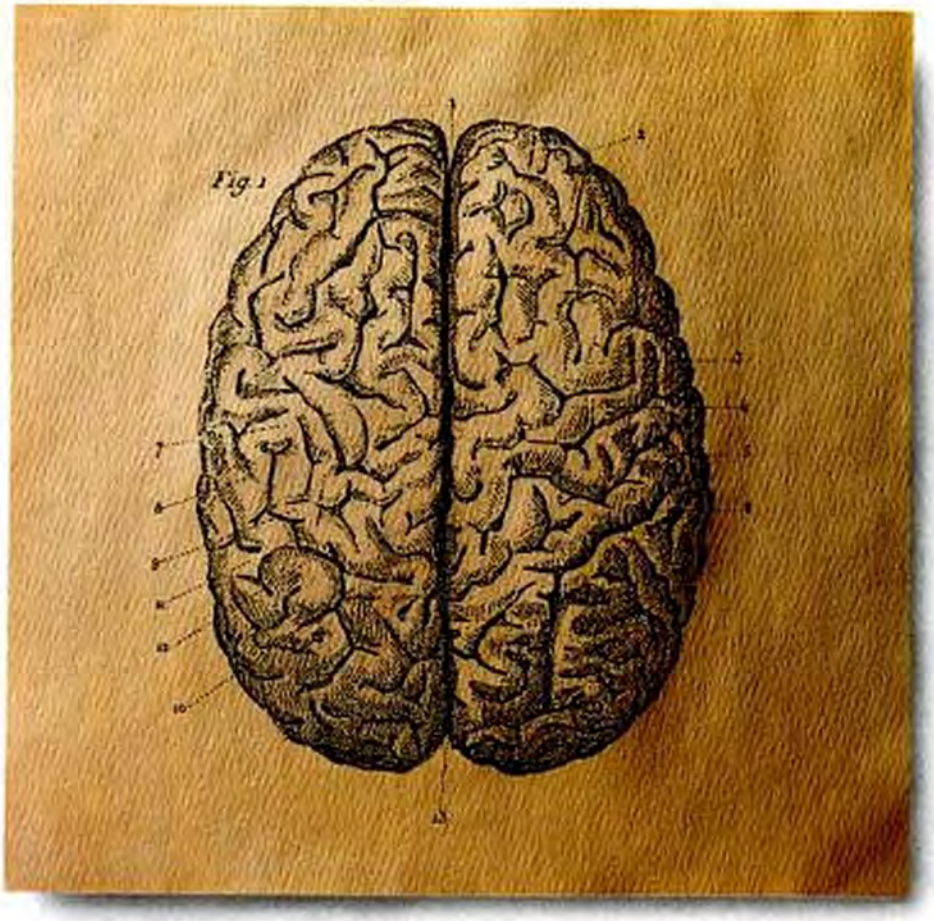
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edited by
Tony Rizzo

Languages

EDITOR'S NOTE

As can be witnessed by the first reader letter in this issue's column, object-oriented programming has finally arrived; both Turbo Pascal 5.5 and Quick Pascal 1.0 now provide object-oriented extensions to the language. As the importance of object-oriented programming grows, we certainly hope to begin seeing substantial reader interest in the topic. Our readers are therefore encouraged to begin forwarding OOP-based submissions for the Languages column. Readers should note that there is no particular limitation as to which language one can utilize in sending submissions. SmallTalk, for example, would be as suitable to the topic as either of the new Pascals. We look forward to your OOP submissions.

On a similar note, OS/2 and Presentation Manager are finally beginning to gather strong momentum. Readers working with OS/2, Presentation Manager, and LAN Manager are therefore strongly encouraged to begin sending submissions on these vital topics. Now is the time to begin sharing with your fellow readers all those tips and techniques you've been developing. Let's hear from you!—*Tony Rizzo*

- **EDITOR'S NOTE: Let's hear from readers working with object-oriented programming languages and with OS/2.**
- **CONSTRUCTOR METHODS CAN CAUSE PROBLEMS: When an ordinary method of a Turbo Pascal object calls a constructor method, the results can be unpleasant.**
- **BRINGING RANDOMNESS TO ORDERED SETS: Here is a clever way to randomly reorder an ordered set, an example of which is sorting a deck of cards.**

CONSTRUCTOR METHODS CAN CAUSE PROBLEMS

In Turbo Pascal 5.5 any object that contains virtual methods must have a constructor, which initializes the VMT field of the calling instance to point to the object's Virtual Method Table. Frequently the constructor will perform other useful functions, so there may be occasion to call a constructor without this VMT initialization. It is important to note, however, that unless you specifically prevent it, every call to a constructor will reinitialize the VMT field.

The program in Figure 1 illustrates a problem that can happen when a VMT gets initialized by mistake. The constructor Child.Init calls the method InitializeParent to allow the ancestor object to perform any necessary initialization. InitializeParent accomplishes its task by calling the Parent's constructor Init. When this program runs, you may be surprised to find that the call to ChildInst.Message produces the message "Parent Message."

In this example, the call to ChildInst.Init sets the VMT field of ChildInst to point to the VMT for Child objects. Then it calls InitializeParent, which in turn calls Parent's Init method. The unqualified call to the constructor for Parent causes the VMT field of ChildInst to point to the VMT for Parent. From then on, all virtual calls from the instance ChildInst will use the methods for Parent, which of course is not what was intended.

To prevent the VMT field of ChildInst from being overwritten, you can use a qualified method call within the method InitializeParent, as follows:

```
PROCEDURE Parent.InitializeParent;
  BEGIN
    Parent.Init;
  END;
```

As discussed on page 103 of the Turbo Pascal 5.5 *Object-Oriented Programming Guide*, this type of call causes the compiler not to initialize the VMT field. Typically, a call to an ancestor's constructor is done directly within the descendant's constructor, both of which are usually called "Init." This forces you to use a qualified constructor call and thus prevents the problem behavior from occurring.

The best way to avoid problems like the one illustrated is to make sure that every call to a constructor from within a method uses a qualified method call. It is unlikely that you would want a method that is *not* a constructor to initialize the VMT field. Since constructors are always static, use of the qualified call will not affect which method is actually executed at runtime—it will only prevent the unwanted VMT field initialization.

Richard W. Prescott
Madison, Wisconsin

If the Child object had any static methods, the program in Figure 1 would make the instance variable ChildInst into a strange sort of hybrid. All calls to static methods would work correctly, while calls to virtual methods would call the Parent type's method. There is no question about it, you do *not* want to allow a nonconstructor method to make any calls that initialize an object's VMT. Probably, the compiler itself should forbid this, but it doesn't.

One way to prevent the problem is to qualify any calls to the constructor as described above. By putting the object name and a period in front of the constructor's name, you are telling the compiler not to generate code that initializes the VMT of the calling instance.

There is a different approach to this problem that I would recommend. Don't ever call a constructor from within another method. If necessary, you should separate the code that initializes the object's data fields into a separate method and have the constructor call that method. In the exam-

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CONSTRUC.PAS COMPLETE LISTING

```
PROGRAM construc;

TYPE
  Parent = OBJECT
    CONSTRUCTOR Init;
    PROCEDURE InitializeParent;
    PROCEDURE Message; Virtual;
  END;

  Child = OBJECT(Parent)
    CONSTRUCTOR Init;
    PROCEDURE Message; Virtual;
  END;

CONSTRUCTOR Parent.Init;
BEGIN END;

PROCEDURE Parent.InitializeParent
BEGIN
  Init; {- Calls Parent.Init -}
END;

PROCEDURE Parent.Message;
BEGIN WriteLn('Parent Message');
END;

CONSTRUCTOR Child.Init;
BEGIN InitializeParent; END;

PROCEDURE Child.Message;
BEGIN Writeln('Child Message');
END;

VAR
  ChildInst: Child;

BEGIN
  ChildInst.Init;
  ChildInst.Message;
END.
```

Figure 1: Illustrated here is the danger of calling a constructor from a nonconstructor method in Turbo Pascal 5.5.

ple given here, the constructor Init would call the method InitializeParent, instead of the other way around.—*Neil J. Rubenking*

BRINGING RANDOMNESS TO ORDERED SETS

There are many sorting routines that take an arbitrary collection of elements and rearrange them into an ordered set. However, I need to take an ordered set and randomly scramble it, much like shuffling a deck of cards. Unfortunately, I cannot just call a random number function to generate my elements randomly. The reason for this (continuing the card-shuffling analogy) is that I might end up with the equivalent of, say, two jacks of hearts but no three of diamonds. Altering this scheme to avoid generating the same element twice is objectionable because it requires either too much programming overhead or too many calls to the random function, which slows down the routine considerably.

Fortunately, I was able to develop a scrambling routine that uses the "quick

SHUFFLE.C COMPLETE LISTING

```
/* SHUFFLE.C - rearranges a given set of specific objects - in this
               case a deck of playing cards - into random order. This
               illustrates the proper use of the subroutine shuffle().
*/

#include <stdio.h>
#include <stdlib.h>
#include <time.h>

#define N 52     // number of objects in the set - 52 for a deck of cards
#define NMAX 100 /* maximum number that shuffle() can rearrange:
                    must be greater than or equal to N */

typedef struct {
               int word1;
               int word2;
               } dword;     // structure needed by shuffle()

char *suit[4] = {"spades", "hearts", "clubs", "diamonds"};
char *value[13] = {"ace", "two", "three", "four", "five", "six", "seven",
                   "eight", "nine", "ten", "jack", "queen", "king"};

void shuffle(int, int *, unsigned int);      // function prototypes
int compare(dword *, dword *);

main()
{
     int i;
     int a[N];           // one-dimensional array to be shuffled
     unsigned int see;   // arbitrary integer to seed rand()
     long tval;

     seed = (unsigned int) (time(&tval) % 65536); // random seed based
     shuffle(N, a, seed);                         // on time
     for(i=0; i<N; i++)
          printf("\n%s of %s", value[a[i] % 13], suit[a[i]/13]);
}


/* shuffle() - This is the heart of the program. It assigns a one-
               dimensional aray of integers, whose beginning address
               is base, all the values from 0 to N-1 in random order.
               The seed is arbitrary and is used only to have repeated
               calls to shufle() return different sequences.
*/

void shuffle(int n, int *base, unsigned int seed)
{
     int i;
     dword RandomIndex[NMAX]; /* "dword" structure randomizing vehicle.
                                 NMAX is the maximum possible number of
                                 objects in the set, and must be
                                 initialized by the user. */

     srand(seed);             // initialize rand()
     for(i=0; i<n; i++)       // initialize RandomIndex
      {
        RandomIndex[i].word1 = rand(); // first part is a random number
        RandomIndex[i].word2 = i;      // second starts as a
      }

     qsort(RandomIndex, n, length, compare); /* sort first part only,
                                                but "drag" second parts
                                                along */

     for(i=0; i<n; i++)
          *base+i) = Randomndex[i].word2;    /* assign array to
                                                newly randomized
                                                second parts */
}


/* compare() - routine needed by qsort() to compare the values of
               dwords according to their first parts only */

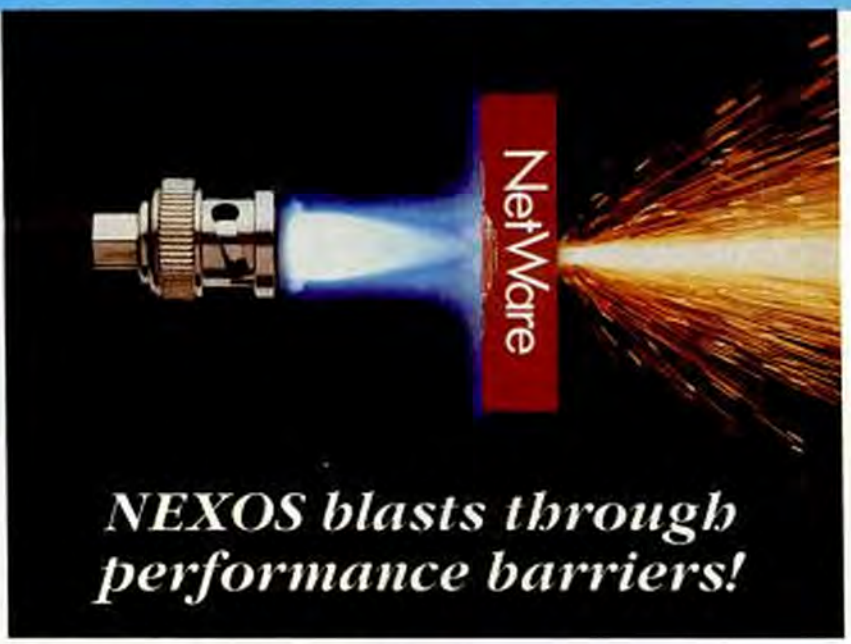
compare(dword *elem1, dword *elem2)
{
     return(elem1->word1 - elem2->word1);
}
```

Figure 2: This program demonstrates the use of the shuffle routine to shuffle a deck of cards. The routine is independent of the program and can be used to randomly reorder any ordered set.

