JULY 1991

WANS: AROUND THE BLOCK OR AROUND THE WORLD Page 158

BYTE

A McGRAW-HILL PUBLICATION

Northgate's Upgradables: CEG Graphics Built In

Page 43

Microsoft's all-in-one system now includes a 386 memory manager, disk and performance utilities, a task-switcher, a real text editor, and more

The New DOS

Readers' Choice Awards
Unicode: Beyond ASCII
Remote-Access Computing
Understanding OS/2 Device Drivers
Inside Mac Sound Hardware

PLUS
DRI's Multiuser DOS
Tandy's $399 CD-ROM Drive
5 New Sparcstation Clones
Autodesk's AutoShade release 2
Motorola's Wireless LAN
Farallon's DiskPaper

$3.50 U.S.A./$4.50 IN CANADA
0360-5280

Introducing Lotu

There's a lot to like about the new Lotus® 1-2-3® for DOS Release 2.3.

For starters, it's not just a graphical spreadsheet. It's a fast, graphical spreadsheet for DOS. It's easy to use.

And it works as well on an older XT with just 512K of memory as it does on the newest 486 machine.

It also shares many features in common with our powerful 3D spreadsheet 1-2-3, Release 3.1. Including its superb spreadsheet formatting and publishing capabilities and full mouse support. Along with its popular Auto Compress feature that gives you a trouble-free way of making larger worksheets print on a single page.

We've also added new features you won't find in other spreadsheets. Like the Viewer (based on Lotus Magellan® technology) which lets you view files before retrieving them and makes file linking as easy as point and click. And a very helpful Auditor

Lotus 1-2-3 Release 2.3 runs smoothly and quickly no matter what hardware you're running it on

Lotus 1-2-3

The world's most popular spreadsheet

WHAT'S NEW IN LOTUS 1-2-3 RELEASE 2.3.

- A WYSIWYG graphical environment with live on-screen formatting
- Lotus Magellan viewer technology for fast file previewing, retrieving and linking… all without leaving your active worksheet
- More graph types, including 3D-effect graphs and graph annotation capabilities
- Auto Compress, for a trouble-free way of making larger worksheets print on single page
- Dialog Boxes for an easier, more interactive way of working
- Text-editing for easy on-sheet word processing, including automatic word wrap, even around graphs
- The Auditor for documenting or highlighting your spreadsheet logic
- Improved memory management for building larger worksheets up to 12 MB in size
- New printer drives that support all leading laser and dot-matrix printers
- Context-sensitive, interactive Help and an on-line tutorial

ʟs 1-2-3 Release 2.3

that simplifies the job of documenting and analyzing worksheet logic.

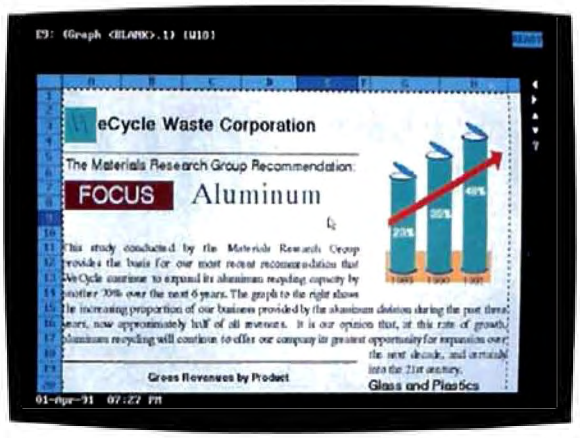
Of course, you won't just like what Release 2.3 does. You'll like how it feels. It's quick and smooth. With a WYSIWYG (what-you-see-is-what-you-get) graphical environment that lets you format text, data, and graphics "live" on screen. With the mouse, you can execute commands, highlight cells or ranges, open dialog boxes, place and size graphs, change type styles, fonts and point sizes. All with unparalleled speed and ease.

What's more, Release 2.3 gives you a wide range of printing and reporting capabilities. Including the capacity to place as many live graphs on a worksheet as you'd like.

Along with 96 type style combinations, drop shadows, new 3D-effect graphs, drawing and annotation tools, and the most font support, choices of colors and shading available.

Compatibility? As with any 1-2-3 product, it's no problem. Because Release 2.3 will read all of the files you've created on previous versions of 1-2-3, including files you've formatted using Allways™ and Impress.™ So you'll preserve all your work, as well as your training.

To order your upgrade direct from Lotus* call **1-800-TRADE-UP, EXT. 1208.** Or see your Lotus Authorized Reseller.



With its WYSIWYG graphical environment, you can do all your formatting "live" on screen. Which means you'll always know what your output will look like before you print.

An unimpressive report is something you'll never have to create again.

Align titles or text across a range of columns—left, right, or center—with one simple command

You can wrap text around graphs automatically.

Add freehand drawings or symbols to call attention to critical data.

A feature that only 1-2-3 offers to DOS spreadsheet users is the ability to embed as many "live" graphs on a worksheet as you'd like.

Improved, 3D-effect graphs can add even more impact to your report.

Mix bold, italics, underlines, colors, and typefaces to create over 100 text style combinations—more than any other spreadsheet.

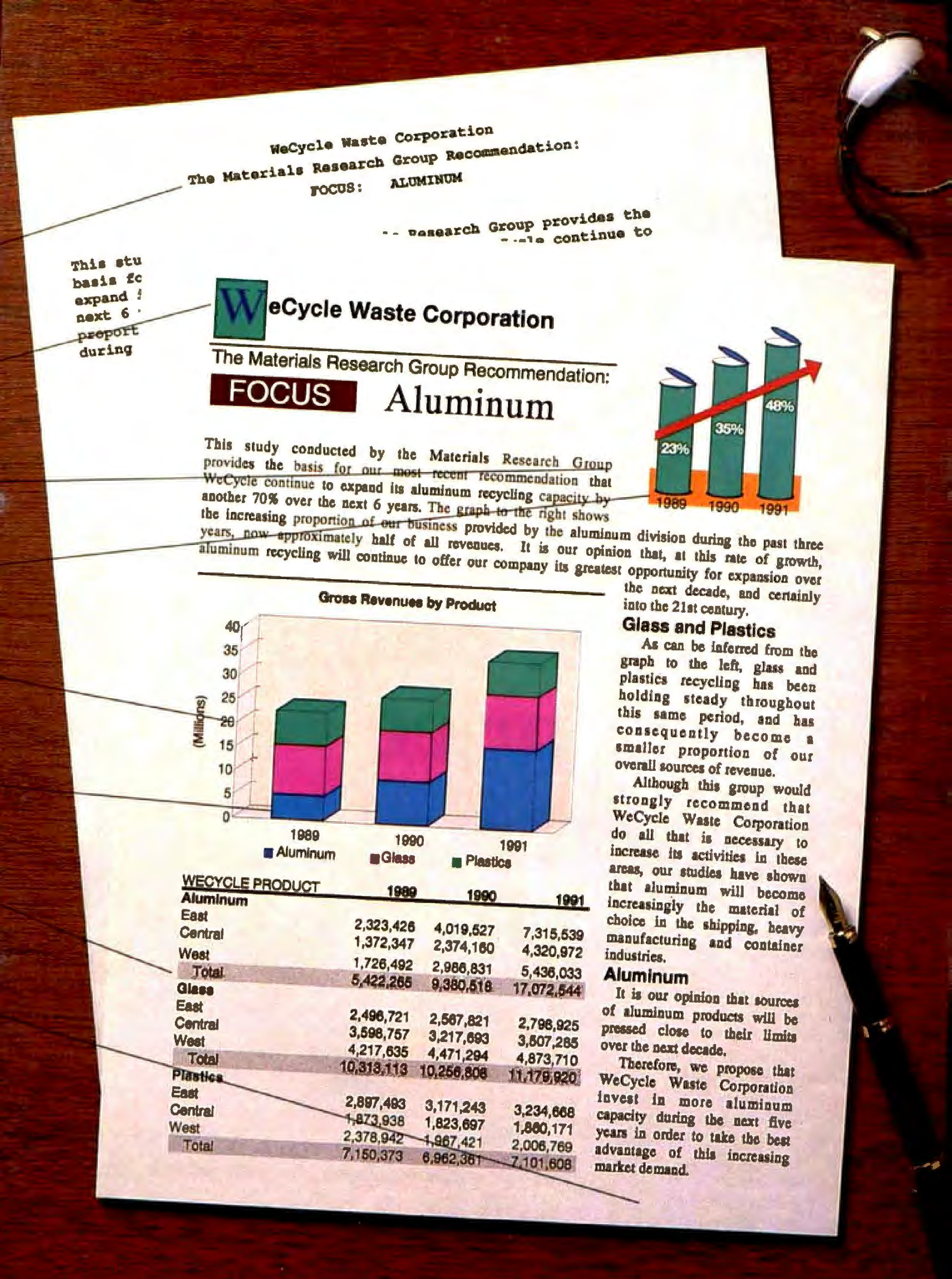
Thanks to Auto Compress, you can easily make an entire report fit on one page.

**Please have your credit card and product package ready when you call. In Canada, call 1-800-668-1509.*

The new Lotus 1-2-3
for DOS

Lotus

Now you can upgrade your spreadsheet without upgrading your hardware.



WeCycle Waste Corporation
The Materials Research Group Recommendation:
FOCUS: ALUMINUM

WeCycle Waste Corporation

The Materials Research Group Recommendation:

FOCUS Aluminum

This study conducted by the Materials Research Group provides the basis for our most recent recommendation that WeCycle continue to expand its aluminum recycling capacity by another 70% over the next 6 years. The graph to the right shows the increasing proportion of our business provided by the aluminum division during the past three years, now approximately half of all revenues. It is our opinion that, at this rate of growth, aluminum recycling will continue to offer our company its greatest opportunity for expansion over the next decade, and certainly into the 21st century.

Gross Revenues by Product

WECYCLE PRODUCT	1989	1990	1991
Aluminum			
East	2,323,426	4,019,527	7,315,539
Central	1,372,347	2,374,160	4,320,972
West	1,726,492	2,986,831	5,436,033
Total	5,422,265	9,380,518	17,072,544
Glass			
East	2,496,721	2,567,821	2,798,925
Central	3,598,757	3,217,693	3,507,265
West	4,217,635	4,471,294	4,873,710
Total	10,313,113	10,256,808	11,179,920
Plastics			
East	2,897,493	3,171,243	3,234,668
Central	1,873,938	1,823,697	1,860,171
West	2,378,942	1,967,421	2,006,769
Total	7,150,373	6,962,361	7,101,608

Glass and Plastics

As can be inferred from the graph to the left, glass and plastics recycling has been holding steady throughout this same period, and has consequently become a smaller proportion of our overall sources of revenue.

Although this group would strongly recommend that WeCycle Waste Corporation do all that is necessary to increase its activities in these areas, our studies have shown that aluminum will become increasingly the material of choice in the shipping, heavy manufacturing and container industries.

Aluminum

It is our opinion that sources of aluminum products will be pressed close to their limits over the next decade.

Therefore, we propose that WeCycle Waste Corporation invest in more aluminum capacity during the next five years in order to take the best advantage of this increasing market demand.

ALR's LAW

What goes up in performance must come down in price.

The ALR POWERPRO

The concept is as simple as the law of gravity, yet as revolutionary as the theory of relativity... Build a superior system and sell it for an irresistible price. That's exactly what we've done with the ALR POWERPRO VM Series. These systems have everything you could want in a powerful network server or multiuser host. Fast 32-bit processors complemented by a substantial 64-KB cache provide excellent CPU power, while the POWERPRO's ten industry standard expansion slots and large floor-standing chassis give you all the room you'll ever need for customization. Factor in the POWERPRO's 32-bit EISA bus and 32-bit ESDI disk controller (standard on hard drive models), and you have one unbeatable system.

Yet the POWERPRO sells for less than you'd expect for a system of this caliber.

The POWERPRO VM 386/33 with its 33-MHz i386™ processor starts at just $4995. Or you can select one of our 20-MHz i486SX™, 25-MHz i486™ or 33-MHz i486 models. Just choose the level of power you need today. With ALR's modular *Just Upgrade the CPU!*™ processor upgrade technology, you can upgrade processing power simply by swapping CPU modules.

The only upgradeable EISA-based file server under $5,000

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Who says you have to pay more to get a great system? The ALR POWERPRO sets a new standard for performance, flexibility, and value.
To find out more, call:

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Manufacturer	ALR®	Compaq®	AST®
Model	POWERPRO VM 386/33	SYSTEMPRO™ 386/33	Premium™ 386/33TE
CPU	33-MHz i386	33-MHz i386	33-MHz i386
BUS Architecture	EISA	EISA	EISA
RAM Standard	5-MB	4-MB	4-MB
Floppy Standard	1.2-MB	1.44-MB	1.2-MB
Storage Bays	4	11	6
Total Slots	12	11	10
Starting List Price	$4995	$11,999*	$6495
Upgrade Path	20-MHz i486SX 25 MHz i486 33-MHz i486 Dual Processing 33-MHz i486	Dual Processing 33-MHz i486 *includes 240-MB Hard Drive and VGA controller	25-MHz i486 33 MHz i486

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July 1991 *Volume 16, Number 7*

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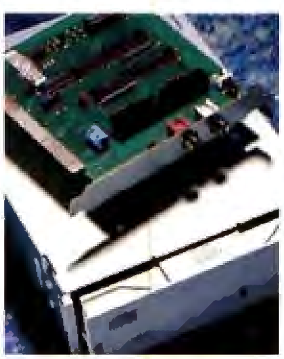

FEATURES

NSTL SUPPLEMENT

STATE OF THE ART

REVIEWS

HANDS ON

OPINIONS

INSIDE BYTE

REGIONAL SECTION begins after page 72

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BYTE Topic Index and Author Guide

This index helps you find articles that contain information on each of the listed topics. (The topic list changes each month.) Combined with the table of contents (page 4) and the Editorial Index by Company (page 338), you can identify articles by type, subject, title, author, or product discussed.

Why your next should be a

This year, millions of DOS users will move to the kind of graphical computing Apple® Macintosh® personal computers first made popular over eight years ago.