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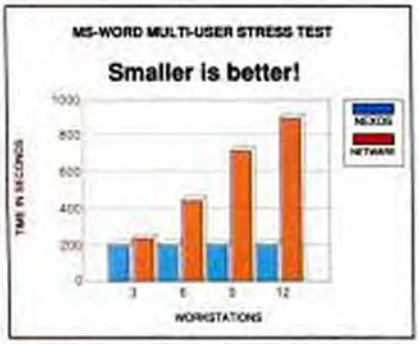
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sort" algorithm to solve my problem. Figure 2 provides the C source code for my routine, called shuffle(), as well as a sample card-shuffling program that utilizes it. The most important thing to observe is that it calls the random number generator, rand(), only once for every element.

Shuffle() takes three arguments and generates an array of N integers that contains all values from 0 to N-1, arranged randomly. To use the function from within a program, it must be declared as follows:

```
void shuffle(int N, int *base,
 unsigned int seed);
```

where N is the number of elements in the collection, *base is a pointer to the start of the array, and seed resets rand() with a new initial value.

The function basically works by generating an internal array of N elements, where each element is a structure consisting of two parts. The first is a random number, and the second is one of the original integers 0 through N-1, where the values increase in consecutive order.

I use qsort(), the standard C library version of the quick sort algorithm, to arrange each structure according to its first part. The second element is taken along in the process. The array at base is then assigned to the second parts of the structured array, which now contains the integers 0 through N-1 in random order.

Sooner or later, every programmer needs to create a randomly ordered set.

Shuffle.C illustrates the shuffle routine. After the program is compiled, typing "shuffle" at the command line will produce a list of 52 playing cards in random order.

Jeffrey J. Hamilton
Jessup, Maryland

PC MAGAZINE

Sooner or later, every programmer faces the need to create a randomly ordered set of one kind or another. Mr. Hamilton's idea of creating one by way of the qsort() function is certainly clever.

Beginning programmers should take a close look at the code, as it provides a clear lesson in using qsort(). The example program that uses the shuffle routine should also be studied carefully, as it provides a handy lesson for those of you trying to write your first blackjack game. The algorithm can be extended any number of ways to accommodate many games requiring a randomizing process.—*Tony Rizzo*

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edited by
Tony Rizzo

Tutor

HOW DEVICE DRIVERS WORK

Can you tell me something about what device drivers are, and how they are loaded and initialized by DOS?

Harold S. Harrington
Jerome, Arizona

■ HOW DEVICE DRIVERS WORK: Understand how DOS loads and initializes device drivers.

Device drivers—program modules that insulate software from hardware by providing a low- to medium-level communications interface between the two—are loaded into low memory directly above the operating system's file-control blocks and disk buffers. Device drivers become permanently resident in memory, acting like extensions of the operating system itself.

DOS positions the device drivers in memory during start-up and chains them together to form a linked list. When a call is made to open a device, DOS begins with the first device driver in the chain and searches until it finds a character driver of the same name or a block driver with the designated logical drive letter. The NUL driver is always first in the chain, followed by the installable device drivers loaded from CONFIG.SYS. The internal device drivers that DOS loads by default appear at the end of the chain.

It's important to note that a device driver's location in memory doesn't necessarily correspond to its position in the chain. Installable device drivers are loaded last, after DOS's internal drivers, but DOS tweaks the links in the chain so that installable drivers come earlier in the search order than internal drivers.

One benefit of this is that any of DOS's internal character device drivers, with the exception of NUL, can be replaced by an installable driver of the same name. One familiar device driver that does this is ANSI.SYS. When installed, ANSI.SYS replaces CON, the default system console driver. All data streams that are directed to standard input or standard output are routed through ANSI.SYS, even though the original CON driver remains in memory. Unlike character drivers, however, block drivers cannot be replaced. Instead, DOS assigns logical drive letters to block device drivers loaded from CONFIG.SYS on a first-come, first-served basis, with its own block driver taking precedence over all others.

At start-up, DOS loads the NUL, CON, AUX, PRN, and CLOCK$ device drivers, followed by a single block device driver that provides support for mass storage devices. After these and additional internal device drivers that support the COM and LPT ports are installed, DOS turns to the CONFIG.SYS file for a list of installable device drivers to be loaded from disk. Drivers are processed and placed in memory in the order in which they appear in CONFIG.SYS.

Immediately after a driver is loaded, DOS calls the driver's Init function to verify that the device it is associated with is present and operational and to give the driver the opportunity to perform any needed initializations. The driver, in turn, notifies DOS of the address of the next higher block of available memory. DOS

A DEVICE-DRIVER CHAIN

Address	Logical name*	Number of units**	Comments
027A:0048	NUL	—	DOS NUL device driver
206F:0000	CON	—	ANSI.SYS
103F:0000	—	1	VDISK.SYS
09C9:0000	$$SCACHE	—	IBMCACHE.SYS
0070:016E	CON	—	DOS console driver
0070:0180	AUX	—	DOS serial port driver
0070:0192	PRN	—	DOS printer driver
0070:01A4	CLOCK$	—	DOS clock driver
0070:01B6	—	6	Drives A: thru F:
0070:01CA	COM1	—	Additional system driver
0070:01DC	LPT1	—	Additional system driver
0070:01EE	LPT2	—	Additional system driver
0070:0200	LPT3	—	Additional system driver
0070:0212	COM2	—	Additional system driver
0070:0224	COM3	—	Additional system driver
0070:0236	COM4	—	Additional system driver

* Character device drivers only.
** Block device drivers only.

Figure 1: A device-driver chain as it appears on an IBM PS/2 Model 70 running DOS 3.3 with a 120MB hard disk divided into four logical units. The first device driver in the chain is always the NUL driver supplied by DOS, positioned in such a way that it can't be superseded by subsequently loaded device drivers. Next come the installable device drivers loaded from the CONFIG.SYS file. Last come the remaining system drivers DOS 3.3 installs on a machine: COMx and LPTx, which support up to three parallel ports and four serial ports and permit application programs to open them by name.

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uses this address as the physical location of the next device driver it loads.

As the device drivers are loaded, DOS forms a linked list by filling each device header with the segment:offset address of the next driver in the chain. The last driver in the chain is identified by the double-word value −1 (4 consecutive bytes equal to FFh).

Figure 1 illustrates how DOS 3.3 arranges the chain of device drivers in an IBM PS/2 Model 70 with a 120MB hard disk partitioned into four logical drives. Three drivers are loaded from the CONFIG.SYS file: IBMCACHE.SYS, VDISK.SYS, and ANSI.SYS, in that order. Note that the drivers are listed in the order they appear in the chain, *not* in the order in which they appear in memory. The physical address of each driver is indicated by the segment:offset address in the leftmost column of the table.

The first driver in the chain, predictably, is NUL. NUL is followed by ANSI.SYS, then by VDISK.SYS and IBMCACHE.SYS. You should note that IBMCACHE.SYS, the first driver that appears opposite a DEVICE statement in CONFIG.SYS, resides lower in memory than VDISK.SYS and ANSI.SYS, but higher in memory than any of DOS's internal device drivers. Also note that VDISK.SYS is capable of handling only one logical unit, while the block driver provided by DOS provides support for six disk drives: two floppies plus the four hard disk partitions. In this case, DOS assigns the drive letters A: through F: to its own block device driver and the drive letter G: to VDISK.SYS.

You can trace the chain of device drivers in your own system by using DEBUG to inspect the contents of the device headers. The structure of the DOS device header is shown in Figure 2. The first two words designate the segment:offset address of the next driver in the chain. The word at offset 04h contains a series of bit flags that provide information about the nature of the device driver. A 1 in bit 15 identifies a character driver, while a 0 identifies a block device driver. The words at offsets 06h and 08h contain the offset addresses of the device driver's strategy and interrupt routines, respectively. The 8 bytes beginning at offset 0Ah contain the logical name of the driver if it is of the character type or the number of units it supports if it is of the block type.

Once you find one device driver in memory, finding the next one is easy. The key is locating the first one. There are two ways to find the NUL driver. The first is to search low memory for the first occurrence of the character string "NUL", then subtract 10 bytes from its address to locate the beginning of the device header.

But the better way to locate NUL is to call on the undocumented DOS function 52h, which returns a pointer to a list of internal DOS parameters in ES:BX. The list, whose length varies between 23 and 34 bytes, depending on the version of DOS, is immediately followed by the NUL device driver.

To inspect the device chain, start DEBUG and type

```
A
MOV  AH,52
INT  21
RET
```

Press Enter once by itself to terminate the assembly process, then type G 0104 and record the values of ES and BX on return. Then type D SSSS:XXXX, substituting the segment value returned in ES for SSSS and the offset address returned in BX for XXXX. Afterwards, you should see the characters "NUL" displayed somewhere on the right side of the screen. Count back 10 bytes from the "N" in "NUL" to find the beginning of the NUL device header and the address of the next driver in memory. By dumping the contents of memory at the addresses indicated in successive device headers, you can trace the chain of device drivers through memory and see exactly how DOS stacks them up.—*Jeff Prosise*

ASK THE TUTOR

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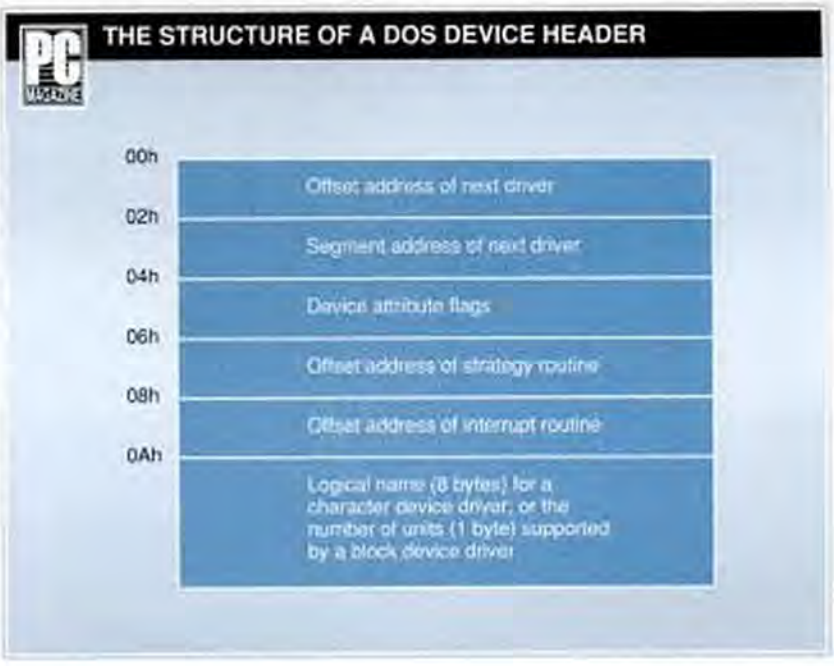


Figure 2: The structure of a DOS device header. The first two words designate the segment:offset address of the next driver in the chain (the value −1 indicates the driver is the last in the chain). The word at offset 04h contains a series of bit flags that provide information about the nature of the device driver. The words at offsets 06h and 08h contain the offset addresses of the device driver's strategy and interrupt routines, respectively. The 8 bytes beginning at offset 0Ah contain the logical name of the driver if it is of the character type, or the number of units it supports if it is of the block type.

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CIRCLE 158 ON READER SERVICE CARD

by
Frank J. Derfler, Jr.

Connectivity Clinic

SINGLE-USER SOFTWARE ON A LAN

We have two PC-XT's networked together using IBM PC LAN software. Some word processing software came with the computers, but I don't know where to look for other multiuser or networkable applications—particularly accounting software. The package we used before was *Dac Easy*, but unfortunately, it isn't designed for use on a network. Can you suggest a source for this type of software?

Nancy Ethier
Plattsburgh, New York

None of the application programs you use on a network need be network versions—that is, multiuser. If you like *Dac Easy* and you don't need to give more than one person access to the same files at the same time, then use *Dac Easy*. Put the software on the hard disk of the machine acting as a file server and let only one person use it at a time.

On a small network, it is relatively easy to control how and when the software is used. If you regulate access to the software through human management, you can load any single-user application on your network and run it one-user-at-a-time.

If you expect your network to grow and may need to allow several users to access your accounting software simultaneously, our review of multiuser accounting packages in the September 26, 1989 issue will help you decide which package will meet your needs.

REDUCING MEMORY LOAD

Your March 28 review of LAN software describes how some networks reduce the amount of RAM they require by downloading drivers and interface software to the network adapter cards. We have token-ring wiring installed, and our users need every byte of RAM they can get. Does anyone sell token-ring cards that download the *NetWare* drivers to on-board RAM?

John R. McGovern
Daytona Beach, Florida

- **SINGLE-USER SOFTWARE ON A LAN: Regulating software access lets you use your current software.**
- **REDUCING MEMORY LOAD: Downloading NetWare drivers to network adapter cards.**
- **BRIDGES, ROUTERS, AND BROUTERS: Learn how networks and systems can be connected.**

Getting the *NetWare* drivers out of the DOS 640K working space is the goal of many LAN managers. However, when software utilities throw programs into the space between 640K and 1 megabyte, they always have the potential for stepping on memory used by video adapters or as I/O address ports by communications boards of various kinds. Downloading drivers to an adapter card is a dandy way to handle the problem.

Madge Networks markets both Micro Channel and AT-bus token-ring adapters with a program that moves *NetWare*'s IPX (Internet Packet Exchange) to the adapter. You save only about 20K of RAM because IPX isn't very big, but since token-ring boards are otherwise pretty much alike, this feature could decide whose boards you buy. Contact Madge Networks at (703) 982-0638 for information on its IPX/SPX LAN Support Program. The people at Madge tell us that these boards will be more valuable with *NetWare 386* because of its bigger driver stack.

BRIDGES, ROUTERS, AND BROUTERS

I recently sat through a presentation where various connectivity terms were casually tossed around. I think I understand bridges and gateways, but routers and brouters have thrown me.

Jessie McWilliams
Simi Valley, California

Bridges, routers, and brouters are great buzzwords, but they cause a lot of confusion. Here are some things you should understand about them.

There are five ways to hook one network to another or to expand a network over a wider area. The names of the different devices you can use are bridge, MAC-layer bridge, router, brouter, and gateway. These devices are illustrated in Figure 1.

Think of a *bridge* as a two-way electrical repeater. It extends the cable and repeats every packet. The physical cable, the electrical signaling, and media access control protocols (usually CSMA) are the same on both sides of the bridge.

A *media access control (MAC layer) bridge* can connect networks using different kinds of cabling. This technique relies on a common method of formatting and addressing a packet, such as the IEEE 802.X MAC protocol descriptions, so that it can move packets between dissimilar systems. For example, it can link twisted-pair Ethernet, fiber-optic cable, and coaxial cable Ethernet networks.

Routers start out passing all packets to both sides of the bridge, but their on-board processors quickly "learn" where addresses are. Thus, they are able to transfer only packets that need to be transmitted to the other network segment, reducing traffic on both sides of the bridge. If the network has multiple connections providing more than one route to move a packet to an addressee, the routers exchange traffic information to determine the best path.

Brouters are routers that can link dissimilar networks. Like a MAC-layer bridge, they use some common protocol, perhaps the IP portion of the TCP/IP protocols, to direct traffic between dissimilar transmission systems.

Gateways link networks to very dissim-

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ilar systems. Each gateway is typically designed for a specific application, like a network of PCs talking to an IBM SNA computer.

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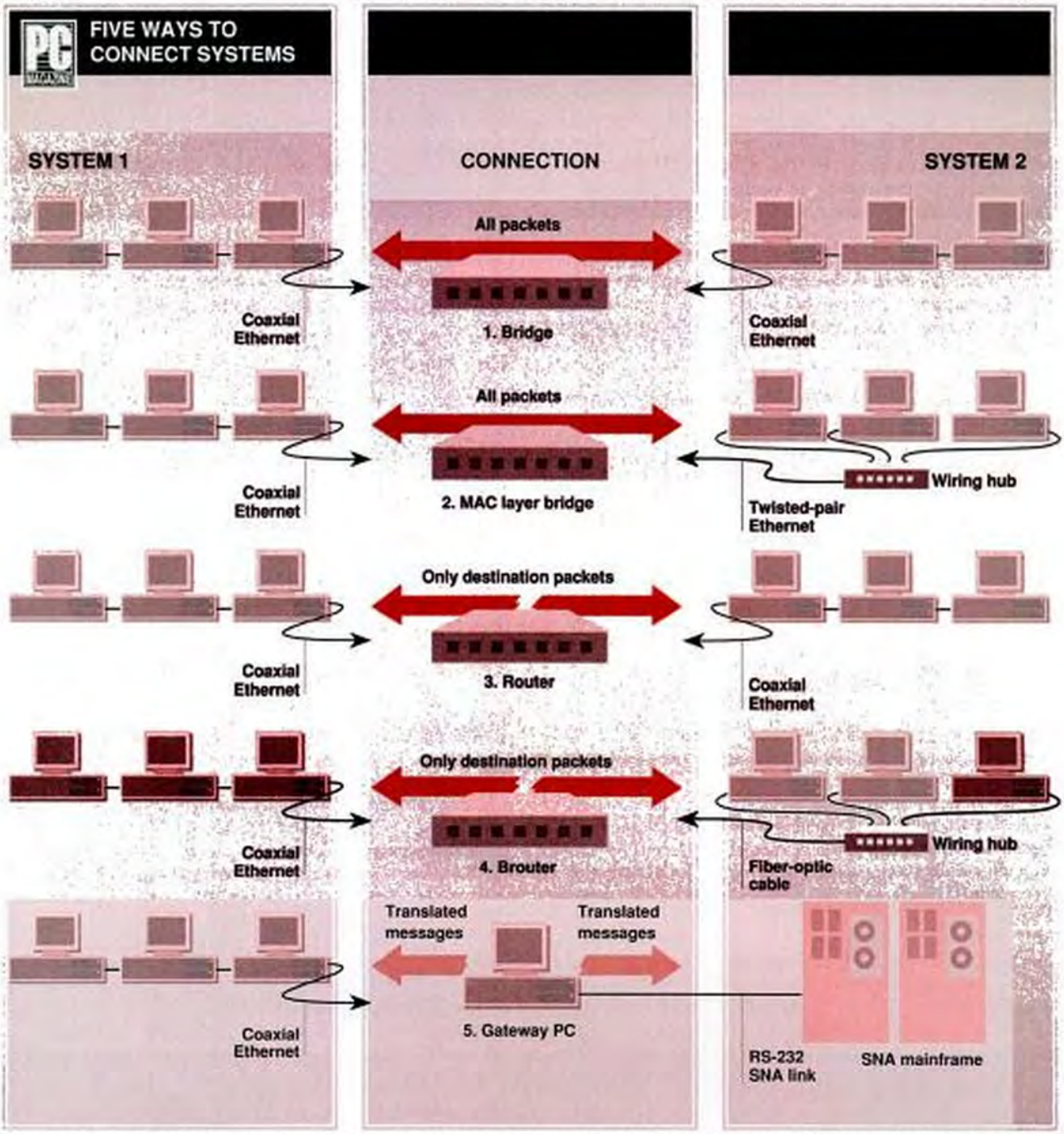


Figure 1: Bridges of all kinds pass all packets in both directions. MAC-layer bridges can link dissimilar cabling systems. Routers and brouters pass packets from one network to another only if they have a destination address on the other network. Gateways translate between very different systems such as PC-based LANs and IBM mainframes using the SNA communications scheme.

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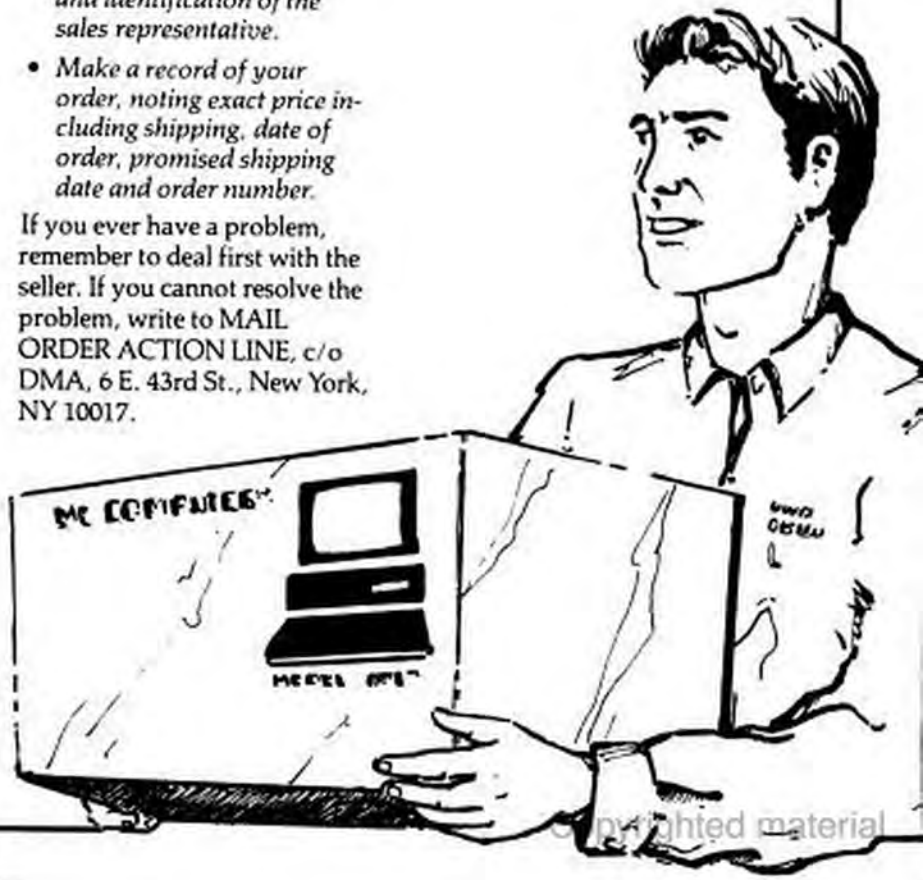
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ZENITH