They'll probably need new hardware to handle the demands of the graphical environment. And they'll almost certainly have to buy new programs that take advantage of it.

Before you spend a fortune on all of that, why not invest a few minutes considering a Macintosh? It is the computer that started it all. And it remains the system against which all graphical computers are measured.

Finding out about how Macintosh fits in with the PCs you already own is as easy as picking up the phone. Call 800-635-9550, ext. 100, and we'll send you a copy of our new, fact-filled color brochure, *The Apple Guide to Macintosh/MS-DOS Compatibility*. It's free.*

It tells you how you can run Lotus 1-2-3, dBase and other favorite MS-DOS programs on a Macintosh.

How you can easily move information back and forth between Macintosh and your MS-DOS PCs on a standard 3 ½" floppy disk.

And how you can connect Macintosh with your DOS PCs over a Novell, 3Com, Token-Ring or just about any other kind of network.

You'll see that Macintosh lets you run more than 4,000 graphical programs that all work together in the same consistent, logical way.

You learn the basics of one, you've learned the basics of all of them. No other computer system offers you so much consistency with so many choices.

You'll also discover that Macintosh is the only system in which the hardware, operating system and

DOS computer Macintosh.

applications have been optimized to work together since the very first chip—with no compromise in performance. (Contrast this with a "graphics shell" that can slow other systems to a crawl.)

You'll read about our latest system software breakthrough – System 7 – and the exciting new capabilities it brings to Macintosh.

And you'll read about a recent independent study conducted by Ingram Labs, in which Macintosh computers blew the windows off 286, 386sx, 386 and 486 PCs from IBM and Compaq running graphics-based applications.**

Apple Macintosh computers are easy to set up, easy to use and easy to afford. And they come complete with built-in networking; printer, modem and SCSI ports; even built-in video support in most models. (Translation: no hidden costs.)

So pick up the phone. Give us a call. Find out why Macintosh could well be considered the most powerful, flexible, valuable, affordable DOS computer you can buy today.

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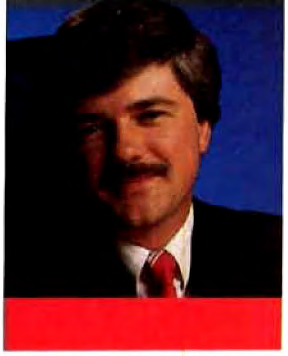


EDITORIAL

FRED LANGA

BEST OF SPRING

BYTE editors name the best products at Spring Comdex and Windows World

This year's Spring Comdex/Windows World was busier than most for the BYTE editorial team. In addition to our normal duties, we had the happy task of selecting and presenting the Best of Spring awards in an official event cosponsored by the Interface Group, which runs Comdex.

To make the task manageable, we grouped products in several large categories: desktop systems, portables, peripherals, connectivity, graphics, DOS applications, DOS utilities, Windows applications, and Windows utilities. We also selected an overall Best of Show and named a Rookie of the Year from the new companies exhibiting at the show.

Our criteria were simple but stringent: We looked for new products and new kinds of products that would serve as bellwethers, products that not only deserved notice in their own right, but that exemplified major trends in personal computing.

It was a tall order, but with the participation of the full editorial staff, and with on-site help from columnists Jerry Pournelle, Martin Heller, and Wayne Rash Jr., we chose 30 finalists and 11 winners. Our congratulations to all who won.

Best of Spring Winners

Best Portable: Zenith Data Systems, for its MastersPort 386SL, the first portable using the innovative 386SL chip and exploiting its automatic power-conservation features. (See the June BYTE for a First Impression of the MastersPort.)

Best Peripheral: Citizen America, for its diminutive notebook printer, the PN48: a printer with good-looking output in a package not much larger than some notebook power supplies.

Best Graphics Product: Graphics Vantage from ATI Technologies, a powerful, low-cost board that uses custom driver software and proprietary VLSI chips to accelerate graphics-intensive environments. Windows runs 11 times faster on this board than on some others.

Rookie of the Year: Realizer from Within Technologies: a strong competitor to Microsoft's Visual BASIC (see below).

Best Desktop Systems: Tandy, for its line of affordable, MPC-standard multimedia personal computers.

Best Connectivity Product: Artisoft, for its Central Station, a modem-size device that lets you simply, painlessly, and inexpensively connect a wide variety of devices (e.g., printers, laptops, and modems) onto your LAN.

Best DOS Application: Fox Software, for its blazingly fast FoxPro 2.0 database. (See the April BYTE for a First Impression of FoxPro 2.0.)

Best DOS Utility: Sonera Technologies, for DisplayMate, an $80 program that exercises, evaluates, and diagnoses your monitor almost as well as $10,000 worth of custom lab hardware.

Best Windows Application: Lotus Development, for its long-awaited 1-2-3 for Windows, a product that could help make Windows a full-time environment.

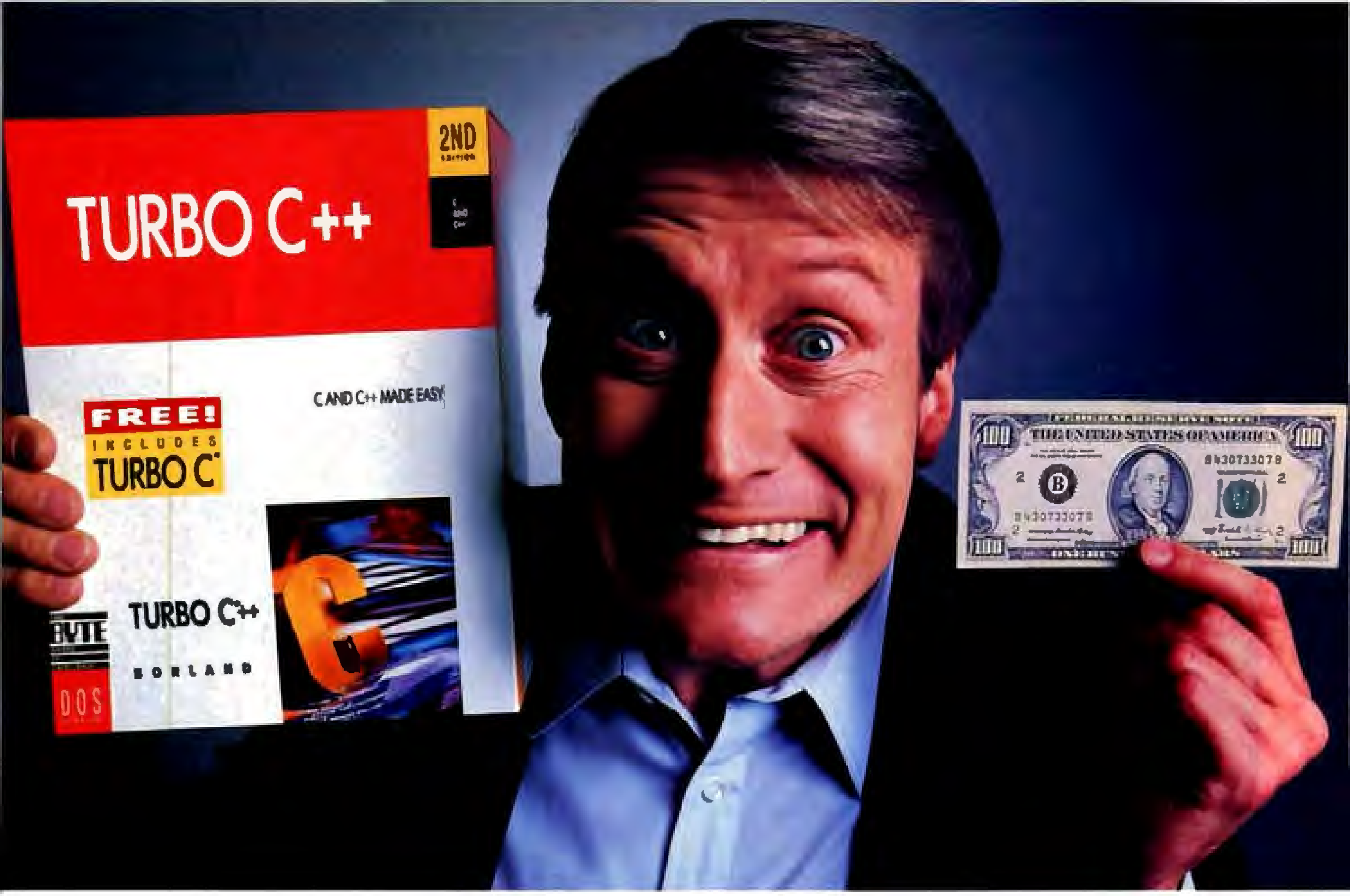
Best of Show

Microsoft, for Visual BASIC, which is also Best Windows Utility. This is a milestone product—part of a new wave of visually oriented point-and-click development tools. And in some ways, it's a positive echo from the early days of personal computing: the original BASICs of more than a decade ago that let us build small, quick-and-dirty solutions to immediate problems without the hassle and labor of coding in machine language. Today, Visual BASIC lets us craft quick solutions to the same kinds of problems within the Windows environment without having to resort to C or C++. Instead, Visual BASIC offers the relative ease of a point-and-click operation and the accessibility and obviousness of BASIC.

Visual BASIC isn't the be-all of Windows programming, of course, nor is it meant to be. But it will enable many Windows users to quickly and easily write their own small Windows programs and custom Windows applications, and to fill in the gaps between commercially available Windows products. As such, Visual BASIC will help us all realize far more of Windows' currently underused potential.

Watch for coverage of Visual BASIC and many of these winning products in upcoming issues of BYTE.

—Fred Langa
Editor in Chief
(BIX name "flanga")



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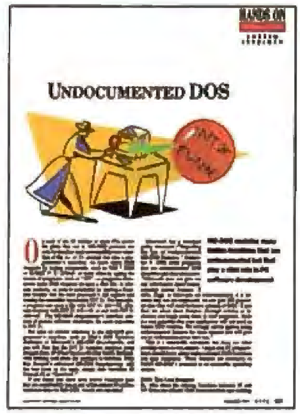
LETTERS

Coping with Undocumented Features



I am interested in Andrew Schulman's list of undocumented DOS features ("Undocumented DOS," March), but at the same time I have reservations about the enthusiasm with which he advocates actually using them. I propose that it be a matter of professional ethics that if a software company uses an undocumented feature, it must explain in the manual exactly why it was necessary to do it. Let's go a step further: Let's require that if the software developer is not prepared to disclose its source code, it must nonetheless compile and release, ordinarily in the user's manual, a complete inventory of the machine and operating-system resources used. This sort of honesty is essential if software is to be consistently reliable.

Sometimes, the need to use undocumented features is nothing more than lazy programming. For example, one accessory from a software house apparently was an afterthought to the vendor's major program. This accessory program implements scripts by copying them into a batch file and then using an undocumented feature to pass control to that batch file. Quite apart from the issue of compatibility and portability, this is a bad idea because users lose the program's settings, position pointers, and so on whenever they run a script. The company may justify this odd approach by the need to conserve RAM, but that is merely a poor excuse for not designing appropriate overlays and data-swapping mechanisms. If the company had been compelled to explain this approach to users, I'm sure it would have seen the wisdom of going back and doing the job right.

Andrew D. Todd
Springfield, OR

Roundtable Reactions

Your April Roundtable "Whither Innovation?" really pushed my hot button. The comments by Wayne Rash Jr. were right on target. Many PC manufacturers and publishers are so busy trying to be innovative, they've lost sight of what they should really be doing: producing goods and services consumers want and need. Instead, they figure out a way to build a better mousetrap and then try to sell it.

The Next computer is a classic example. Steve Jobs decided that we no longer needed floppy disk drives. Guess what? His customers wanted floppies. WORM (write once, read many times) drives and optical drives are nice, but for better or worse, the PC world is floppy disk-based and will be for some time to come. Just being innovative isn't enough. Innovation without customer focus is a waste of time and money, two things that are always in short supply.

It's a new world, folks, and it's going to take a whole new way of doing things to survive in it. Our industry is littered with thousands of products that simply don't work. And customers are tired of paying for hare-brained software, hardware, and services. More than anything, they are frustrated when truly needed features fail to materialize but fluff gets added to products just to increase marketing hype.

Manufacturers must start taking their direction from customers. We won't accept hype and hoopla anymore. We won't accept empty promises. Make sure your idea is something customers want and need and that it completely fulfills those needs. That's how to get innovation back into the PC market.

Sid Phillips
LaGrange, GA

I was really surprised by Wayne Rash's comments about Next in "Whither Innovation?" The new Next computer does come with a floppy disk drive (of course, why would you want to back up a large file on one optical disk when you can put it on 20 floppies?) and, in my opinion, is reasonably priced ($5000 to $10,000) for a 15-million-instruction-per-second machine.

The real innovation by Next is in the development environment NextStep, something not readily apparent to nonprogrammers (or those who haven't taken the time to look at Interface Builder). Next is perhaps the first computer company to really understand how important the development environment is to creating breakthrough applications. That's why Lotus came out with Improv on Next first. Fred Langa did mention how slick NextStep is, but I don't agree that it has been overlooked because everyone focuses attention on "the matte-black finish and the shape." It wasn't overlooked by IBM, which licensed NextStep for its RISC System/6000.

It has been overlooked by nontechnical "analysts" because they know nothing about development environments. In fact, the ignorance of these analysts holds back innovation that occurs outside their small sphere of knowledge. It's easier to say Windows is great because it's from Microsoft than to take the time to look under the hood of a Next computer.

James Engel
Burlingame, CA

Bravo! Your eight editors told it like it is in the March Roundtable, "Why Doesn't Software Work?" It's reassuring, although cold comfort, to know that we poor users are not alone in our continuing frustration with incompatible software and hardware and incomprehensible installation and operating instructions.