Supersport 2	1389
Supersport 20	2039
Supersport 286: 20MB	2889
Supersport 286: 40MB	3179
Turbosport 386/40	CALL

TOSHIBA

T1000	619
With 768K Card	865
T1200F	1285
T1200FB	1369
T1200H	1779
T1200HB	1879
T1600/20MB	CALL
T1600/40MB	CALL
T3100E/20MB	2549
T3100E/40MB	2999
T3200/T3200SX	3259/CALL
T5100/40MB	3699
T5100/100MB	4689
T5200/40MB	4699
T5200/100MB	5199

LAPTOP ACCESSORIES

AC Adapter: T1000/T1100+	69
110/220 Dual Voltage	99
AC Adapter: T1200/T1600	99/129
AC/Auto Adapter with Battery: Specify: T3100, T3200, T5100, T5200	349
Auto Adapter: T1000/1100+	69
Battery Charger: T1200/T1600	249
Battery Pack: T1200/T1600	79/109
Carry Cases: T1000/T1200	59/79
Other Models	99

DELUXE Carry Case w/shoulder strap, extra pockets for SW, manuals, portable printer, etc. Specify model 149

Leather Case by Toshiba: Specify for T3100, 3200, 5100 or 5200 275

Expansion Chassis w/interface card Specify Toshiba model 999

Expansion Slot (1): WonUnder 279

WonUnder II: 2 slots 379

Floppy 5.25" External: 360K/1.2MB 299/349

MEMORY EXPANSION:

T1000: 768K Card	259
T1200: 1MB	599
T1600: 2MB	999
T3100E: 2MB	999
T3120: 1MB/2MB	599/999
T3200: 3MB	1299
T5100: 2MB	999
T5200: 2MB	869

MODEMS: Specify Laptop model

Megahertz 1200/2400	169/199
Megahertz 2400 MNP Level 5	329
NEC 2400	369
Toshiba 2400	289
World Port Pocket Modems:	
1200 with AC Adapter	159
2400 without Carbon Copy	249
2400 Ext W/Carbon Copy+	269
Ext Modem Cable for Toshiba	25
Numeric Keypad: T1000/12/16/3100	99
Ethernet Card for Toshiba	499
Battery Watch	39
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TOSHIBA T1000 *with 768K card and DESIGNER Carry Case* 999

TOSHIBA 3415L *w/stand* 485

NEC P2200 *w/stand* 319

TOSHIBA T5100/40MB *with DESIGNER Carry Case* .. 3799

PANAFAX UF-135 575

PANASONIC KXP-1124 *w/stand* 315

MONITORS

MITSUBISHI

Diamond Scan 1381	519
Diamond Scan Tilt & Swivel	20
NEC 2A Super VGA	499
MultiSync 3D	639
MultiSync Plus	899
MultiSync 4D / 5D	CALL
PACKARD BELL MultiSync 8530	399
SONY VGA 1320	499
SONY MultiScan 1304	689
ZENITH ZCM-1490 Flat Screen	629

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NEC P2200 Parallel	329
5200/5300	499/659
Color Kit for 5200/5300	109
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PANASONIC 1180/1191	199/225
KXP 1124	319
KXP 4450 Laser	CALL
TOSHIBA 301/311	339/389
321SL/341SL	459/529
KENSINGTON Printer Stand	20
With Printer	10

DRIVES & BACKUP

TOSHIBA 3.5" internal w/universal mounting kit: 720K/1.44MB	99/109
FLOPPY 5.25" External for Laptops 360K/1.2MB	299/349
PLUS HARD CARD 20/40 MB	489/629

SEAGATE: Preinstld & formatted, with controller, cables, manual & mounting kit.
30MB for PC/XT 269

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With Gem Graph Software	199
PARADISE VGA Plus	229
Paradise VGA Plus 16	245
Paradise VGA Professional	369
VIDEO-7 Vega VGA	225
FastWrite VGA	345
Vega V-RAM VGA (256K)	379

MODEMS/MOUSE, ETC.

ATI 2400 ETC Int w/sw	169
ATI 2400 ETC External	199
HAYES 1200 Int w/Smartcom II	249
ZOOM 2400 Internal w/sw	109
2400 External	119
LOGITECH Bus Mouse	59
HiRez Bus Mouse	69
MICROSOFT Mouse: Ser	109

INTEL

In factory sealed boxes with manual & factory warranty

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80287: 8/10 MHz	209/235
80387: 16/20/25 MHz	349/399/509
80C287-A	CALL

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BITCOMM 3 Ver 3.5 - 5.25"	25
BORLAND Sidekick: Specify 5.25 or 3.5	29
CARBON COPY Plus Ver 5.1 - 5.25"	99
EASY by MicroPro Ver 1.5 - 3.5"	39
GEM GRAPH 5.25"	39
LAPLINK III: Serial & Parallel	99
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LOGITECH Publisher	35
LOTUS Metro 3.5" Ver 1.0	25
PC PAINT Plus - 5.25"	25

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JT Fax Portable 4800	319
JT PRO 96 Modem & Fax Board	CALL

WORLD PORT 2496

Portable Fax/Data Modem 449

BROTHER 330

869

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CANON Fax 8	589
CANON Fax 15	659
CANON Fax 20	759
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EPSON F1000

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EPSON F2000	855
EPSON F3000	1069

MURATA M900

MURATA M900	575
MURATA M1200	519
MURATA M1400	655
MURATA M1750	759
MURATA M1800	699

PANAFAX UF-135

PANAFAX UF-135	599
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PANAFAX UF-155	839
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PANAFAX UF-260	1399



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PANASONIC KXF 120	869
PANASONIC KXF 220	1099

RICOH RF 850

RICOH RF 850	639
RICOH RF 900	769
RICOH RF 920	CALL

SHARP FO-220

SHARP FO-220	629
SHARP FO-300	689
SHARP FO-330	899
SHARP FO-510	1189
SHARP FO-550	CALL
SHARP FO-700	CALL
SHARP FO-800	CALL
SHARP UX-110	619
SHARP UX-180	669
SHARP UX-350	1039
SHARP GX-9500	CALL

TOSHIBA 3300

TOSHIBA 3300	719
TOSHIBA 3600	849
TOSHIBA 3700	969

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Computer Material



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It's easy to see why removable disk drives are becoming so popular. Sensitive data can be removed from the system and stored in a secure location. People who do work at home or at multiple locations can take their programs and their data with with them and work as if they were at their own desk. Shamrock's Removable, Affordable, Portable, Internal/External, Disk Drive Kits offer all this convenience at Leprechaun sized prices. Fast access Seagate drives in a wide range of sizes mean you won't have to sacrifice performance or capacity for portability.

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Rapid Recall

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Seagate



Optional Travel Case $29

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ST 412 Interface Drive Kits	**8 bit PC/XT**	**16 bit 286/386**
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8 bit kit includes hard disk controller.
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Call for prices on kits without controllers.

High Speed SCSI Kits for PC/XT/286/386

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Prices include short slot SCSI host adapter.
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RAPIDisk External Chassis $199

Terms: No extra for Visa/MasterCard/Discover (AMEX add 3%). Prices include UPS surface shipping. Federal Express shipping just $1.50 per pound. Corporate and Institutional purchase orders accepted (subject to credit approval).

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- High Resolution Amber Monitor
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- Clock Calendar
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- 8 Expansion Slots
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- Call for other Options

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- Phoenix BIOS
- Monochrome Graphics Card
- 101 Key Enhanced Keyboard with tactile click
- Parallel & Serial Ports
- Clock Calendar
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- 8 Expansion Slots
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EGA Color	Add:$350
16 Bit VGA Color	Add:$450

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- Phoenix BIOS
- 101 Key Enhanced Keyboard with tactile click
- Parallel & Serial Ports
- Clock Calendar
- 1.2mb Floppy Disk Drive
- 5 Drive Bays
- 8 Expansion Slots (1-32 bit)
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16 Bit VGA Color	Add:$450

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Citizen GSX140	325
Diconix	
150 Plus	319
Epson	Call
Fujitsu	
DL3400	519
NEC	
P2200	309
P5200	495
P5300	659
LC890	Call
Okidata	
182 Turbo	225
320 (IBM)	335
390 (IBM)	469
393 (IBM)	999
Panasonic	
KXP1180	175
KXP1191	225
KXP1124	297
KXP1595	425
KXP1524	535
KXP4450	1299
Star	
NX1000	167
NX2400	289
Toshiba	
P321SL	439
P341SL	599
P351SX	929

LAPTOPS

Megahertz Modems	
2400B Most Toshiba	149
2400B NEC, Epson Mitsubishi or Zenith	189
Mitsubishi	Call
NEC MultiSpeed's	Call
Toshiba	
T1000	639
T1000 768k Card	259
T1200F	1349
T1200FB Backlit	1449
T1200HB Backlit	1949
T1600	Call
T5200/100mb	5495

BOARDS

ATI	
2400 ETC Int.	147
VGA Wonder 256	259
VGA Wonder 512	309
Everex	
1200B Int Modem	59
2400B Int Modem	119
VGA 16 bit 256K	249
Genoa	
Super EGA Hi-Res	139
Super VGA #5300	199
Super VGA #5400	255
FastData (satisfaction gauranteed)	
2400B Int. Modem	85
CGA or MGP Card	39
Super EGA Card	99
Parallel/Serial/Game Card	39
XT 1.44 Floppy Controller	33
Hercules Graphic Card +	169
Intel	
8087-2	119
80287-10	219
80387-20	379
Orchid	
ProDesigner	229
ProDesigner Plus	319
Tiny Turbo 286	207
Paradise	
Autoswitch 480	115
VGA Plus	175
VGA Plus 16	229
VGA Professional	299
Practical Peripherals	
1200B Int Modem	59
2400B Int Modem	129
Prometheus	
Promodem 1200B Int.	49
Promodem 2400B Int.	99
Promodem 2400G Ext.	Call
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1200 Baud Internal	69
2400 Baud Internal	119
2400 Baud External	149
Video 7	
Fast Write VGA	237
Vega Deluxe	169
Vega VGA	199
V-RAM VGA	369

MONITORS

Magnavox	
7BM749 VGA White	129
9CM082 VGA	419
Mitsubishi	
1410 EGA	325
Diamond Scan 1381	479
NEC	
Multisync 2a	489
Multisync 3d	645
Multisync 4d/5d	Call
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Max15	237
Ultrasync 12"	479
Ultrasync 14"	519
Ultra 16	835
Seiko CM1430	549
Sony	
1302 Multiscan	659
1304 Multiscan	Call
Zenith 1490	595