Your editors, bless them, have articulated for me and

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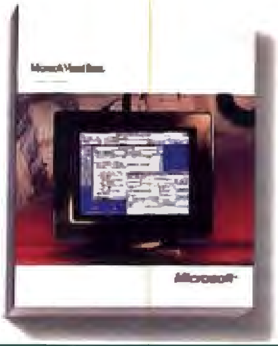

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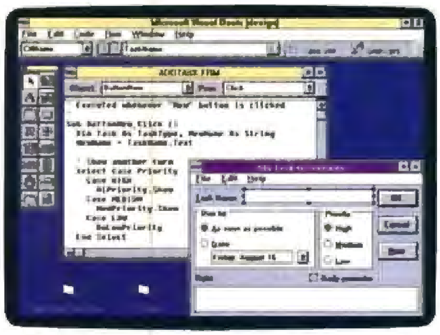
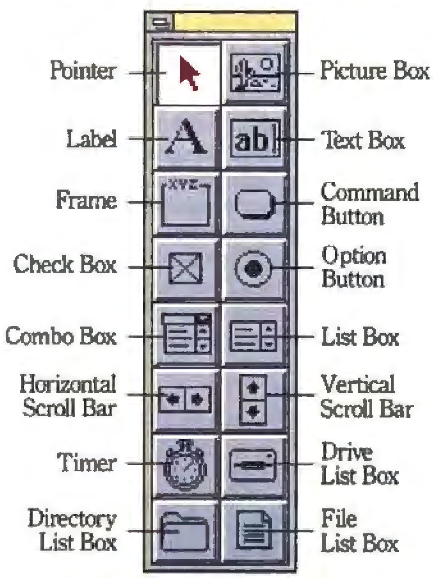


Graphical forms and a robust programming language combine to create powerful Windows-based applications.



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uncounted others our continuing plea for mercy from those on the other side who simply will not hear and cannot understand why we are in pain. Wayne Rash says that we can "hold [vendors'] feet to the fire," and Jerry Pournelle says that "we don't spend enough time yelling at them. . . . I will do better in future."

Bravo, I say.

Joseph A. Robinson
San Francisco, CA

In the March Roundtable, two of your editors described reports of software compatibility problems with new Macs as "folklore" and "rumors" and blamed them on programmers "violating the Apple standards."

Among the established programs that would not run on the first Mac II were Microsoft's FORTRAN compiler and Columbia University's Kermit. These were not "folklore" or "rumors" but reports by reputable programmers.

Apple standards may have been violated. But in the same issue of BYTE, we are told that correct DOS TSR programs cannot be written without violating DOS standards ("Undocumented DOS" by Andrew Schulman). There may have been similar reasons for violating Apple's standards.

Robert L. Montgomery
Littleton, CO

Fiedler Fan

Let me take this opportunity to thank David Fiedler for his articles in The Unix /bin from May to July 1990—they took the fear out of doing a UUCP. I configured the /usr/lib/Devices and /usr/lib/Systems files holding BYTE in one hand and keeping my fingers crossed on the other. It worked! And by taking the fear out of UUCPing, Fiedler made it possible for me to succeed at learning Unix at the BNU level, at least.

By all means, write about networking, because I discern a real need for general and specific knowledge about this vast and ever-evolving topic. You are so good at giving your readers an overview with just enough specifics without getting overly deep into techie stuff. You usually let your readers see the woods and not get lost in the trees.

Samuel Fivian
Rochester, NY

Another Look at Ethernet

I have just read "Ethernet: Ten Years After" by Rich Seifert (January) and found it to be preposterously inaccurate. Datapoint's ARCnet—the first commercially successful, true LAN—was installed for the first out-of-house customer (Chase Manhattan Bank in New York) toward the end of September 1977. It was announced to the public on December 1, 1977.

I was the system-software designer and implementer of Datapoint's ARCnet. In direct contrast to Seifert's statements, that system was a true token-passing LAN, with a distributed-stars cable topology using coaxial cable (since we, unlike Ethernet, used RG-62 coaxial cable and BNC connectors, existing 3270 customers found that they were already totally wired for ARCnet; contrast this with the admitted wiring hassles mentioned in Seifert's article). It had a client/server architecture and used (internal) transceivers. Due to our concept of "conjoint networks," we had no need for bridges or routers. We simply allowed selected network workstations and/or file servers to participate directly in up to six LANs at one time. There was no need for complex, slow, or costly bridging or routing. This implementation also provided the ability to absolutely limit (by hardware means) access within and across a group of LANs.

Indeed, by the 1980 date Seifert refers to, Datapoint had already placed production versions of ARCnet in thousands of customer installations worldwide. Contrary to what he states, we used neither point-to-point connections (unless he wants to refer to our connections to our active hubs as such), leased lines, nor 300-bps modems.

It is also outrageous for him to propose that Ethernet's designers started with a blank sheet of paper "where no one had gone before." In fact, Ethernet's principles of operation are heavily based on the Aloha project, developed in the late 1960s and early 1970s at the University of Hawaii, which envisioned a CSMA-type system sent by radio waves (the original radio-wave transmission medium is where the *Ether* in Ethernet comes from). A brief look at the relevant articles published in the various journals of the period will dispel any claims to Ethernet's "unique" and "first" claims.

It is significant that availability of Datapoint's ARCnet as a commercial, production product preceded the publication of the Ethernet specification by almost three years. What is more, the Datapoint ARCnet as shipped to Chase Manhattan Bank was not a product that was tweaked—it was a finished product. That first ARCnet can coexist peacefully and amicably on any Novell (or other) ARCnet system found in commercial use today. The same cannot be said for Ethernet.

Gordon E. Peterson II
Paris, France

Mr. Peterson makes some valid points. I quite agree that ARCnet was a commercially available LAN prior to Ethernet. However, it was then (as it is now) a proprietary, nonstandard system with limited capability. It has never achieved the kind of widespread acceptance that Ethernet (or Token Ring, for that matter) has enjoyed.

Ethernet, of course, was built on earlier work, including not only the Aloha network (a distant relative) but the more relevant Xerox experimental Ethernet prototypes designed in 1975–77 (pre-ARCnet). Even so, when we developed what is now called Ethernet, we really did look forward to the future and did not constrain ourselves by the past. In fact, we changed cables, connectors, physical signaling, frame format, the cyclic-redundancy-check algorithm, addressing, the backoff algorithm, and both the transmit- and receive-state machine definitions from the earlier prototypes.

What made Ethernet successful was open architecture (public standards and easy access to the technology), planning for the future (address space, data rates, and silicon), and rigorous worst-case design.

These are the lessons we can learn from 10 years of Ethernet.—Rich Seifert

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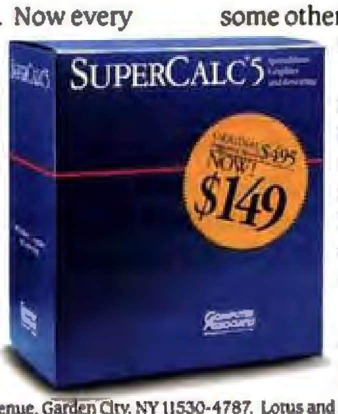

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EASE OF USE			
Control Center organizes data, queries, forms, reports, labels, applications on one screen	Yes	No	No
Create applications *without programming*	Yes	Yes	No
Modern pulldown menus for all Design Tools	Yes	No	Limited
Query by Example (QBE) for easy access to information	Yes	Yes	No
Context specific help by menu item	Yes	No	No
PRODUCTIVITY			
Quick Layout for automatic forms, reports and labels	Yes	No	Yes
Application Generator for quick application development	Yes	Yes	No
Automatic code generation for all Design Tools	Yes	No	No
Automatic maintenance of multiple indexes for ordering data	Yes	No	No
Memo fields for notes, letters, descriptions	Yes	No	Yes
POWER & FLEXIBILITY			
Bold, underline, italic, subscript, superscript text for high impact reports and labels	Yes	No	No
User Defined Functions for extending programming language	Yes	No	Yes
Data input validity checking in forms	Yes	Yes	Yes
Multi-user transaction processing ensures data integrity	Yes	No	No
Number of file formats imported/exported	7	6	3
INDUSTRY STANDARDS			
#1 Selling, #1 Rated multiuser database; over 3 million users (1)(2)	Yes	No	No
Compatible with dBASE III PLUS data and applications	Yes	No	Yes
Compatible versions for DOS, VAX VMS, Macintosh, SunOS and other UNIX platforms (3)	Yes	No	Limited
Structured Query Language (SQL) integrated with programming language	Yes	No	No

(1) dBASE III PLUS and dBASE IV comprise approximately 55% of PC database systems sold (3 times nearest competitor) according to the most recent report by the market research firm Audits & Surveys (Oct. 1990) (2) Software Digest rated dBASE IV #1 among multiuser databases, October 1990 (3) Versions of dBASE IV are shipping for DOS, VAX, and SunOS. Macintosh and other UNIX Platforms are announced.

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Software Digest rates dBASE IV version 1.1 the #1 Multiuser Database (Vol. 7, No. 13, Oct. '90).

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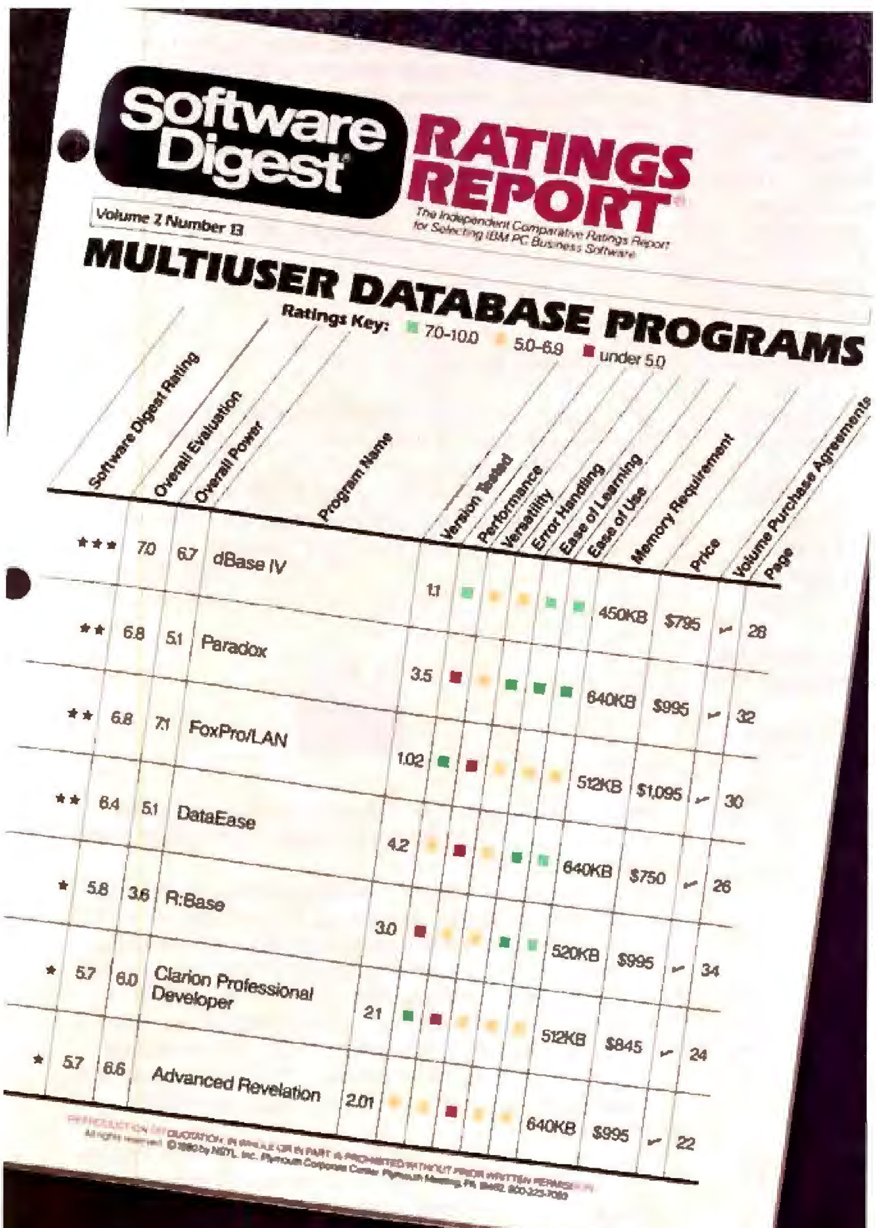

Perhaps the most independent publication in the industry, *Software Digest* accepts no advertising whatsoever. Corporations pay hundreds of dollars a year to receive their monthly reviews—which are considered highly unbiased and objective. Their exhaustive, 75-page report concludes:

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Ashton-Tate

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LETTERS

Gratuitous and Offensive?

I had hoped that, in my sixth year of owning and using Amigas in my business, I no longer needed to write letters like this. Unfortunately, it seems that I still do.

I refer to Tom Yager's review of the Video Toaster ("Newtek's Video Toaster Makes Professional Video Affordable," March). Gratuitous and offensive was the subhead "Where Does the Joystick Go?" followed by Mr. Yager's remark "Unfortunately, most current Amiga users don't have what they need to make the best use of the Toaster. This isn't a video toy." I doubt that many current PC or Macintosh owners are equipped to make immediate, full use of a professional video-processing system either, but would Mr. Yager have made the same facetious remark about them?

Neither the editorial nor advertising content of BYTE suggests that the magazine is particularly popular with teenage video-game fanatics. I had hoped that BYTE's editors and reviewers would realize that most of the current Amiga users who do read BYTE are professional and technical users—many of them in the graphics, video production, and multimedia businesses. These readers do not need, nor do they appreciate, such humor at their expense.

What they do need is a level of technical expertise and performance evaluation that Mr. Yager's review did not supply. The Video Toaster's performance was described in a totally qualitative manner without reference to industry technical standards or even to BYTE Lab benchmarks. Remarks, comments, and explanations in the review exposed a somewhat less-than-professional understanding of video technology.

The review failed to do full justice to the capabilities of this excellent device, did not evaluate it according to the technical standards used by its most likely purchasers, and managed to insult those purchasers within the first few paragraphs. Not a great score card for the Multimedia Lab's first attempt!

Alun Whittaker
Sacramento, CA

Nothing facetious about it, the vast majority of Amiga users are not equipped to run the Video Toaster without investing first in a fair amount of additional equipment. I have tremendous respect for the Amiga (I own one). The statement was not a slur on the Amiga or its users, but rather a clarification of the Video Toaster's purpose and market. —Tom Yager

Jerry's Law

In the March Letters, David Fiedler correctly highlights the problems of having "to deal with a completely heterogeneous environment." However, the problem has been recognized for years (even in the prehistoric days of the mainframe). Now, with the past decade's explosion in processing on the desktop, urgency has shifted to LANs and wide-area networks, often containing differing architectures. There are efforts, existing and planned, to handle file-sharing and network management issues. Sharing processor cycles is also being attempted (see "In Praise of Remote Procedure Calls," March).

Success will, of course, involve many more layers of overhead code and processor cycles, but engineers seem able to give us the processor performance, coprocessors, and memory density to handle the need.

On another subject, I have always been a supporter of the "one person, at least one CPU" law of Jerry Pournelle (many of us have held the opinion—Jerry was able to get it into print). Multiprocessors, coprocessors, and true distributed computing make this a law to uphold. The letters by Thomas Adams (extolling traditional centralized computing resources) and Robert Foldi (praising diskless workstations because "these wonderful machines. . . make the life of the network supervisor much easier") are reactionary. File-sharing network schemes and distributed processing networks ought to be perfected. Mr. Pournelle's "law" should be supported. No backsliding should be permitted to the days of central control, which only made the lives of the MIS staff easier. Computing resources (hardware, software, and people) are there to serve the end user, *not* the other way around (i.e., to provide job security for the staff). Jerry, stick to your guns. . . uh . . . logic gates!

John Neubert
Director, Academic Computing
Drew University
Madison, NJ

Bubble-Sort Kudos

Congratulations on maintaining a very informative magazine for all these years. I turn to BYTE for up-to-date information I can't find in any other magazine. In particular, Stephen Lacey and Richard Box deserve a round of applause for actually making a bubble sort worthwhile in "A Fast, Easy Sort" (April).

Taran Rampersad
Ozone Park, NY

FIXES

• In "A Talk with Intel" (April), we misspelled the name of David Vannier of Intel Corp. Our sincere apologies to Mr. Vannier.

• In "An Editor's View," which accompanied the April cover story on Soviet computing, a typographical error stated that "one-tenth of an inch works out to be about .254 mm." The correct figure is 2.54 mm.

• The correct version number for Da Vinci eMail ("Please, Mister Postman," March) should have been 1.70, which costs $1495 for the DOS, Windows, and OS/2 combination server license. The software also provides native support for MHS (message handling service).

• In the May review "QEMM-386 and 386Max Square Off Under Windows," we inadvertently dropped the last three words. The final sentence should read as follows:

"Its VIDRAM utility, which reallocates up to 96K bytes from the EGA and VGA high memory area to conventional memory, is excellent if you're running text-mode applications." ■

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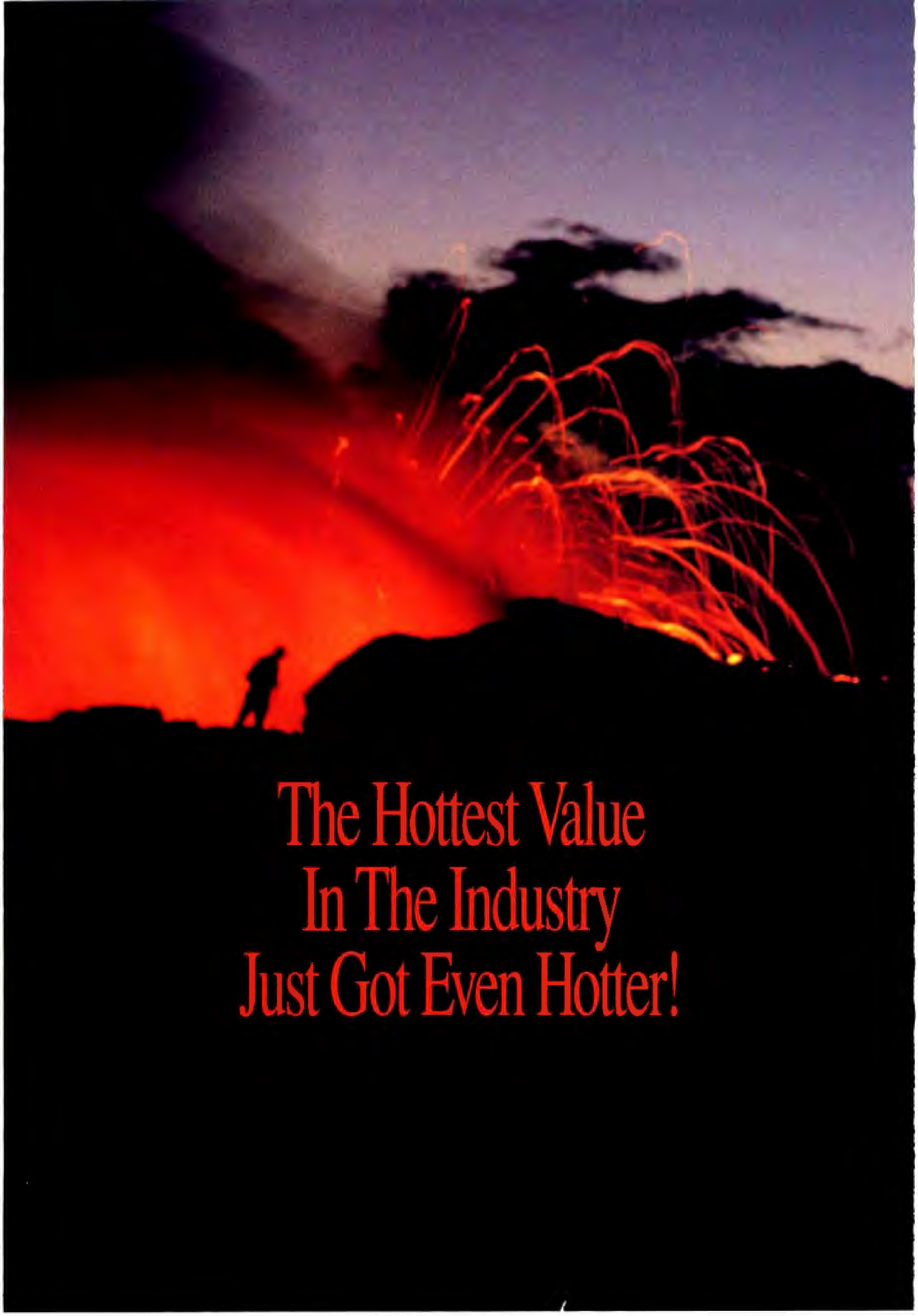
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NEWS

MICROBYTES

Weitek's Controller Chip Will Rev Up Windows

Weitek (Sunnyvale, CA) has developed a "user-interface controller" chip that will speed things up for people running Microsoft Windows. Weitek's new chip, the WTL5086, encodes some of the key functions of Windows 3.0's graphical device interface (GDI) in hardware, improving the performance of Windows and Windows applications.

The WTL5086 takes over the BitBlt and line-drawing functions from the Windows GDI. According to Weitek representatives, the chip increases the speed of execution by between five and 26 times. BitBlt and line drawing are the two most common graphical calls made in Windows; as a result, they have the biggest effect on overall performance.

The WTL5086 can also act as a standard VGA chip to work with all non-Windows DOS software. The chip can be used to provide graphics systems with 2048- by 1024-pixel resolution in monochrome mode, 1024 by 768 pixels with 16 colors, or 800 by 600 pixels or 600 by 480 pixels in 256 colors.

The company will sell the chip in a 70-MHz 100-pin package for $30 each in 1000-unit quantities. Samples are supposed to be ready this quarter, with production volumes scheduled for the third quarter, the company said. A future version, the WTL5186, will run at 80 MHz and will be available for sampling in the third quarter, Weitek officials said. VGA boards using the new controller could show up later this year.

Weitek, known primarily for its math coprocessors, intends to produce further graphics enhancement chips, not all necessarily for the DOS and Windows platforms. The company also plans to produce chips to support two-dimensional and 3-D graphics, audio, still image, and video, all in the next two years.

—Owen Linderholm

IBM Polishing Up 2.0, the "Real OS/2"

As the release date for OS/2 2.0 approaches, IBM is running a major campaign to fire up interest in this 32-bit version of the operating system. Now that IBM has taken the responsibility for 2.0 away from Microsoft, it has a chance to make OS/2 more than a server operating system or development system for Big Blue shops.

The new version is a protected-mode,

OS/2 2.0: THE MAIN POINTS

- Takes advantage of Intel's 32-bit processors
- Runs most DOS applications, all Windows 3.0 applications, all current OS/2 applications, and new 32-bit applications
- Runs DOS and Windows applications faster than under DOS
- Has new Workplace user interface that's more Mac-like, features icons for documents and folders
- Has a set of simple applications, including a spreadsheet, a database, and a sticky pad program
- Has Adobe Type Manager
- Occupies 10 MB to 15 MB of hard disk space
- Costs "less than $200"; $99 upgrade for Windows and DOS owners

NANOBYTES

"If you start object-oriented programming today, don't expect to see the benefits of class reuse before two years go by." That is the advice from someone who knows: **Adele Goldberg**, CEO of **ParcPlace Systems** and one of the leading proponents of object-oriented technology.

Goldberg says that it will take eight weeks of OOP "immersion" for experienced COBOL programmers to become productive and six months for them to become comfortable and expert. OOP is not magic, Goldberg said in an interview with BYTE at the recent Monterey Software conference. She bemoaned the fact that object-oriented technology is being advocated by "religious" devotees who have gotten "a little sloppy." OOP shortens coding time but places more emphasis on the analysis and design portions of the development cycle. Still, she conceded that "very few languages make it if there isn't a religious cult behind them." □

IBM has licensed **Micrografx's** (Richardson, TX) Mirrors technology, which facilitates **porting Windows applications to OS/2** by remapping Windows calls to Presentation Manager. The two companies will reengineer the OS/2 Graphics Engine to improve its performance, and Micrografx will release various development tools, including a facility that ports Windows device drivers to OS/2. According to Micrografx chairman Paul Grayson, the availability of these tools will offer developers a choice for how they deal with OS/2. □

multitasking operating system that takes full advantage of the 386 instruction set. It uses a flat-memory model to address more than 16 MB of physical memory and up to 512 MB of virtual memory. It supports the High Performance File System, long filenames, and extended file attributes, which are critical in an object-oriented environment. And it sports an upgraded Presentation Manager interface, called the Workplace, that brings true drag-and-drop capability to the desktop.

But the real breakthroughs of OS/2 2.0 are its support for the Windows application programming interface and its vastly improved DOS compatibility mode, which gives you 633 KB of space to run almost any DOS program, except those that use certain extended memory managers. Windows programs run unmodified on top of OS/2 2.0, IBM officials say. According to IBM, these non-OS/2 applications run faster under OS/2 than under DOS. You can run DOS, Windows, OS/2 1.x, and OS/2 2.0 applications side-by-side in adjoining windows. OS/2 2.0 requires a 386-class processor and at least 4 MB of RAM.

Although official prices for OS/2 will not be available until the product ships (supposedly during the fourth quarter of this year), the company said that the price will probably be below $200. DOS and Windows users can upgrade to OS/2 2.0 for just $99.

Reaction from those who have seen OS/2 2.0 has been positive. Many applications vendors have expressed support for the new version and have said that it is the OS/2 that they have been waiting for. "We want this to succeed in a big way," said Lotus CEO Jim Manzi.

Much as Windows scraped along for years until version 3.0 reversed its fortune, so could OS/2 2.0 be the edition that will help OS/2 become "the operating system of the nineties" before the nineties are over.

—Andy Reinhardt

New Architecture Will Let Borland Software Interoperate

Borland (Scotts Valley, CA) is developing a new architecture that will allow interoperability between all its application programs, company officials said at the recent Borland Languages conference. Currently, Borland products share data and have a certain level of interoperability through the Paradox data format; for example, the Paradox Engine lets ObjectVision, Quattro Pro, and Borland languages operate with Paradox. Borland says that it is expanding this architecture to give all its applications access to several different data formats, in addition to Paradox files, and to let them work together closely.

Borland's new architecture will have a bottom layer that acts as a basic data-access layer with mechanisms for accessing Btrieve, Paradox, Structured Query Language, and xBase data, as well as spreadsheet data. Above this layer will be an object layer that will consist of Windows dynamic link libraries, which act as drivers and data requesters. It will also include C++ and Turbo Pascal classes and methods, as well as mechanisms, similar to those in the current Paradox Engine, to let Quattro Pro, ObjectVision, and even Sidekick 2.0 access the data layer.

These layers will all reside at different levels in hardware and software, on stand-alone PCs or Novell-based networked systems. Microsoft Windows will act as software glue to hold Borland's software architecture together.

—Owen Linderholm

Quiet Down! Dot-Matrix Printers Lower the Noise

Dot-matrix printers have gotten faster, their output no longer has to look like buckshot, and their prices are hard to beat. But those machine-shop sounds—the rat-a-tat-tat typing and the shrieking carriage returns—can be annoying, particularly in a quiet office environment.

Panasonic (Secaucus, NJ) says that its new Quiet Technology results in dot-matrix printers with a noise level of about 45 dB, or about 10 dB less than its current versions. This is also much lower than the "quiet mode" of competing models, and even lower than inkjet printers like the Hewlett-Packard DeskJet. This drop

NANOBYTES

IBM has cut the **price of OS/2.** A one-time license fee for OS/2 1.3 Standard Edition now costs $150, down from $340. The Extended Edition is now $690, down from $830. If you're a registered IBM DOS user, upgrades cost $99 and $635, respectively. People who buy version 1.3 between now and year's end can get version 2.0 free. □

The Video Toaster, the "desktop TV studio" from Newtek (Topeka, KS), is now available as a **stand-alone system** rather than as just an add-in card for the Amiga computer. The new model is an OEM Amiga 2000 (with the Commodore and Amiga labels removed) packaged with the original Toaster board and the latest release of the software, which includes a variety of new real-time video effects. It's priced at $3995 without a monitor. The Toaster (see "Newtek's Video Toaster Makes Professional Video Affordable," March BYTE) provides switching, digital video effects, character generation, color processing, three-dimensional animation, paint graphics, and other types of video trickery. For full-fledged video production, you'll still need a pair of professional video recorders such as the Panasonic S-VHS AG-7750. A company spokesperson said that Newtek is talking with Apple about making the Video Toaster available as a Mac accessory. □

Apple Computer's proposal for **radio frequencies** reserved for carrying data communications has received support from various other major computer makers, including **IBM**, **Tandy**, and **NCR**. As was reported in the April Microbytes, Apple has requested the FCC to allocate frequencies—40 MHz between 1850 MHz and 1990 MHz—for a new wireless personal communications service called Data-PCS. Basically, this concept will create a wireless LAN for portables positioned up to 150 feet away from a base transmitter. □

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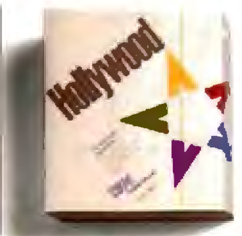

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in decibels might not sound like much, but BYTE Lab tests have shown that a difference of only 2 dB is noticeable.