DISK DRIVES

Colorado	
Jumbo 40-120mb Int. Tape	269
Miniscribe	
40MB XT Kit #8450	299
40MB AT #3650	259
71MB AT #3085	549
Mitsubishi	
60MB AT MR535	379
Seagate	
20MB XT Kit #225	239
30MB XT Kit #238	249
40MB AT #251-1	319
65MB AT #277R-1	365
80MB AT #4096	559
Toshiba	
360K Floppy	69
720K 3.5" Floppy	69
1.2MB 5.25" Floppy	79
1.44MB 3.5" Floppy	79

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Foxbase Plus	185
Paradox 3.0	419
Q & A	197
RapidFile	179
Rbase for DOS	397
Reflex	159

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Byline	175
GEM Desktop Pub.	159
Pagemaker	479
PFS:First Publisher	69
Publisher's Paintbrush	149
Ventura	Call

Financial

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Computer Assoc. BPI	Call
DAC 3.0	53
DAC Payroll 3.0	53
Dollars & Sense	Call
Managing Your Money	113
Peachtree Complete II	139

Graphics

Corel Draw	Call
Deluxe Paint II	45
First Graphics	Call
Freelance Plus	307
GEM Artline	269
Generic Cadd Level 3	149
Harvard Graphics	255
Perspective Jr.	69

Integrated

First Choice	Call
Works	89
Windows 286	59
Windows 386	117

Mice

Keytronics Professional	75
Logitech C7 Serial	59
Logitech HiRes C9 Bus	69
Logitech HiRes C9 Serial	75
Microsoft Serial or Bus	94
Microsoft W/ Windows 286	129
OmniMouse Serial	39
PC Mouse II Serial or Bus	79

Power Protection

Curtis Ruby Plus	59
Datasheild 100	57

Programming

Macro Assembler	89
Norton Guides (Specify)	58
Turbo Assembler/Debugger	87
Turbo Basic	60
Turbo C 2.0	90
Turbo Pascal 5.5	90
Quick Basic	60
Quick C	60
Quick Pascal	60

Spreadsheets

Allways	79
Excel	Call
Lotus	Call
Lucid 3-D	53
Quattro	145

Utilities

CoreFast	60
Carbon Copy Plus	104
Desklink	95
Desqview	68
Desqview 386	99
Direct Access	46
Fastback Plus	97
Formtool	54
Formfiller	85
Laplink Plus	59
Laplink III	75
MS-Dos 4.01	79
Mace Utilities	53
Norton Advanced	79
PC Tools Deluxe	69
ProComm Plus	Call
SideKick Plus	119
Sideways	37
Super PC Kwik	43
XTree Pro	67

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Ami	Call
GEM First Word Plus	57
Grammatik III	49
Manuscript	Call
Multimate Adv. II	267
Professional Write	125
Rightwriter	45
Sprint	117
Q & A Write	109
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Word Perfect	215
Word Perfect Library	59
WordStar Prof. 5.5	189

SPECIALS

Toshiba T1000

$639



The T1000 is the perfect second PC! It comes with 512K of Ram, a 720K floppy drive, a supertwist LCD screen and MS-DOS in ROM! All this in a battery-powered 7 pound package. A 768K Ram card is just $269 and can be set as base, expanded, or a non-volitile Ram disk.

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by Video Seven



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The design team chose to downsize and build five new functions into each new motherboard: a dual IDE hard drive interface, a dual diskette drive controller, two serial ports, a parallel port and a game port interface. These built-in functions reduce by two the number of expansion cards users typically purchase. The result to you: increased functionality and reliability and a smaller footprint.

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What wasn't downsized? Expansion card flexibility and drive configuration options. Every new low profile CompuAdd system is five-card expandable. Up to three full-size and two half-size cards can be added. Users retain maximum flexibility in diskette and hard drive configurations, including the freedom to specify two half-height hard drives.

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2. Toll Free Technical Support · One-Year Limited Warranty · Free Return Freight for Mail Order Repairs If you experience a problem with anything you purchase from CompuAdd, call 800-999-9905 weekdays from 8:00am to 7:00pm, CST. Our technical support staff will be happy to assist you with any hardware or software difficulty. If we cannot resolve a hardware problem over the phone, we will assign you a return material authorization number (RMA). You ship the equipment to our Austin Service Center (freight and insurance prepaid). We will repair or replace the product (at our option) without cost to you and pay for the return freight. You may also carry the product into one of our North American Superstores where our repair staff can assist you on the premises. Call 800-666-1872 for a copy of CompuAdd's complete warranty.

3. No-Charge 90-Day Express Part or Product Exchange for Mail Order Customers
If a problem affects the service or operation of a component purchased as a CompuAdd system (CPU, monitor, or keyboard) in the first 90 days, we will determine the cause and, if needed, ship a replacement part or product within 48 hours (depending on availability of part), via Federal Express® standard air—at our expense.

4. Onsite Service Available
Onsite service is available within 280 Metroplex/Telex service areas nationwide on all CompuAdd systems. The CompuAdd 220 and 316 series systems come with *FREE* onsite service during the *initial* one-year warranty period. Purchasers of other CompuAdd systems may buy a year of onsite service at the time of purchase. Extended two- and three-year warranties are also available on all CompuAdd systems. *A completed service agreement must be received prior to onset of any onsite coverage.* ***Call 800-666-1872 or visit a CompuAdd Superstore for more information.***

Call Today! And discover the new standard for corporate and personal computing.

800-666-1872



$595
64709

810 Monitor and Hard Drive Options

	MGA	CGA	CVGA
No Hard Drive	64703 $690	64706 $630	64711 $1130
20MB (28ms)	64702 $970	64707 $1110	64712 $1410
40MB (28ms)	64703 $1120	64708 $1260	64713 $1560

The CompuAdd 810

Perfect for word processing, spreadsheet and database applications, the 810 is also an economical alternative for LAN stations that don't need 286 or 386 architecture.

An unbeatable value:
- NEC V20® processor rated at 10MHz
- 640KB RAM with parity checking
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- Built-in parallel port and two serial ports
- Built-in game port interface
- Three full-size and two half-size PC/XT™ expansion slots
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- Real-time clock
- 101-key enhanced keyboard
- 145-watt power supply

Monitor optional.

The CompuAdd 212

Far and away the best value on the market in a 286 PC AT® class system, the 212 can handle the toughest MS-DOS®-based software at 12MHz.

- 80286® processor running at 12MHz
- 512KB RAM expandable to 4MB on motherboard
- 0 wait state page-mode memory
- Built-in dual IDE hard drive interface
- Built-in dual diskette drive controller
- Built-in parallel port and two serial ports
- Built-in game port interface
- Three full-size 16-bit and two half-size 8-bit expansion slots
- 80287® math coprocessor support
- Choice of 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- Real-time clock
- 101-key enhanced keyboard
- 145-watt power supply

Monitor optional.



$895
64720

212 Monitor and Hard Drive Options

	MGA	EGA	CVGA
20MB (28ms)	64731 $1350	64736 $1700	64741 $1799
40MB (28ms)	64732 $1499	64737 $1849	64742 $1949
80MB (15ms)	64733 $1729	64738 $2079	64743 $2169



$995
64776

The CompuAdd 216

Our new 216 meets the speed and power needs of OS/2™ and SCO™ XENIX®. All of the same features as the CompuAdd 212 with a blazing processing speed of 16MHz.

Monitor optional.

216 Monitor and Hard Drive Options

	MGA	EGA	CVGA
40MB (28ms)	64777 $1599	64837 $2049	64782 $2039
80MB (15ms)	64778 $1829	64838 $2279	64783 $2269
110MB (15ms)	64779 $2029	64839 $2479	64784 $2469

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of CompuAdd computers.

The CompuAdd 316s

Power packed on a small footprint, the 316s opens the door to 386 software at an exceptionally low price. ***Like all 300 series systems, the 316s comes with one year of FREE onsite service.***

- 80386SX* processor running at 16MHz
- 1MB memory expandable to 4MB on motherboard
- 0 wait state page-mode memory
- Built-in dual IDE hard drive interface
- Built-in dual diskette drive controller
- Built-in parallel port and two serial ports
- Built-in game port interface
- Three full-size 16-bit and two half-size 8-bit expansion slots
- 80387SX* math coprocessor support
- Choice of 5.25" 1.2MB or 3.5"1.44MB diskette drive
- Real-time clock
- 101-key enhanced keyboard
- 145-watt power supply

Monitor optional.



$1495
64787

316s Monitor and Hard Drive Options

	MGA	EGA	CVGA
40MB (28ms)	64788 **$2099**	64843 **$2449**	64793 **$2539**
80MB (15ms)	64789 **$2329**	64844 **$2679**	64794 **$2769**
110MB (15ms)	64790 **$2529**	64845 **$2879**	64795 **$2969**



The CompuAdd 220

"If what you want is a fire-breathing DOS machine, the CompuAdd (220) is a good choice." *PC Magazine* (4/11/89)

$2449
64799

- 80286 processor running at 20MHz
- 1MB RAM expandable to 5MB on motherboard
- 0 wait state page-mode memory
- Disk caching software
- LIM 4.0 support
- ROM shadowing into faster DRAM
- Dual IDE hard drive interface
- Dual diskette drive controller
- Built-in parallel port and two serial ports
- Six available expansion slots
- 80287 math coprocessor support
- **40MB IDE hard drive**
- Choice of 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- Monochrome VGA monitor
- 16-bit VGA video adapter card
- 101-key enhanced keyboard
- INTEGRATOR™ software

220 Monitor and Hard Drive Options

	MVGA	CVGA
40MB (28ms)	64799 **$2449**	64805 **$2699**
80MB (15ms)	64800 **$2679**	64806 **$2929**
110MB (15ms)	64801 **$2879**	64807 **$3129**
150MB (12ms)	64802 **$3329**	64808 **$3579**

FREE technical support and onsite service are included in your purchase of a CompuAdd 220 system. ***It's just part of being a completely customer driven company.***

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From the beginning, CompuAdd has been a new kind of technology company, intent upon building better machines measured against one ultimate standard—better value for the dollar.

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CompuAdd's New Career Starter Kit™

At the heart of the new Career Starter Kit is our most affordable XT-compatible workhorse, the new CompuAdd 810, with its sleek, small footprint design. Surrounding the 810 is a package that contains everything you need to start computing. Monitor. Printer. Cables. Operating and applications software. Even paper and blank diskettes.

$899
64730

- CompuAdd 810 computer (XT-compatible)
- NEC V20 processor rated at 10MHz
- 640KB RAM with parity checking
- Built-in dual IDE hard drive and game port interfaces
- Built-in dual diskette drive controller
- Built-in parallel printer port and two serial ports
- Three full-size and two half-size XT expansion slots
- 8087 math coprocessor support
- Monographics monitor and adapter
- Star® Micronics NX-1000™ printer and cable
- 5.25" 360KB diskette drive
- CompuAdd MS-DOS v4.01 and GW-BASIC® software
- New Spinnaker® Eight-in-One™ integrated software
- Real-time clock
- 101-key enhanced keyboard
- Computer paper and ten blank diskettes

Color monitor optional.

Career Starter Kit Options

	MGA	CGA	CVGA
No Hard Drive	64716 **$899**	64721 **$1039**	64726 **$1339**
20MB	64717 **$1179**	64722 **$1319**	64727 **$1619**
40MB	64718 **$1329**	64723 **$1469**	64728 **$1769**

CompuAdd's New Professional Starter Kit™

Looking for the value, savings and convenience of a package purchase? Unwilling to sacrifice quality, flexibility, reliability or technical support when you invest in a business computer? Look no further.