The most important changes that Panasonic has made to reduce noise are to the printing mechanism. Instead of all the pins on the print head hitting the paper at once, "we use a dispersion method, in which the pins are skewed and fired independently," said P. J. Johnston, product manager for dot-matrix printers. She compared the redesigned pin movements to "the Rockettes kicking in a line," with one leg going up at a time instead of all in unison. This dispersed action makes less noise than all the pins hitting at once, according to Johnston.

"We've also cushioned the pin head as it rides across the carriage," which eliminates some of the carriage-return noise, Johnston said. Panasonic has improved the performance of its printer motors, too, she said, and used more sound-absorbent plastics in the printer housing.

The first printer to incorporate these noise-reduction features is a successor to the current 1624 model. It's expected to start shipping this month and be priced at "under $750," Johnston said.

Other companies have also worked to tone down the noise of their printers. Output Technology (Spokane, WA) rates its new EuroLine printers at 48 dB. The print head uses needles instead of hammers, the fan is quieter, and the case has been designed to cut down on vibration. But unlike the new Panasonic, this is a high-end printer, priced at over $4000.

Dot-matrix devices will never be as quiet as laser printers, but as manufacturers implement new designs, at least the devices won't sound like a synthesis of jackhammers, cats, and chain saws.

—D. Barker

Ricoh Readying JPEG Compression in Hardware, Software; Uses New Transform

Ricoh (West Caldwell, NJ) is the latest company to join the compression competition, recently demonstrating new Joint Photographic Experts Group–enabling technology that is designed to improve image-squeezing operations in both software and silicon. Ricoh says that its new approach shortens image-compression time by 30 percent compared to competing alternatives and allows for a hardware design that will take up less space on a chip.

The new technology, developed at the company's California Research Center, is based on a proprietary algorithm for implementing the JPEG-compliant discrete cosine transform. DCT is used to break an image into small blocks of 8 by 8 pixels and transform it into a series of two-dimensional waves.

Ricoh's algorithm, called the Generalized Chen Transform, uses no multiplication, substituting more addition steps instead. Since multiplication is an "expensive" operation and addition is a "cheap" one, the image transform is done more quickly, Ricoh says.

Steve Blonstein, Ricoh research manager and inventor of the new technology, said that the increase in transform speed enables the use of less silicon. The transform operation is done in two steps: one for each of the 2-D waves. In conventional JPEG chips, two blocks of silicon are used; one for each transform step. In Ricoh's design, only one block is used. Because the transform is so fast, the single-transform block can be used again, resulting in less silicon space, Blonstein explained. This space reduction lets JPEG silicon become a "super cell" that can migrate onto large chips of wider functionality, he said.

Blonstein demonstrated the Generalized Chen Transform software on a Mac platform. An image was captured from a video camera and stored on a Mac IIfx in 24-bit TIFF. The image was then compressed and retrieved. At a 30-to-1 compression ratio, Blonstein said, compression took 2.81 seconds. (Ricoh's figures claim 3.5 seconds to compress a 512- by 512-pixel, 24-bit image.) Ricoh's benchmark times include only the JPEG implementation itself: color space conversion (conversion of the incoming image to an internal format), transform, quantization (adjustment of the image to human perception qualities), and Huffman encoding (lossless compression based on statistical analysis). The benchmark time does not include disk-access, file-save, or window-painting time.

Due this summer, the hardware implementation is designed for 30 frames per second at NTSC (broadcast-quality) resolution.

The company says that it is "engaged in licensing talks with a number of vendors" and expects to see products within the next 12 months.

—Ellen Ullman

NANOBYTES

Apple's vice president of Advanced Technologies, David Nagel, testified recently before the Communications Subcommittee of the Senate Committee on Commerce, Science, and Transportation in favor of the Emerging Telecommunications Technologies Act of 1991 (S.218), which proposes to provide radio frequencies for new technologies. □

Cue Network (Irvine, CA), one of the largest providers of nationwide paging services, has announced the LapCom modem, which will let a PC **receive E-mail without hooking up to a telephone line.** When you want to send E-mail to an associate who's traveling, you just dial an 800 number and upload the message (along with the ID of the person you want to send it to) to Cue's computer. The message is then sent to a satellite and rebroadcast to 270 FM radio stations throughout the U.S. and Canada. The stations broadcast the message using their FM subcarrier at about 9600 bps. Each message carries a unique identifier keyed to an individual LapCom modem, and when the modem receives the message, a light on the modem goes on, signifying that a message is waiting to be read. □

If the Beach Boys had been at the recent Lap & Palmtop show, this gadget would have gotten their attention: the Executive LapMate from **SolNetics** (Provo, UT). It's an $89.95 **solar-powered recharger** for laptop computers. The little 4- by 12-inch solar panel produces about 100 mA of current—enough, SolNetics says, to give you about an extra hour of battery operation. Or, if you must recharge and there are no plugs, it can recharge a battery in about 12 hours, the company says. The Executive LapMate can't run a laptop by itself, but the company says it's working on higher-current models that can. □

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AMD Now Has a 386SX; Runs Faster, Burns Less Fuel

Advanced Micro Devices (Austin, TX) has added a new player to its roster: its own version of the 386SX chip. Although AMD's clone of the Intel 386 was headline news, this new processor could have a bigger market impact: It's designed for laptop and notebook computers, which represent the fastest-growing class of personal computers.

AMD hopes to beat Intel with speed. The Am386SX runs at 25 MHz, whereas Intel's fastest SX runs at 20 MHz. AMD claims that the clock difference results in a speed boost of about 25 percent over the speed of the Intel chip.

AMD's CMOS chip also consumes less power than Intel's chip, the company says. The Am386SXL can operate in a standby mode that needs only 0.08 mA of current at 0 MHz; AMD says that Intel's lowest consumption rate is 140 mA at 2 MHz. In real life, an Am386SXL-based portable could run on batteries for about an hour longer than a machine using the Intel chip, AMD says. (This assumes that both systems' other components are comparable in terms of their power use.) AMD's other model, the plain SX, consumes less power than Intel's but hasn't been certified as capable of "stopping the clock," AMD spokesperson David Frink said.

AMD will price its SX "competitively" with Intel's, Frink said. Intel currently sells its 20-MHz SX for about $90 apiece in quantities of 1000.

Computer developers who want to upgrade their SX machines to the Am386SX "will only have to change the CPU, the DRAM, and the crystal," Frink said. AMD officials would not yet release the names of companies that are evaluating the chip, but at the company's stockholders meeting in May, they showed a Texas Instruments notebook computer in which the Intel 386SX had been replaced with an Am386SX.

—D. Barker

NANOBYTES

Borland (Scotts Valley, CA) will provide support for the **xBase** language—an emerging nonproprietary dialect compatible with Ashton-Tate's dBase language—at both the data-access and dialect levels of Borland's architecture, president **Philippe Kahn** said at the company's recent Languages conference. This means that Borland will within a year provide some way for all Borland applications and languages to read xBase data, likely in the form of a revision to the Paradox Engine and those portions of the Paradox Engine that are embedded in other applications like Quattro Pro. It also means that Borland will be bringing out a product that can read and execute xBase programs. Borland's ObjectVision already can access dBase files as well as Paradox files. □

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New IBM Technique Should Raise Production, Cut Costs of Semiconductor Lasers

Semiconductor lasers—which are used in optical storage systems, printers, fiber-optic networks, and CD players—could soon become easier and cheaper to produce, which should lower the prices of computer peripherals that use the tiny devices. An innovative new production technique perfected by scientists at IBM's Zurich Research Lab looks set to tumble the price of semiconductor lasers to a quarter of their original price.

Researchers at IBM have squeezed 20,000 individual lasers onto a round wafer that measures just 2 inches in diameter. This new fabrication technique, called "full-wafer technology," is significantly faster and around 50 percent less expensive, and even in the research labs, it produces a good yield, IBM scientists say. Preliminary research also indicates that the overall reliability and working life span of the laser is enhanced, according to IBM.

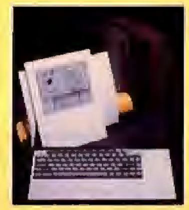
The new production process uses a photolithographic technique that is similar to the process used to make electronic semiconductors. A trench some 1/5000 inch deep is etched in the aluminum gallium arsenide crystal. The walls of this trench are then coated to produce the laser mirrors that are needed to amplify the signal.

Another advantage of this technique is that you can test the lasers while they are still a part of the semiconductor wafer. Only when the lasers are complete and tested are they split from the wafer and packaged.

The research team has yet to explore the effect that this technique will have on optical computing. Using this fabrication technique, there is now the possibility of creating an optical processor on a semiconductor substrate without having to use any cumbersome mechanical production techniques. ■

—Andy Redfern

NANOBYTES



An industrial design firm hopes its new trio of computing components will become a household name. **Synapse**, the manufacturing division of **Technology Design** (Bellevue, WA), has introduced a PC compatible called **Emily, Julie, and Max.** Emily, the keyboard, looks like a spiral notebook, with a wide, sloping front. Julie is the 10-inch, VGA-compatible, backlit LCD. It plugs into Max, the CPU, which looks like five books standing on end. A 25-MHz 386-based model sells for $7995 with a 100-MB hard disk drive, a 3½-inch floppy disk drive, 4 MB of memory, and five 32-bit slots. ■

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The All-in-One DOS

JON UDELL

Version 5.0 of DOS incorporates a number of crucial wish-list items

Last year, a remarkable dialogue took place on BIX and on CompuServe. Microsoft asked the DOS power-user community how it thought future releases of the world's most used, loved, and hated operating system ought to work. Said chief architect Gordon Letwin: "I've never met a programmer who didn't think he could have done it better; here's an opportunity to enlighten us."

Suggestions, often contradictory, spewed forth. "Support HPFS [OS/2's High Performance File System]" but "make DOS smaller." "Run in protected mode" yet "don't abandon the 8088." "Support DPMI [the Windows 3.0 and OS/2 2.0 DOS Protected Mode Interface]" but also "support VCPI [the Phar Lap/Quarterdeck Virtual Control Program Interface]."

Eventually, it became clear that there were really two versions of DOS on the table: the much-improved yet essentially familiar DOS 5.0 we see today, and a high-tech DOS (version 6.0?) whose shape we can dimly discern on the horizon. As participants in the BIX new.dos conference began to receive beta copies of DOS 5.0, anxiety gave way to acclaim. While not yet the high-tech DOS for which many had hoped, the new version incorporates a number of crucial wish-list items. DOS 5.0 merits the BIX power users' seal of approval—and mine as well. Spend the hundred bucks, install it, and use it. Unlike the ill-starred version 4.0, DOS 5.0 earns its keep.

Wishes That Didn't Come True

Let's get the bad news out of the way first. DOS 5.0 isn't trimodal like Windows 3.0, it doesn't exhibit CPU-specific behaviors, and it is neither a VCPI- nor a DPMI-compliant DOS extender. In simple terms, DOS 5.0 doesn't raise the roof for DOS programs the way Windows 3.0 did for Windows applications. The file allocation table (FAT), eight-dot-three filename, 126-character command line, and paleolithic batch language survive intact. You still can't move or delete subtrees. Although *many* users recommended that Microsoft license or imitate 4DOS, J.P. Software's superior shareware replacement for COMMAND.COM, that didn't happen.

The care and feeding of TSR programs remains as tricky as ever. The installable file system feature that briefly debuted in version 4.01 has vanished. DOS dynamic link libraries—widely proposed as a way to deliver optional extra features on demand without increasing the size of the base operating system—never materialized. You can't use Unix-style wild cards. There's no enhanced or new support for serial devices, tape drives, optical disk drives, or printers, although 2.88-megabyte floppy disk drives are now supported. DOS remains nonreentrant. The INT13 interface hasn't changed, so DOS still doesn't know what to do with disks that have more than 1024 cylinders.

Wishes That Did Come True

Relax, there's plenty of good news. Memory relief tops the list. The kernel has shrunk back down to its pre-DOS 4.0 size, which helps a little, and it will load up in the high memory area (the "A20 wraparound segment" just above the 1-MB boundary), which helps enormously. Virtually all new PCs, and many older ones, can now boost about 40 kilobytes of DOS code (and buffers) out of the precious 640-KB reservoir, thereby achieving a program workspace on the order of 620 KB. Of course, 8088s, lacking extended memory, miss out on this treat. For the rest of the 80x86 family, it's a wonderful free lunch.

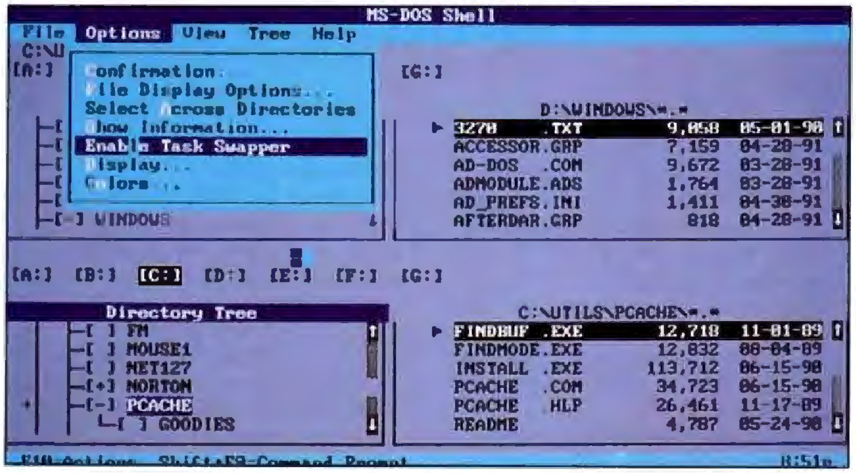
Next on the list comes upper-memory-block management. Version 5.0 includes tools that are equivalent to QEMM-386 and 386Max, so 386/486 users can oust device drivers and TSRs from conventional RAM. The revamped EMM386 .EXE (formerly EMM386.SYS), now a VCPI-compliant EMS emulator, can convert extended memory to UMBs. New DEVICEHIGH and LOADHIGH commands stuff device drivers and TSRs, respectively, into these upper regions. You are already a QEMM-386 or 386Max user? Fear not. Their UMB providers and high-loaders will work with DOS 5.0, no questions asked. But if you operate 386 or better hardware and haven't yet ventured into the weird, wonderful world of post-modern DOS memory management, version 5.0 can be your ticket.

Remember the DOS 4.0 shell? It has taken a detour through Windows and has emerged as a rather useful file manager/program manager/task swapper (see the photo). The file manager—like others of its genre—presents accordion views of the disk hierarchy and supports application-linked documents, drag-and-drop, and mouse-driven copy, move, and delete operations. The program manager, as in Windows and Presentation Manager, offers an alternate view of the machine: not a tree of directories, but a collection of activities supported by groups of programs.

It's the task swapper, though, that really makes the shell. Techno-snobs hate to admit it, but many DOS users don't need true multitasking. They do, however, want to toggle between Lotus 1-2-3 and WordPerfect, or Quattro and dBase. For these users, Windows- or Desqview-style gymnastics can be overkill. Simple task switching may be the appropriate technology. The DOS 5.0 task swapper lacks some of the features of third-party switchers such as Software Carousel. It's disk-oriented rather than RAM-oriented and doesn't cut and paste between sessions. But it gets the job done, and even the rudimentary task switching it offers can make the vanilla DOS environment much more productive.

DOS 5.0 supports large disk partitions (up to 2 gigabytes) directly, without asking you to load SHARE.EXE, as DOS 4.0 did. You're a DOS 3.x user with Disk Manager- or SpeedStor-owned partitions? No problem; install the new version of DMDRVR.BIN or SSTOR.SYS (these come with DOS 5.0), and you'll be on your way.

What about networks? Either the existing drivers plug and play or, as with NetWare and LAN Manager, new ones come in the box. Contrast that with the release of Windows 3.0, when users scrambled to Novell's CompuServe forum for an updated NetWare shell. Microsoft worked closely with thousands of users and dozens of hardware and software vendors for well over a year to make the upgrade to DOS 5.0 painless and hassle-free. The effort paid off. Value-added resellers, consultants, and others who frequently install or upgrade DOS will find the result worth the wait. In addition to a vastly improved manual, which discusses optimization and tuning, several invaluable README files address a variety of specific hardware and software compatibility issues.



The DOS 5.0 shell, which runs in text mode (shown here) or graphics mode, features file and program managers that resemble their Windows counterparts.

New and Improved Commands

DOS commands, both internal and external, now respond to the /? argument with a blurb of description. Not a radical new concept, I'll admit, but a welcome change for traditionally user-hostile DOS. I toured our building and found three or four PCs with yellow stick-on notes documenting the FORMAT command. Good riddance to that embarrassing practice.

FORMAT, by the way, now supports "quick" formatting of previously formatted disks. If you specify /q, FORMAT zeros out the FAT and the directory, but it leaves the data intact—a big time-saver when you're reusing disks that are in good condition. Moreover, if space permits, FORMAT /q saves the original FAT and root directory elsewhere on the disk so that you can UNFORMAT it. UNFORMAT is a utility that Microsoft licensed from Central Point Software. There are two others.

MIRROR, a TSR, establishes a *deletion-tracking* file (MIRROR.FIL) that records information used by the companion UNDELETE tool. UNDELETE can recover a file whose sectors haven't been recycled. If no MIRROR.FIL exists, UNDELETE (like the Norton undelete tool) snoops the DOS directory and prompts you for the missing first character of each deleted filename. If MIRROR was active, there is no guesswork: the UNDELETE tool grabs complete names from MIRROR.FIL. UNFORMAT uses a hidden

THE FACTS

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DR Stays a Step Ahead

Jim Hansen

Digital Research's Multiuser DOS is the first multiuser operating system to reach the marketplace that gives PC users Unix-like performance and file security. Capable of supporting up to 16 concurrent users on 386 and 486 computer systems, it is an operating system that will appeal to small businesses and power users alike.

Installation of Multiuser DOS is smooth and easy. It coexists (in a private directory) with any existing operating system, leaving all your files and your previous operating system intact. Once it's installed, a prompt allows selection of DR Multiuser DOS or any other operating system after a system reset. You must install the copy-protection dongle before you can bring up Multiuser DOS or store files on it. This feature also helps secure your data by letting you remove the dongle and disable the system.

Multiuser DOS can be a cost-effective alternative to networking for many small businesses. Taking the place of the network file server, a medium- to high-performance 386 computer can be used as the host system and supervisor's computer with as many as seven Wyse-compatible terminals connected via a relatively inexpensive serial-port card. An emulator program that is supplied with Multiuser DOS lets you use any vintage PC as a terminal. Ordinary telephone-type cable connects the terminals to the host computer.

Multiuser DOS can also serve as a single-user system, where each user partition is used to run an independent program or additional copies of the same program. Unlike programs that suspend and save programs to disk or memory buffers when they aren't on-screen, such as Software Carousel, Multiuser DOS executes all active programs on a time-shared basis, whether or not they're in the partition currently shown on-screen. Jumping between partitions is as simple as typing a control-partition number on the numeric keypad. This takes about the same time as refreshing the screen.

A few limitations to Multiuser DOS include serial support for only COM0 and COM1, leaving you in the lurch if you have modem and fax boards assigned to COM2 or COM3. Mouse support is for only Logitech and Microsoft serial mice, and no bus mouse support is available. A particular annoyance is the way the system spooler operates: Output to the system printer is not started until an application program finishes output to the spooler, thus lengthening the time it takes to get a printed copy.

Multiuser DOS is a serious, large, and competent multiuser environment. It provides all the software tools and system resources necessary to manage large-scale system security and resources, but it can't do it for you. As operating systems become more complex, PC coordinators, supervisors, and power users will have to spend more time managing and maintaining their systems...just as mainframe folks have been doing all along.

Jim Hansen is director of engineering at Digi Test Corp. in Amherst, New Hampshire. He can be reached on BIX c/o "editors."

THE FACTS

DR Multiuser DOS
$695

Requirements:
A 386- or 486-based PC, PS/2, or compatible with a hard disk drive and at least 4 MB of RAM. In a multiuser environment, a serial port and a terminal (or a PC emulating a terminal) are required for each user.

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MIRROR.FIL written by FORMAT /q to recover the root files and directories of an accidentally formatted disk. If you've run MIRROR with the /partn switch, which saves a hard disk's partition table, you can also use UNFORMAT to recover from even more serious trouble.

A number of shareware utilities emulate the Unix shell's command-history and alias capabilities. Finally, DOS itself does so. A small TSR, DOSKEY, maintains a scrollable list of commands, recalls and completes partially typed commands, and supports aliases (macros) with replaceable parameters.

DIR wins my "most improved DOS command" award. You can now include (or exclude) files matching specified attributes; do an ascending or descending sort by name, extension, size, or date; and display names in lowercase. DIR will traverse subtrees if you specify the /s option, and you can use the DIRCMD environment variable to save your favorite configuration of DIR switches.

EDLIN hasn't gone away, but you'll probably prefer the new EDIT. It's a basic full-screen editor—pun intended, since EDIT.COM just launches the editor embedded in QBASIC.EXE, a QuickBASIC derivative that comes with DOS 5.0. QBASIC is a throwaway: It has QuickBASIC's hypertextual help, syntax- and module-oriented editing, and a debugger, but it compiles only to memory. Like the venerable GWBASIC, it will rarely be the tool of choice, yet, in a pinch, it can be extremely handy. QBASIC's mouse-sensitive editor makes a nice replacement for EDLIN, and one of the QBASIC demonstration programs, in which gorillas lob exploding bananas, rates a chuckle.

continued

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Taking the Plunge

I first installed DOS 5.0 on my own 4-MB 386, which had been running DOS 4.01 and Windows 3.0. The SETUP program began by saving my existing DOS to an "uninstall" disk and an archive directory—a nice bit of software etiquette. Then it rattled through the floppy disks, decompressing files and moving them to C:\DOS. I copied over NET5.COM, rebooted, and sailed smoothly along. QEMM-386 still worked its magic, Windows was happy, and I'd gained 40 KB for DOS (and DOS-under-Windows) programs, thanks to a new CONFIG.SYS command (DOS=HIGH) SETUP tacked on for me.

What if you don't already own QEMM-386 or 386Max? There is no DOS 5.0 equivalent to Quarterdeck's OPTIMIZE or Qualitas's MAXIMIZE, so it's up to you to figure out how best to use your UMBs. Put on your propeller hat, fire up EDIT, and experiment. EMM386 takes a more conservative approach than its competitors, but when you tell it explicitly to include all eligible regions, it obliges. Note, however, that the DOS 5.0 high-loading commands work a bit differently than their Quarterdeck/Qualitas counterparts.

DOS=HIGH instructs DOS to allocate for itself the UMBs that are produced by EMM386 (or another provider). LOADHIGH and DEVICEHIGH thus work through, rather than around, DOS. Moreover, any DOS 5.0–aware application can ask for UMB space by way of an extension to INT 21 function 58 hexadecimal (Get/Set Allocation Strategy). I like this approach. Regularizing access to UMBs won't change the world, but it's a step in the right direction.

I've run DOS 5.0 for several months with no compatibility problems—and my machine sees an awful lot of new and exotic software. I've also gotten good results on a variety of other 386, 286, and 8088 PCs.

DOS 5.0 looks like a good all-in-one solution for a group of 2-MB 386s that need to run XyWrite, FoxPro, and Procomm. The users of these machines, relative PC neophytes, seem to like the task-switching shell. With DOS, network drivers, SmartDrive (now included with DOS), and MOUSE.SYS loaded high, and the swapper enabled, each task gets 550 KB of conventional RAM. FoxPro, with 0.75 MB of extended memory to play with, is deliriously happy. (On one machine, a 2-MB 286 that can't convert its extended memory to expanded memory, I gave the extra RAM to RAMDRIVE .SYS. If you set the TEMP environment variable to a RAM drive, the shell will swap much faster.)

There is one glitch: You can't switch away from Procomm, which in this application talks to an X.25 host by way of Eicon's ITI.SYS. However, DOS 5.0 does define a task-switcher application programming interface that Eicon—and other vendors of DOS communications software—plans to support. The new API resembles Software Carousel's Open Link Extender. An application that subscribes to it will be able to maintain, or at least gracefully suspend, its session with a host.

The only failure I ran into—GeoWorks wouldn't run under DOS 5.0 on my father's 8088-based Zenith—turned out to be a false alarm. As the lengthy and very informative README.TXT explains, some programs needlessly tie themselves to specific versions of DOS. An intriguing new DOS 5.0 device driver and command, SETVER, can satisfy such programs' spurious version checks. After I typed SETVER GEOS.EXE 4.01 and rebooted, GeoWorks behaved properly. DOS 5.0 automatically installs the SETVER driver, along with a table of phony version numbers that you can extend by means of the SETVER command. Incidentally, conspiracy theorists who charge Microsoft with systems/applications collusion should note that the default SETVER table includes entries for Word for Windows and Excel.

The Lowest Common Denominator

Little in DOS 5.0 is new. Products from Digital Research (DR DOS), SoftLogic Solutions (Software Carousel), Quarterdeck, Qualitas, and others, used in combination, have for some time delivered nearly all DOS 5.0's key features. Cynics complain that Microsoft has followed, not led, the crowd. I take a more generous view. DOS 5.0 raises the lowest common denominator, and that is enormously useful.

As an integrator, I like getting all the tools I need in one package, and if that package propagates widely, my job gets much easier. While I'd hoped this version would be the promised high-tech DOS, and am bitterly disappointed that Microsoft didn't put in a more sophisticated command processor/batch language such as 4DOS, on balance I rate DOS 5.0 a solid success. ■

Jon Udell, a BYTE senior editor at large, administrates the BYTE editorial LAN. He can be reached on BIX as "judell."

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With these considerations in mind, EEF was designed as a turn-key solution which relieves the clients of all the intricacies involved in integrating a truly functional electronic filing system. Its flexible design allows continuous and smooth upgrade as the users needs grow and change.

Open Architecture

EEF is designed as a totally open architecture system. Rather than being a closed package, EEF is composed of building blocks defined by their area of electronic filing functionality. These blocks are not bound to specific hardware/software limitations. As such, they can be combined in a variety of forms on each of the following operating platforms, to achieve optimal satisfaction of an application's specific demands:

- A single user workstation under the **DOS** or the **OS/2** operating system.
- **A local area network** - Novell NetWare 286 and higher or any MS DOS compatible network.
- **A host computer** under the UNIX, VAX/VMS or IBM AS/400 system with a PC connection.

EEF

Input
Scanner, Fax, Word Processing, OCR, Host Computer, Etc.
Processing
Document Manager, Retrieval Engine, Hyper-Media, 5GL Image Database Application Generator
Output
Printer, Plotter, High Res. Display, Fax, Host Computer

EEF Applications

The EEF system opens a vast new world of opportunities for you. The possible applications are limitless, and to name a few:

- Automatic Fax Routing
- Work Flow Management
- Banking Signature Verification
- Medical Records Management
- Legal Case Management
- Personnel/Human Resource System
- Insurance Claims Management
- Mortgage/Loan Management
- Contract Management
- Engineering Department

EEF Entry System

For prospective clients wishing to step ahead with Document Imaging solution, we propose an Entry System, encompassing in one package the full range of functions necessary for implementing electronic filing.