Computerize Your Business For $1495
64747

- CompuAdd 212 computer (AT-compatible) **with 40MB hard drive**
- 80286 processor running at 12MHz
- 512KB RAM expandable to 4MB on motherboard
- 0 wait state page-mode memory
- Built-in dual IDE hard drive and game port interfaces
- Built-in dual diskette drive controller
- Built-in parallel printer port and two serial ports
- Three full-size 16-bit and two half-size 8-bit expansion slots
- 80287 math coprocessor support
- Monographics monitor and adapter
- Panasonic® 1180 printer and cable
- Choice of 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- CompuAdd MS-DOS v4.01 and GW-BASIC software
- CompuAdd INTEGRATOR productivity software
- Real-time clock
- 101-key enhanced keyboard
- Computer paper and ten blank diskettes

Color monitor optional.

Professional Starter Kit Options

	MGA	EGA	CVGA
40MB	64747	64752	64757
	$1495	**$1845**	**$1935**
80MB	64748	64753	64758
	$1745	**$2095**	**$2185**

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Color makes charts and graphs easier to read and our ***EGA combo*** *makes adding color video to your system easy on the budget. Features 14" (13" viewable) EGA color monitor and EGA-480 card. Provides 640×480 resolution, 0.31mm dot pitch, and 16 out of a possible 64 colors.* **$489** *51702*

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Monitors

Color CGA 14" analog monitor offers a 14" (13" viewable) display with a 0.31mm dot pitch and 640×480 resolution. *51019* **$379**

NEC® Multisync 2A Super VGA color analog monitor 14" (13" viewable) screen and 0.31mm dot pitch provides 800×600 resolution. *51398* **$510**

Seiko Instruments 14" monitor flat, black Trinitron™ screen with up to 1024×768 resolution, 0.28mm dot pitch, and one electron gun technology for intense colors. *51092* **$595**

Graphics Cards

CompuAdd 16-bit VGA adapter card provides up to 800×600 resolution, with 16/256K colors. *48332* **$259**

Orchid ProDesigner VGA Plus features 512KB memory with up to 1024×768 resolution, and 16/256K colors. *48330* **$415**

Flat Screen Monographics Combo 12" monitor, tilt and swivel base, monographics adapter card. *51700* **$139**

Video Graphics Array (VGA) Combo 14" (13" viewable) analog color monitor and a CompuAdd VGA graphics card. *51704* **$579**

PC MAGAZINE EDITORS' CHOICE

"One of the giants of mail order, CompuAdd offers quality hard disks, competitive prices, excellent documentation, and courteous service backed up by a 30-day trial period and money-back guarantee."

—PC Magazine, Editor's Choice for Mail Order Hard Disks, June 27, 1989

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Take advantage of the convenience and greater flexibility provided by the speedy ***40MB Seagate*** *(28ms) AT-compatible hard drive. Every CompuAdd hard drive kit includes the drive, connecting cable, mounting hardware, manual, and FREE PC-FullBak™ disk backup software.* **$399** *47207*

XT Class Hard Drives

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30MB MiniScribe (65ms) half-height, with RLL controller. *47200* **$299**

30MB Seagate (65ms) half-height, with RLL controller. *47201* **$299**

40MB Seagate (40ms) half-height, with controller. *47209* **$425**

60MB MiniScribe (61ms) half-height, with RLL controller. *47250* **$389**

XT FlashCards

FlashCard-20™ 20MB MiniScribe (65ms). *47005* **$299**

FlashCard-30™ 30MB MiniScribe (65ms). *47104* **$329**

AT Class Hard Drives

20MB Seagate (65ms) half-height drive. *47003* **$219**

40MB MiniScribe (61ms) half-height drive. *47203* **$319**

80MB Seagate (28ms) full-height drive. *47401* **$629**

ESDI Hard Drives

90MB CDC (18ms, 10MBit) half-height drive. *47405* **$899**

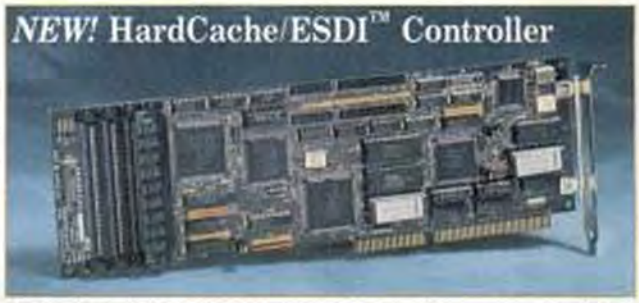
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320MB MiniScribe (18ms, 10MBit) full-height drive. *47434* **$1699**

320MB CDC (14.5ms, 10MBit) full-height drive. *47433* **$1789**

630MB CDC (14.5ms, 15MBit) full-height drive. *47476* **$2699**

NEW! HardCache/ESDI™ Controller



The new CompuAdd ***HardCache/ESDI Controller*** *reduces system access time to cached data to less than 0.5ms—up to 30 times quicker than even the fastest hard drive! Perfect for any network, CAD/CAM, or graphics application. Features automatic system self-configuration, programmable prereads, and automatic cache set definition. Base configuration 256KB. Upgrades require 100ns SIMMs.* **$495** *48330*

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Our double-sided, high-density 3.5" ***1.44MB diskette drive*** *is an exceptional bargain.* **$89** *65253*

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720KB XT-compatible (black). *45205* **$89**

Tape Backup Systems

40MB internal tape backup for AT-compatibles. *45955* **$329** ***(Regularly $359)***

60MB internal tape backup for XT- or AT-compatibles. *45950* **$859**

Math Coprocessors

80287-8 math coprocessor (8MHz). *50251* **$219**

80287-10 math coprocessor (10MHz). *50253* **$249**

80387-20 math coprocessor (20MHz). *50277* **$439**

80387-25 math coprocessor (25MHz). *50278* **$549**

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I/O Card for XT-compatibles with serial port, parallel port, game port, and clock/calendar with battery backup. *48067* **$55**

I/O Card for AT-compatibles with serial port, parallel port, and game port. *48053* **$49**

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AT-compatible EMS card with 0KB expandable to 2MB. *48105* **$119**

Intel Above™ Board PLUS with 512KB expandable to 2MB for XT- and AT-compatibles and PS/2™-30. *48176* **$419**

Multifunction Boards

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Model 450AT **for PC AT, PS/2-80 and 386 systems.** **$425** *40710*

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Power Supplies

150-watt XT-compatible replacement power supply. *40700* **$59**

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Internal Modems

1200 baud ½-card internal modem with software. *49500* **$69**

2400 baud internal modem with software. *49553* **$119**

Hayes 2400B 2400 baud ½-card internal modem. *49552* **$409**

Everex Evercom™ 2400 baud ¾-card internal modem with software. *48557* **$149**

External Modems

2400 baud external modem. *49557* **$129**

Everex 2400 baud external modem. *48575* **$179**

FAX Boards

Internal JT FAX board (4800 bps). *56107* **$249**

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Epson FX-1050 (15" carriage, 290 SuperDraft/54 NLQ). *56317* **$469**

Okidata Microline® 321 (15" carriage, 300 draft/63 NLQ). *56300* **$465**

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Panasonic 1124 (11" carriage, 192 draft/63 LQ). *56309* **$339**

Okidata Microline 390 (11" carriage, 270 draft/90 LQ). *56307* **$469**

Panasonic 1524 (15" carriage, 240 draft/80 NLQ). *56333* **$559**

Okidata Microline 391 (15" carriage, 270 draft/90 LQ). *56302* **$649**

Epson LQ-1050 (15" carriage, 264 draft/88 LQ). *56333* **$775**

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Hewlett-Packard LaserJet Series IID. *56002* **$2999**

QMS-PS® 810 Adobe® PostScript® laser printer. *56821* **$3949**

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QMS UltraScript™ PC adds the powerful flexibility of PostScript printing to practically any printer. *58549* **$138**

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• Zoom Image Windows
• Image Library



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For IBM PC/XT/AT and Compatibles



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JE2017 Pictured

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41256-120	262,144x1 (120ns)	$3.69
41256-150	262,144x1 (150ns)	$3.25
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CPU	8088-2	8088-1	V20	80286	80286	80386	80386
Speed (Mhz)	8/4.77	10/4.77	12/4.77	12.5/8	16/8	20/8	24/8
BIOS	ERSO	ERSO	ERSO	AMI	AMI	AMI	AMI
Wait States	1	0/1	0/1	0/1	0/1	0/1	1
Standard Memory Config.	640K	640K	640K	1MB	1MB	1MB	1MB
On Board Memory Expansion				4MB	8MB	8MB	8MB
Shadow RAM BIOS					384K	384K	384K
Coprocessor Support	8087	8087	8087	80287	80287	80387	80387
Expansion Slots	8-8 bit	8-8 bit	8-8 bit	2-8,6-16	2-8,6-16	2-8,5-16	2-8,5-16
Dual Hard Floppy Controller	w/H.D.	w/H.D.	w/H.D.	Yes	Yes	Yes	Yes
Device Bays(E-external,I-Int.)	4-E	2-E,2-I	2-E,2-I	3-E,2-I	3-E,2-I	3-E,2-I	3-E,2-I
Serial Ports	1	1	1	optional	optional	optional	optional
Parallel Ports	2	2	2	1	1	1	1
Game Ports	2	2	2	1	1	1	1
Bus Mouse Port	1	1	1	1	1	1	1
Power Supply Size	150W	150W	150W	200W	200W	200W	200W
Key Tronics USA Keyboard	Yes	Yes	Yes	Yes	Yes	Yes	Yes
EZ-DOS 4.0 w/GEM,TopDOS	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Battery Backup Clock	Yes	Yes	Yes	Yes	Yes	Yes	Yes
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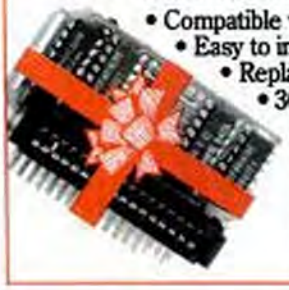
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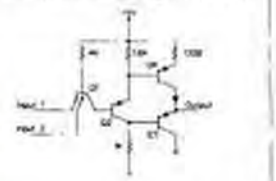
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COMING UP

■ SUPERCHARGED PORTABLES

As their name implies, portables are traveling fast—along an upward path of greater speed and power. PC Labs brings you up to date on 11 80386-based machines running at speeds of 20 MHz and faster, including IBM's Model P70, Compaq's Portable 386, and the Toshiba T5200. It wasn't long ago that this type of power was extraordinary in the desktop arena. Now you can take it on the road to make impressive presentations and keep up with the office workload at the same time.

■ PAPER-WHITE MONITORS FOR DTP AND CAD

Desktop publishing and computer-aided design are flooded with display and adapter card options. To reduce the confusion, we test 13 monitors that produce dual-page displays with readable type and that come bundled with their own video adapter cards to guarantee compatibility.

■ MEMORY BOARDS

286 owners, do you ever feel like the benefits of multitasking are out of your reach? *PC Magazine* can help you take advantage of today's multitasking environments with detailed testing and reviews of ten LIM EMS 4.0 memory expansion boards. These boards can carry at least 8MB each and are optimized to work with environments like Quarterdeck's *DESQview* and *Microsoft Windows*. In addition, they all support extended memory for OS/2, so you'll never waste a bit of RAM.