The system components are:

Hardware

- Intel workstation with 386 CPU, 8 MB RAM, 500 MB Hard Disk with Disk Caching controller.
- Reflections 1GB Multi-function Optical drive.
- Fujitsu 3096E 400 DPI, 20 PPM scanner with 50 sheets ADF.
- HP Laser Jet III 300 DPI, 8 PPM printer.
- 19" High-resolution (1664x1200) CRT display.
- Hardware compression, image manipulation and video printing technologies.

Software

The EEF software license including:

- 5 GL Document Imaging Solution Generator for quick implementation of filing problems.
- Generic Work Flow Data and Image management system.
- 20 Hours of Prototyping and Application Support Services.

Total cost for the complete Entry system is US $35,000.

EEF Implementation

Fax your specifications and we will prototype your application within weeks, to demonstrate the ease of development with EEF's 5GL Document Imaging Solution Generator.

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Trademarks: DOS, OS/2, Microsoft Corp; NetWare, Novell, Inc.; UNIX, SCO Corp; AS/400, IBM Corp; VAX/VMS, Digital Equip. Corp.

Circle 101 on Inquiry Card.

Northgate Slides into CEG

DAVID ANDREWS

Northgate's new SlimLine lets you choose which chips you want included in your system

With another chip war brewing, it's getting harder than ever to avoid that look-over-your-shoulder feeling when it's time to buy a new PC. Should you get a system based on an AMD 40-MHz 386 or an Intel 20-MHz 486SX? 25- or 33-MHz 386? 25- or 33-MHz 486? While it's great to have these choices, it's almost like being in the middle of a fireworks stand when you're allowed to buy only one bottle rocket: You make your choice and hope that you'll get the most bang for your buck. You also hope that you don't get burned.

Fortunately, Northgate makes the decision easier with its SlimLine SP (Scalable Processor) ISA system. Every SlimLine has the same motherboard design. When you order the machine, however, you get to pick which of the above microprocessors you want included in the system. If you want to upgrade later, you just remove the old CPU module and insert a new one. This modular design isn't anything earthshaking; other manufacturers offer upgrade paths in their modular systems. But when you open up the SlimLine and look at the motherboard, you'll find an Edsun CEG/DAC (Continuous Edge Graphics, D/A converter) chip, which provides superb antialiasing and up to 790,000 colors simultaneously on a standard VGA monitor.

Northgate will also make the Edsun chip available as an option if you buy a PC from the company's Elegance SP line of systems. At press time, these systems were still in the early prototype stages and thus not ready for evaluation. By the time you read this, both the desktop and tower modules should be Class B–approved and certified by the FCC. Northgate says that the desktop and upright versions of the Elegance PCs will also share a common motherboard. Thus, Northgate will have to support only two motherboards. Presumably, the company will pass its production and support savings along to its customers.

Preliminary figures from Northgate indicate that you will be able to upgrade from a 33-MHz 386 module to a 33-MHz 486 module for just $999 (plus the return of the module). This upgrade price is hundreds of dollars less than that of similar upgrades from other manufacturers.

While all the upgrade prices were not yet available, Northgate said that a base 33-MHz 386 module with 2 megabytes of RAM, one floppy disk drive, a keyboard, Super VGA on the motherboard, DOS, a mouse, and Windows (without a hard disk drive, monitor, or processor module) will cost $1899. A fully configured 33-MHz 386 system with 8 MB of RAM, a 200-MB hard disk drive, a mouse, a Super VGA adapter and monitor, DOS, and Windows will cost $4499.

Memory Cards Need Not Apply

The first thing you'll notice about the SlimLine is its 4¼-inch height. Northgate achieves this low profile with a card tree that lets you add expansion boards horizontally instead of vertically. When you order a SlimLine, you don't specify just the CPU: You also specify how much RAM you want on the motherboard. You can get from 1 MB to 32 MB of fast-page-mode RAM on the motherboard via SIMMs (up to 64 MB on the Elegance systems). In this way, Northgate eliminates the need for memory cards, although the system does support add-in memory.

When you remove the case, you'll see five expansion slots in the card tree: three full-length 16-bit slots and two half-length 8-bit slots. The card tree is solid and bends reluctantly under pressure. In fact, the entire base of the system seemed solid and didn't have a tendency to sway.

Along with the 32-bit DRAM on the motherboard, Northgate integrates two

PRELIMINARY BYTE BENCHMARK SCORES

For each test, the SlimLine had a 64-KB direct-mapped cache installed. Test results are indexed; for each index, an 8-MHz IBM AT = 1. Higher numbers indicate better performance. N/A = not applicable.

	CPU	Disk I/O	Video	FPU
SlimLine with Intel 33-MHz 386	4.50	2.88	7.44	N/A
SlimLine with AMD 40-MHz 386	5.41	2.92	9.72	N/A
SlimLine with Intel 25-MHz 486	5.15	2.51	16.30	24.88
Tandy 4033LX (33-MHz 386)[1]	3.10	2.49	5.41	N/A
Compaq Deskpro 486/25[1]	6.40	3.80	16.20	24.80
Gateway 486/25[1]	6.60	3.50	18.80	24.70
Club American Eagle Series 3/40[2]	5.41	2.76	8.04	N/A

[1] For comparison only.
[2] The Club American numbers are also based on tests performed on a preliminary unit with an AMD 386 CPU

serial ports and a parallel port. Other specifications include an integrated 16-bit Super VGA adapter with up to 1024- by 768-pixel resolution, 512 kilobytes of video RAM, an Intelligent Drive Electronics hard disk drive interface, support for a 387 or Weitek coprocessor, and a 150-watt power supply. American Megatrends manufactured the BIOS in the unit I used, but this is subject to change. Overall, the system measures 4¼ by 16½ by 16½ inches.

The unit I looked at also had 4 MB of installed RAM, a 64-KB direct-mapped cache (expandable to 256 KB), two floppy disk drives, a Panasonic PanaSync C1381 Super VGA monitor, a 200-MB hard disk drive, three separate CPU modules, and a mouse. You can easily swap the individual CPU modules. It takes a slight tug to free the board, but not much more. Once in place, the CPU modules connect solidly to the rest of the system.

The three CPU modules of the SlimLine posted respectable results in the BYTE benchmarks (see the table). With the AMD 386 CPU module, the SlimLine posted slightly better numbers than did the Club American Eagle Series 3/40 in its preliminary tests (see "The 486SX Falls Short," June BYTE). Other CPU modules (e.g., the 20-MHz 486SX) were not available for testing. The SlimLine unit I used came with a standard OmniKey/102 keyboard. There's not much to say about that, except that Northgate has not lost its knack for making a solid keyboard with just the right touch.

CEG: It's Like the Fourth of July

The effect that CEG can have on an image is simply amazing, but not without its caveats. Rob Ryks, vice president of R&D at Northgate, said that many people seem to think that the CEG chip will accelerate your application. In fact, some applications using CEG drivers may experience a slight increase in display execution time. The CEG chip isn't yet being used in real-time animation.

What the chip does provide is realistic rendering on a standard VGA display. Using Edsun's CEG algorithms, the chip smoothes pixels on the screen and blends colors to eliminate the stair-step effect.

The CEG chip can blend VGA's palette of 256 colors into 700,000 shades.

As of this writing, CEG drivers were available for a limited number of applications (e.g., Lotus 1-2-3 release 2.x, AutoCAD, most Windows 3.0 applications, and for viewing still TARGA images). The benefits of CEG will really pay off when Edsun drivers are available for font technologies such as FaceLift and TrueType.

If your application has a CEG driver, the chip automatically detects it. If your application doesn't have a CEG driver, the chip is disabled by default, and you don't even know it's there. You can toggle between CEG and standard VGA in CEG-supported applications.

With its built-in color-mixing engine, the CEG/DAC chip can blend VGA's palette of 256 colors into more than 700,000 shades. It also provides a perceived resolution of 1024 by 768 pixels in a normal 640- by 480-pixel screen. Basically, if your application supports CEG, you're getting workstation-quality images on standard VGA, without having to take out a second mortgage.

Where There's an NCR Cash Register, There's Help

In a new agreement, NCR has agreed to provide field service for Northgate computers in the U.S. At press time, the

A look inside the SlimLine system reveals the Edsun CEG/DAC chip at the lower left and the sturdy card tree at the right.

A MAP FOR ALL REASONS...

Most business people still view maps as a tool used only for planning things like an RV vacation, or teaching geography to the kids. At Strategic Mapping™ we're helping businesses use maps to enhance their information systems. By linking maps to a database or spreadsheet on a personal computer, we've taken the classic model of an atlas into the 21st century. Now, over 20,000 companies – including many of the Fortune 500 – are using our ATLAS★Software to help make critical business decisions for a multitude of reasons.

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Distribution Planning – Federal Express, Miller Brewing and Coca-Cola are radically improving productivity and efficiency with ATLAS★Software – making certain that deliveries are on time, and on budget.

Research shows that 85% of business databases contain critical location based information, yet most businesses fail to view their information geographically. With ATLAS★Software, you can visualize your database, and even print high quality map graphics and database reports – adding sizzle to your presentations.

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4030 Moorpark Ave., Suite 250
San Jose, CA 95117

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STRATEGIC MAPPING INC.

companies were working on a similar agreement covering other countries.

What does this agreement mean if you buy a SlimLine or Elegance PC? According to Northgate, it means that if the town you live in has a grocery store, it should also have an NCR service center nearby. That's because, in addition to fixing PCs, NCR service personnel are responsible for fixing its cash registers, which are used in many businesses. NCR has more than 400 service centers and over 5000 field-service personnel in the U.S. Northgate says that, for major accounts, it will offer a response to a service call in as little as 4 hours.

Northgate also offers 24-hour phone technical support. Just for fun, I called the number at 4:30 a.m. EST with a few questions. The technical people were friendly and helpful.

Decisions: Who Needs Them?

While the competition between AMD and Intel is bound to confuse buyers, in the end it will result in more power at lower prices. It will be interesting to watch what will amount to a tennis match as the two chip-making rivals exchange volleys in the PC marketplace.

Meanwhile, manufacturers like Northgate that make solid, affordable, and, most important, expandable PCs will let you sit back and enjoy the game even more. It's a lot easier to make a purchase decision when you know you can't go wrong. ■

David Andrews is a BYTE associate news editor. You can reach him on BIX as "dave.news."

THE FACTS

NorthGate SlimLine SP
$1899
CPU modules: 386/25, $300; 386/33, $600; 386/40, $900; 486/20, available in late summer; 486/33, $1400

Northgate Computer Systems, Inc.
Northgate Park
7075 Flying Cloud Dr.
Eden Prairie, MN 55344
(800) 548-1993
(612) 943-8181
fax: (612) 943-8331
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PC MAGAZINE
EDITORS' CHOICE AWARD

IDEK

IDEK—THE FIRST COMPLETE FAMILY OF FST COLOR MONITORS

PC MAGAZINE
EDITORS' CHOICE
March 26, 1991
Idek MF-5117

IDEK's MULTIFLAT Series of 17-Inch Color Monitors

IDEK's MULTIFLAT Series of 17-inch Color Monitors take full advantage of the remarkable properties of their Flat Square Tubes (FST) to deliver superior resolution and a sharper image that is easier on your eyes. A glimpse at our 17" Color Monitors reveals their matchless over-scanning capability that delivers a crisp, distortion-free display across the entire screen.
In addition, Automatic Frequency Scanning realizes outstanding performance for business graphics, CAD/CAM applications as well as desktop publishing on your Mac or IBM compatible system.

As you can see below, whether your requirements are simple or complex, IDEK has the Flat Screen Color Monitor that's just right for you. And priced right, too! See for yourself what a difference a Flat Screen Monitor from IDEK can make.

MULTIFLAT Series (17" Flat CRT Monitors)

Model	H. Frequency	Dot	Resolution
MF-5117	20 to 50kHz	0.28	1024 × 768
MF-5217	30 to 57kHz	0.28	1024 × 768
MF-5317 (Coming soon)	30 to 80kHz	0.28	1280 × 1280

MULTIFLAT Series (21" Flat CRT Monitors)

Model	H. Frequency	Dot	Resolution
MF-5021	15 to 38kHz	0.31	1024 × 768
MF-5121	21 to 50kHz	0.31	1024 × 768
MF-5221	30 to 80kHz	0.31	1280 × 1280
MF-5321 (A.R.Panel)	30 to 80kHz	0.31	1280 × 1280
MF-5421 (A.R.Panel)	30 to 80kHz	0.26	1600 × 1280

IDEK also offers its MULTIFLAT Series of 21-inch Flat Screen Color Monitors that deliver the same superior resolution and performance as the other members of the IDEK lineup.

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IDEK Europe (Germany)
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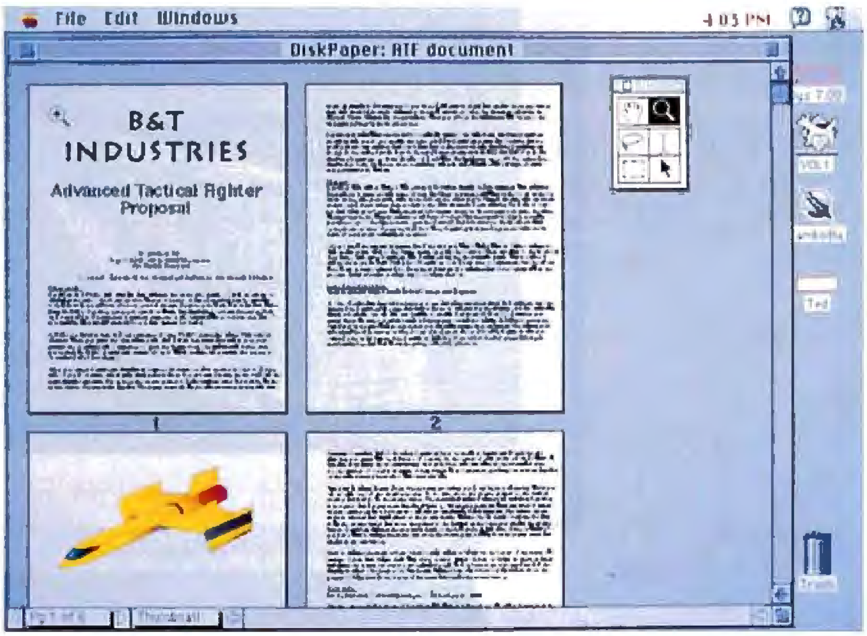
Circle 135 on Inquiry Card.