■ THE GREAT KEYBOARD DEBATE

If you aren't comfortable with your keyboard's layout or degree of sensitivity, you're a candidate for a replacement keyboard. We assemble an opinionated panel of PC experts (our staff) and take aim at seven of the most popular replacement models on the market today. ■

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After Hours

Products for the Leisure Side of Personal Computing

Vette!, from Spectrum Holobyte, Puts You In a Fantasy Corvette

GAMES
by Bill O'Brien

Spectrum Holobyte has combined the competitive thrill of *Pole Position*, the driving challenge of *Test Drive*, and the door-slamming speed of a NASCAR Winston Cup race. The result is *Vette!: The Street Race Simulation Through San Francisco*, a $49.95 street-racing program that brings out the speed demon in any car enthusiast.

Vette! offers the PC driver a wide choice of classic Corvette models. For the timid, there's a stock Vette, with its 245-bhp 350 CID engine. Driving the pathetic, four-speed automatic, with its lock-up torque converter, you'll be propelled down the road at a miserly 154 miles per hour, max.

If you've packed your glycerin tablets, you might try the ZR1. Its 380-bhp 349 CID engine will unwind around the six-speed transmission to the tune of 7,200 rpm for a top speed of 180 mph. The ability to go from zero to 60 in 4.2 seconds makes you at least competitive.

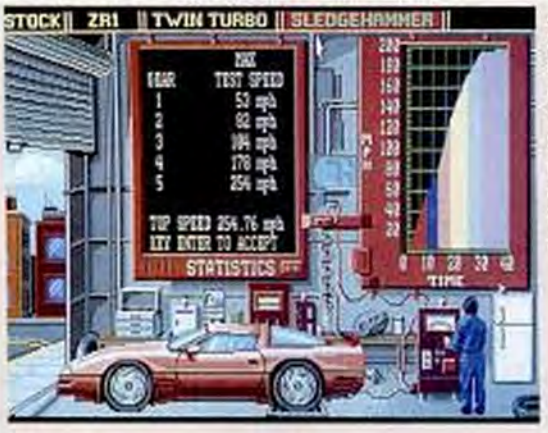
Just above the ZR1 is a Callaway "Twin Turbo," conceived by the Callaway crew in the otherwise staid state of Connecticut. Its twin air pumps add 2 bhp to the ZR1 spec and bump the top speed to 191 mph.

Of course, if you live by the motto "excess is best," you will insist upon the "Sledgehammer." Also a product of the mad geniuses at Callaway, the twin turbos in this monster are more than just hair driers. Pumping 898 bhp out of its 350 CID engine, this hog rockets along at a top speed of 254 mph.

Just so you don't get bored, *Vette!* lets you vie for bragging rights against a tame (computer-driven) Porsche 928S/4, a flashy Countach (pronounced "Coon-tosh"), or either of a dashing duo of Ferraris.

Which racetracks do you abuse with all this power? None. *Vette!* is a *street*-racing simulator. It inflicts you and your lead foot on the otherwise placid streets of San Francisco. Armed with a map of the city and its environs, you can wreak havoc along any of four possible courses. You howl through busy streets, along crowded highways, and over city bridges. On these courses, skill is as valuable as speed.

- **GAMES**
  Gauntlet II moves out of the arcade and onto your PC.
- **SCIENCE**
  Add-on device turns your PC into a Geiger counter.
- **TRAVEL**
  Streets on a Disk prints maps and travel directions.



Among the Corvette models offered in *Vette!* is the Sledgehammer, a no-compromise street racing monster.



Vette!'s excellent graphics include realistic views of downtown San Francisco. You must avoid other cars as well as pedestrians.

Vette! has considerable carnage potential. As you go barreling down city streets or across the Bay or Golden Gate bridges, unwitting pedestrians can plod into your path. Buses, trucks, and slow-moving cars may make you plead for divine intervention as you zig, zag, brake, and swerve around them. On the highways, you'll need to contend with guardrails and tight-radius turns as well as other vehicles.

Not unsympathetic to your plight, Spectrum gives you a choice of three driving modes: Trainee, Rookie, and Pro. Trainees are immune to the damage caused by hitting solid objects, and your only real worry is staying out of the bay. Collisions do slow your car down, however.

As a Rookie you notice that collisions damage your vehicle in direct proportion to your speed at impact. You are also subject to the attentions of the local police (if they can catch you). The men in blue are more than

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Fifty years from now, we'll be sitting on porches with our grandchildren, recounting the wondrous story...

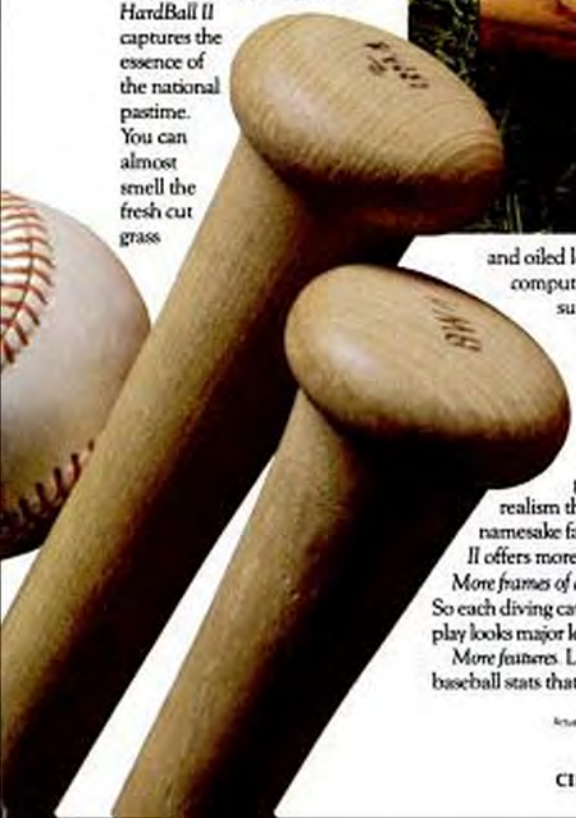


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Actual game screens from IBM PC EGA version of the game. Other versions may vary.

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After Hours

Vette!

CONTINUED

happy to write you up a ticket for any of a plethora of traffic violations.

If you're really good and your family name is Waltrip or Petty, you might try the Pro mode. Be warned, however; you will watch your car disintegrate around you as you forgo better judgment and bounce off of other motorists while trying to take a 90-degree switchback at 252 mph.

Vette! consistently satisfies with its complexity and attention to detail. Spectrum gives you a simulated 3-D environment to impress on you that you are dealing with solid objects. No matter which car you select, you can run it with either an automatic or a manual transmission.

A forward view through the windshield is the default, but you can toggle between left and right mirrors and maintain a rear-view mirror display (drive too slowly and your car will be rear-ended by oncoming traffic). Add to this a helicopter view (with or without dash display), as well as variable elevation for your point of view, and you might begin to understand the amount of graphics manipulation going on behind the scenes.

This graphic environment is so complex that it sometimes can't keep up with itself. I spent a good portion of a bridge crossing riding on a solid sea of blue when the graphics manager forgot to switch the bridge back on after a collision. On another ride through hell I was caught beneath the wheels of a tractor trailer as it ran back and forth over my Sledgehammer until I switched the computer off.

But these are minor, infrequent problems (I logged 46 hours on the game and fell victim to only two such incidents). They are negligible when weighed against the full impact of *Vette!*

Having considered all of the possibilities thus far, imagine *Vette!* as a two-player game. No, both drivers don't need to be hunched over a single keyboard. All you'll need is a friend with a serial port or a modem, and you can battle each other while passing angry glares over your monitors or even across long distances.

If you like cars and love competition, *Vette!* is a game you must buy.

List Price: *Vette!: The Street Race Simulation Through San Francisco*, $49.95. **Requires:** For CGA version: 7-MHz or faster PC or compatible; CGA or MGA graphics; DOS 2.0 or later. For EGA version: AT or compatible; 640K RAM, EGA graphics with 256K video RAM, DOS 2.0 or later. Spectrum Holobyte, 2061 Challenger Dr., Alameda, CA 94501; (415) 522-3584.

CIRCLE 426 ON READER SERVICE CARD



Vette! depicts the Golden Gate Bridge, along with a number of other familiar San Francisco landmarks.

Gauntlet II Moves the Dungeon from The Arcade To Your Living Room

GAMES
by Dan Trivette

Here's relief for fans with fingers mangled by chucking quarter after quarter into the arcade game *Gauntlet*. Now, for about 160 quarters, you can own Mindscape's *Gauntlet II* and play it for free in your own living room.

Thor, Thyra, Questor, and Merlin are all there, fighting their way through more than 100 new mazes—make that dark dungeons—in a futile attempt to reach their final reward.

As in the arcade version, you pick a character to represent you. Whether you choose Thor the Warrior, Merlin the Wizard, Thyra the Valkyrie, or Questor the Elf will depend on what characteristics you most value. Thor, for example, has a tough skin that deflects 20 percent of his injuries, but he's none too sharp in the magic powers department. Merlin, as might be expected, is tops with magic but has thin skin. Each character starts with unlimited shooting power and 2,000 health points. Health diminishes with time and combat and can be replenished with food and cider hidden in the dungeons.

Your point of view as you play *Gauntlet II* is a semi-3-D perspective of the dungeons, seen from above. The icons in the EGA/VGA version look more or less like what they are supposed to be: ghosts, grunts, demons, lobbers, sorcerers, death, acid puddles, and other equally vexing obstacles. The graphics aren't stunning—other than on the box and title screen—but they are better than what we were getting a year or two ago from transplanted arcade games.

Tandy players of *Gauntlet II* can enjoy enhanced sound (in machines that support it), while IBM players are stuck with muffled rumbles. In the version I played, there's a problem when both a joystick and a mouse are connected to the computer. Mindscape promises to fix this quickly, and in the meantime you can disconnect the mouse.

The best thing about *Gauntlet II* is that you can play it with your friends. Up to four players can roam the dungeons at the same time, helping one another fend off grunts and avoiding "It," although the keyboard does get a bit crowded. Ask a few friends over, open the box, and once again do battle.

List Price: *Gauntlet II*, $39.95. **Requires:** 512K RAM, DOS 2.1 or later, color graphics. Mindscape Inc., 3444 Dundee Rd., Northbrook, IL 60062; (312) 480-1948.

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The graphics in *Gauntlet II* are better than the usual transplanted arcade fare, but they aren't state of the art.

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Radiation Sensor Helps Your PC Catch Some Rays

SCIENCE
by Jeff Prosise

Does exposure to alpha radiation have you worried? Gamma rays got you down? If so, check out the RM-60 Micro-Roentgen Radiation Monitor from Aware Electronics. More than just a toy or a tool for the curious, the RM-60 lets you use your PC to monitor your surroundings for life-threatening radiation, affording you the peace of mind that can come only from having your own Geiger counter.

The RM-60 is made up partly of hardware and partly of software. The hardware—an unobtrusive plastic box about the size of a pocket modem—contains a sensitive, calibrated Geiger tube similar to those in industrial radiation monitors. A cable running from the box plugs directly into your PC's parallel or serial port.

The software captures raw data transmitted from the radiation monitor and displays it in the form of a scrolling bar chart, accurately reflecting levels of ionizing radiation recorded for periods of days, weeks, or even months.

The RM-60 detects all three types of ionizing radiation emitted by nuclear materials: alpha, beta, and gamma. It can also detect X rays, and, with the aid of a forced-air filtering system, low levels of radon gas (as little as 1 picocurie per liter). The manual that comes with the RM-60 contains a helpful discussion of common sources of radiation in the home, the units of measure, and what to do when the measured dose exceeds EPA-recommended levels.

Plug in the radiation monitor and install the software, and almost immediately you'll get a reading on the background radiation in your home or office. The software samples the environment continuously and averages the radiation levels in microroentgens per hour over the length of time you specify (a typical interval is 5 to 10 minutes). If the most recent reading exceeds a predetermined level (by default, 27 microroentgens per hour), the software warns you by sounding an alarm.

There are as many different ways to use the RM-60 as there are types of radiation it will measure. Run in the foreground, it will graphically display running totals of ionizing radiation levels as they are read. Run as a TSR, it will quietly gather radiation data in the background while you go about business as usual. The software warns you if there is cause for alarm. Data captured and stored to the hard disk can be reviewed at your convenience.

To get you started, the RM-60 comes with a sample radiation data file generated from background radiation at a site in southeastern Pennsylvania. As a test, I set it up and measured the levels of background radiation in my California apartment.

The result: an average of 10.6 microroentgens per hour over a period of 30 minutes, a reasonable figure inasmuch as typical levels of background radiation in this country range from about 5 to 25 microroentgens per hour, depending on where you live and what type of dwelling you live in. The RM-60 is capable of measuring levels as low as 1 microroentgen per hour and as high as 30,000.

You'll find this product particularly useful in environments where nuclear materials are handled—in nuclear plants and medical laboratories, for example. You'll also find application for it in the home if you're simply curious about naturally occurring levels of radiation in building materials, soil, food, or beverages. In addition, the RM-60 is an attractive alternative to home radon monitoring kits, which can cost several times as much and aren't nearly as fun to use.

For a real shock, hold the RM-60 in front of a lantern mantle of the type that can be bought in any camping store. Most lantern mantles contain quantities of thorium salt, a highly radioactive material that occurs in nature. Readings will soar to levels exceeding 500 microroentgens per hour, a clear indicator that this common household item shouldn't be treated lightly.

Among PC hardware and software products, the RM-60 is unique in many respects. Its most notable distinction may be that in the very worst case—in the event of nuclear attack or nuclear mishap—it is the *one* product you won't want to be without.

List Price: RM-60 Micro-Roentgen Radiation Monitor, $97.50. **Requires:** Parallel or serial port, DOS 2.0 or later, 256K RAM, graphics adapter. Aware Electronics, P.O. Box 4299, Wilmington, DE 19807; (302) 655-3800.

CIRCLE 429 ON READER SERVICE CARD



This RM-60 bar chart displays ionizing radiation levels recorded over a period of 30 minutes at 1-minute intervals. You can specify other intervals if you desire.

Streets on a Disk Gets You from Here to There

[redacted]
by Barry Simon

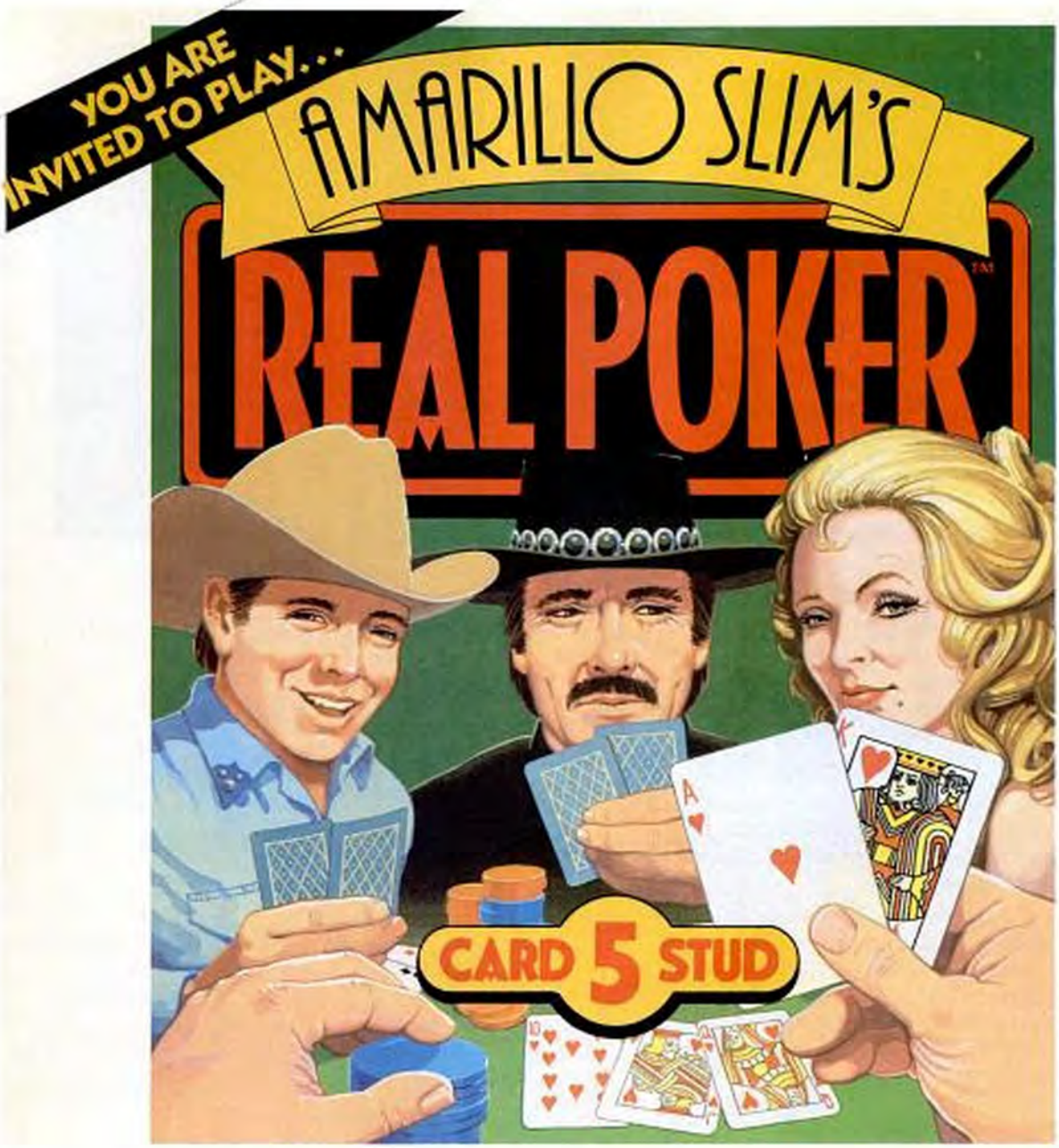
"Dear, didn't the Smiths move to Grant Street? Have you any idea where that is and what the best driving route is?" Sounds like a question your PC should be able to handle. Personal computers are supposed to be ideal for crunching data, after all, and street and address maps represent gobs of data.

Traditionally, however, coping with such data required a mainframe or at least a minicomputer. But advances in PC technology and a remarkable program called *Streets on a Disk* from Klynas Engineering have placed city streets within reach of a well-equipped PC.

The basic program reads map files and displays them on a graphics adapter (CGA, EGA, or Hercules; VGA in EGA emulation works fine). You can display a map on a large scale—say, all of Manhattan. Or you can zoom in on an area of a few blocks. You can search for an area by street name, full address,

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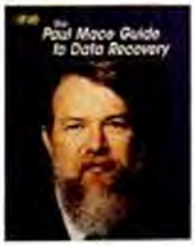
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After Hours

Streets on Disk

CONTINUED

or ZIP code.

You can also load a file of places of interest on each map and search for them too. This list of places can easily be edited. By including your own places of interest, you can develop what amount to personalized maps.

You can even add streets or addresses that are absent—although they shouldn't be needed, because the maps are based on data from the 1990 Census (yes, sounds odd, but that is 1990—the Census Bureau can't find people next year unless it has all the addresses now, and it has published that data).

The program computes the best route between two or more locations, but be prepared for a wait. Even on a 25-MHz 386 machine equipped with a math coprocessor, a 7-mile route through central Los Angeles took about 15 minutes.



Streets on a Disk **uses local maps to plot the most efficient driving route to the destination you specify.**

Slower systems take longer, depending on the processor used and whether a math coprocessor is installed. Heavy use calls for a well-endowed system including a large hard disk.

You can print out maps and route directions on an HP LaserJet or Epson-compatible dot matrix printer.

Lest you think the program comes with detailed street information for the entire United States, keep in mind that the data for the state of California alone costs about $12,000 and runs to several hundred megabytes.

Streets on a Disk does come with one basic map of the major U.S. roads; you'll need to purchase extra map sets for specific localities. For Los Angeles, San Francisco, and Chicago, maps of the major local streets are available for $20 each. Otherwise, you'll need one of the individual packages that are available for all the counties in the U.S. Maps are also available for parts of several counties.

Prices are typically in the $100 to $150 range, but a small county like Manhattan is $70, while St. Lucie County, Florida, weighs in at a whopping $2,210. These maps take considerable disk space: the two we looked at were Manhattan, at 800K, and the Wilshire Corridor subset of Los Angeles, at 2.2MB and $150.

If you want to know where you are going and how to get there, *Streets on a Disk* may appeal to you.

List Price: *Streets on a Disk*, Version 3.0, $150; add-on maps at various prices. **Requires:** DOS 2.0 or later, 512K RAM, graphics adapter; hard disk strongly recommended. Klynas Engineering, P.O. Box 499, Simi Valley, CA 39062; (805) 583-1029.

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by Bill Howard

Abort, Retry, Fail?

The Lighter Side of Personal Computing

You Should Have Seen the Error Rate With Constant Linear Velocity

"The [Ricoh rewritable optical] drive uses highly reliable constant angular velocity tracking, yielding an error rate of about one in every 10-12 bits read."
—*Design Fax*, July 1989.

PC WEEK

BUYERS' GUIDE

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3.5-Inch Disks Grow with Demand

By Kristina B. Sullivan

And when they grow beyond 3.5 inches, some of the lower-quality drives show an error rate of one in every 10–12 bits. (Headline from *PC Week*, July 24, 1989.)



ILLUSTRATION: RICHARD TENNANT

Meanwhile, the Dusseldorf Office Has a 10-Year Overstock of Kanji Turbo Prolog

"While Compaq's international business may be ahead of other PC companies, most companies see opportunities overseas. A number of software companies, including Borland, have recently added Japan to their list of European offices."
—*InfoWorld*, May 29, 1989

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Duties include upgrading office from beta release. (Want ad in the *Hollywood Reporter*, July 21, 1989.)

Why We Remain Suspicious Of the Mac Market

"512K Macintosh computer—external disk drive, and ImageWriter printer, $900 (bicycle included). Call *xxx-xxxx*."
—Want ad, the *Village Advocate*, Carrboro, N.C., June 6, 1989

PC Magazine will give you $50 and a *PC Magazine* T-shirt if we use your submission in Abort, Retry, Fail? Warning: Don't write on the original if it might be reprinted; mark up a photocopy or use a Post-it. In case of duplicate entries, the neatest entry wins. Winners this issue: Pat McMahon (rewritable optical), Kurt Schumacher (growing disks), Beth Woods (WordPerfect .50), Randy Mullis (bicycle included), Marion K. Paynter (Borland in Japan). Cartoon caption by Bill Machrone.

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"You will have to look far and wide to find a better price performance package for the power-user lurking inside you."

First Looks, *June 14, 1988. For the full story see inside back cover.*



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