DiskPaper Works with Virtual Documents

Wouldn't it be great to use E-mail's fast-as-light capability to send an ad-campaign proposal (complete with color images and special typefaces) to a company? Or to electronically submit a portfolio of artwork to a potential employer? Or to transmit a newsletter (complete with masthead and charts) to subscribers? With Farallon Computing's **DiskPaper 1.0**, you can.

DiskPaper is a Mac utility that lets you create virtual documents whose visual fidelity closely matches the original document. This virtual document can be a file that requires the DiskPaper reader or a self-extracting application with the reader built in. DiskPaper accomplishes this seamless transformation by posing as a printer driver. You simply issue the application's Print command and set some controls on the Printer dialog boxes that appear, and DiskPaper creates a file with print images of the document.



You can select the degree to which DiskPaper duplicates the original file. You can allow text only, letting DiskPaper substitute for any missing fonts, or you can create 72-dot-per-inch page bit maps, so that the file retains the document's pagination and format. If the original file contains 24-bit color images, you can dither them down to 8-bit images using a best-fit color palette (not just the default System palette). You can also save typeface information so that you can print a DiskPaper document. If size isn't a problem, you can add 300-dpi page images to the DiskPaper file for a QuickDraw printer or attach PostScript data for a PostScript printer.

With the appropriate equipment, you can add a brief voice message (the length depends on available memory) to the DiskPaper document. For most Macs, you'll need Farallon's SoundRecorder A/D converter unit and SoundDriver file to add sound to the file; for the Mac IIsi and LC, you simply use the supplied microphone and Farallon's built-in sound circuitry. You can also attach prerecorded sound files.

For sensitive information, you can add a password to the document. In this case, DiskPaper encrypts the virtual document's data to prevent a security breach by someone using a disk editor. To ship a portfolio or issue newsletters without losing control of the information, you disable the ability to print the file or extract text and graphics from it.

Self-extracting documents require no licensing to distribute. Distributing the DiskPaper reader with files requires licensing, which can be by document (one document only, such as a manual) or by title (a CD-ROM containing multiple documents). Check with Farallon for licensing information.

I tried a beta version of DiskPaper on a Mac IIci with 8 megabytes of RAM, running System 6.0.5 and equipped with a SuperMac Technology ColorCard/24 and a 13-inch monitor. I also tried it on a Mac IIsi with 5 MB of RAM running System 6.0.7 and equipped with a Radius TPD monitor. Creating a DiskPaper document was just a matter of selecting it in the Chooser and printing it. I printed a variety of files—QuarkXPress 3.0, PageMaker 4.0, FreeHand 3.0, and MacWrite II—with few problems.

The DiskPaper reader shows the document one page at a time, or it lets you use a thumbnail display to get an overview of the document. You can print the pages or zoom in to examine a graphic. If the text-extraction feature is enabled, you can save the document's text to a file or select a portion of text to copy to the Clipboard. Two tools—marquee and lasso—let you select rectangular or irregularly shaped sections from a document's graphic. I was able to add sounds to the documents using a MacRecorder on the IIci and a microphone on the IIsi.

DiskPaper lets businesses enhance the power and speed of communications to distribute information. You can send a time-critical document to an office, where it's dispatched over a network to people faster than using overnight mail, copying the pages, and handing the copies out. The utility is also valuable in cases where document fidelity is crucial.

—Tom Thompson

THE FACTS

DiskPaper 1.0
$149

Requirements:
Mac Plus or higher with 1 MB of RAM and running System 6.0.2 or higher.

Farallon Computing, Inc.
2000 Powell St., Suite 600
Emeryville, CA 94608
(415) 596-9100
fax: (415) 596-9020
Circle 1170 on Inquiry Card.

- Interactive source-level debugger
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"When Novell went looking for a 32-bit compiler for use with the NetWare 386 developer's kit, the company selected WATCOM's...It's clear that Novell chose wisely; this product is a winner."
Fred Hommel, BYTE, December 1989

"WATCOM C/386 is a fantastic new ANSI C compatible compiler for 386-based PC's...If you have written your application in Microsoft C, you will love this compiler."
J. Richard Hines, Electronic Test, December 1989

"Microsoft library- and source-compatibility makes WATCOM C7.0/386 ideal for porting DOS applications to 32-bit native mode. This compiler enables full 386 performance without 640K limitations."
Richard M. Smith, President, Phar Lap Software, Inc.

"WATCOM is definitely the leader in object-level optimizations...For flat-out executable speed, WATCOM C showed shining performance."
Computer Language, February 1989

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- 32-bit flat model simplifies Windows memory management
- Royalty-free run-time license
- Requires Windows 3.0 SDK, does not require DOS extender

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CD-ROM Finally Becomes Affordable

For most of us, the thought of putting a CD-ROM drive in our PC has been an exercise in "someday, maybe." Despite all the hype of unlimited information access and the promises of lower prices, the reality of CD-ROM has been expensive and difficult-to-install drives and a dearth of reasonably priced software.

The software situation has been improving slowly, but low-cost drives were just a dream—until now. The Tandy **CDR-1000** sells for $399 complete, half the cost of other CD-ROM drives.

Not only is the CDR-1000 inexpensive, but it's simple to install. After removing the cover on my PC, I slipped in the drive, checked a few jumpers on the add-in card, connected two cables between the drive and the controller, and put the cover back on the system. At that point, I ran an installation program that installed the Microsoft CD-ROM extensions in my CONFIG.SYS file and tweaked my AUTOEXEC.BAT file.

I was done. The total time was about 15 minutes, and the drive worked flawlessly the first time.

Of course, Tandy had to cut a few corners to keep the price down, but surprisingly few. There are no motor-driven mechanics to slide the CD-ROM cartridge in and out of the drive. In fact, there's no disc cartridge at all, and that's a big plus. You slide out the drive drawer, lift a lid, drop in the CD-ROM, close the lid, and slide the drive drawer back in. It couldn't be simpler. Fewer moving parts mean fewer things to break. And because the CD-ROM doesn't sit in a cartridge (as in all the competing units), you don't have to spend the bucks for extra cartridges or go through the annoying exercise of changing the CDs in a cartridge.

Low cost or not, the CDR-1000 has one great advantage over its competitors: At over 150 kilobytes per second, its data transfer rate is twice what most others can do. That more than makes up for its slow seek time of about 800 milliseconds, especially since CD-ROM applications tend to transfer large amounts of data once they've found its location on the disc. Tandy engineers have designed a custom interface for the CDR-1000, eschewing the usual SCSI port that other CD-ROM drives use. The interface is the key to the drive's performance, delivering data directly to the PC bus.

I shouldn't fail to mention that you can use the CDR-1000 for the mundane (albeit enjoyable) task of playing music CDs. A headphone jack and volume control on the front panel and phono jacks on the back of the add-in card let you hook up to an external stereo system. A pop-up software utility lets you control the music functions.

Tandy is the 500-pound gorilla of computer retailing. You can't help but pay attention when this corporate giant decides to make a move. This is one situation where the company's size is a distinct advantage. With good reason, Tandy sees a huge potential market for CD-ROM applications. And by pricing the CDR-1000 so low, it has set an example that other manufacturers will be forced to follow, pulling CD-ROM applications from an elite corner and putting them into the mainstream. Software prices are sure to fall as well with volume.

A CD-ROM drive brings a new realm to desktop computing—and perhaps some danger as well. I spent hours browsing through the text and pictures of The New Grolier Electronic Encyclopedia, and I had to be almost dragged away from my computer. ■

—Stan Miastkowski

THE FACTS

CDR-1000
$399

Requirements:
IBM PC or compatible with a free half-height 5¼-inch floppy disk drive bay and a free 8-bit add-in slot.

Tandy/Radio Shack
700 One Tandy Center
Fort Worth, TX 76102
(817) 390-3300
Circle 1171 on Inquiry Card.

Dolch

Speed, Power, and Compatibility from Atari

Atari is offering what it calls a true 32-MHz, 32-bit computer system. Geared toward applications such as professional graphics, CAD/CAM, and desktop publishing, the TT030 is based on Motorola's 68030 microprocessor. The open-architecture system includes built-in cache memory and a 68882 enhanced floating-point math coprocessor. Its standard 2 MB of RAM is expandable to 26 MB.

Among other features, the system has a 3½-inch floppy disk drive, four serial ports, an internal A24/D16 VME card slot, and an optional hard disk drive. The three graphics modes of the TT030 are 320 by 480 pixels with 256 colors, 640 by 480 pixels with 16 colors, and 1280- by 960-pixel monochrome. The system also includes network-ready hardware and a real-time clock with non-volatile RAM.

Price: $2399.95 to $3499.95, depending on configuration.

Contact: Atari Computer, 1196 Borregas Ave., P.O. Box 3427, Sunnyvale, CA 94088, (408) 745-2000; fax (408) 745-2088.

Circle 1271 on Inquiry Card.

The open architecture of Atari's TT030 lets you expand your system as your needs change.

Power in a Cube

Based on AMD's Am386DXL 40-MHz microprocessor, the Cube 386/40 Enhanced System provides 21 percent more power than a 33-MHz system at the same cost, according to Cube Computer. The system is available as the 4¼-inch-high Deskline or the 13-inch-high Desktower.

The Cube 386/40's 4 MB of RAM is expandable to 64 MB, and it has a 64-KB high-speed memory cache. It includes a 104-MB Conner Intelligent Drive Electronics hard disk drive, 3½- and 5¼-inch floppy disk drives, a Trinitron Super VGA noninterlaced 14-inch color monitor, a noninterlaced VGA card with 1 MB of video RAM, an internal modem, a Microsoft Mouse, and Adobe Type Manager.

Price: $3690.

Contact: Cube Computer Corp., 150 Clearbrook Rd., Elmsford, NY 10523, (800) 522-2823 or (914) 592-8282; fax (914) 592-3482.

Circle 1272 on Inquiry Card.

The Cube 386/40 Enhanced System offers workstation performance at a 386 price in its Deskline model.

Mini 386SX Offers Something New

A fresh design and an all-new interior coupled with a programmable keyboard delineate the minidesktop 20-MHz 386SX cache computer. The Gateway 2000 machine has an integrated floppy disk/Intelligent Drive Electronics (IDE) host adapter and serial and parallel ports that you can disable through the BIOS.

Designed around a backplane and riser card with five 16-bit slots, the 386SX/20 comes with 4 MB of RAM (expandable to 16 MB), an 80-MB IDE hard disk drive (expandable to 200 MB), and a 32-KB RAM cache. It includes 3½- and 5¼-inch floppy disk drives, a VGA chip set with 512K bytes of RAM on the motherboard, and a color monitor. The daughterboard processor snaps onto the backplane.

Price: $1995.

Contact: Gateway 2000, 610 Gateway Dr., North Sioux City, SD 57049, (800) 523-2000 or (605) 232-2000; fax (605) 232-2023.

Circle 1273 on Inquiry Card.

Infinity in a Small Space

A 20-MHz Infinity Desktop Computer is available in five configurations from Falco. The machine increases CPU performance by 25 percent over the company's 16-MHz Infinity model.

The 20-MHz Infinity has a built-in 65-W auto-ranging power supply. With the exception of the unit's one parallel and two serial ports, peripheral interfaces are on the motherboard. The unit includes 512 KB of video RAM, 1 MB of expandable RAM, and two three-quarter-length 16-bit bus-expansion slots for LAN, fax, or other cards. A 1.44-MB floppy disk drive is standard on all but the diskless version.

Price: Diskless, $1016; with one floppy disk drive, $1098; with 40-MB hard disk drive, $1635; with 100-MB hard disk drive, $1954; with 210-MB hard disk drive, $2404.

Contact: Falco Data Products, Inc., 440 Potrero Ave., Sunnyvale, CA 94086, (408) 745-7123; fax (408) 745-7860.

Circle 1274 on Inquiry Card.

Scan in Color on Your Mac or PC

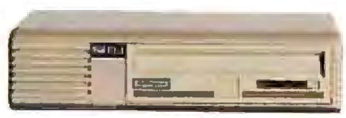
With the Niscan Spectra, you can scan color images on your Mac or PC in over 16 million colors in a single pass. The Spectra uses a single color-corrected white-light source to give true color.

Spectra for the Mac's ScanDo/DA software lets you scan directly to a file. The scanner lets you display an entire image on-screen at full resolution or view just part of an image for previewing. Its RS-422 interface connects to the modem port.

Spectra for the PC includes either Color Lab software for Windows or ScanRix software for non-Windows environments. Its RS-232 interface connects to the serial port.
Price: $899.
Contact: Nisca, Inc., 1919 Old Denton Rd., Suite 104, Carrollton, TX 75006, (214) 242-9696; fax (214) 245-0942.
Circle 1275 on Inquiry Card.

Removable Cartridges In Two Capacities

The Infinity 88 Turbo removable cartridge hard disk drive uses 88-MB cartridges and has an average seek time of 20 ms. Its formatted capacity is 85.3 MB, achieved by an increased track density on the hard disk within the cartridge. Features of the Infinity 88 Turbo include external SCSI termination control switches, an external fuse, and a rotary SCSI ID dial. A SCSI controller card is required.
Price: $1799.
Contact: Peripheral Land, Inc., 47421 Bayside Pkwy., Fremont, CA 94538, (800) 288-8754 or (415) 657-2211; fax (415) 683-9713.
Circle 1278 on Inquiry Card.



DiscXchange is a portable 44-MB external removable cartridge hard disk drive that connects to standard PC parallel printer ports. With an average seek time of 20 ms, DiscXchange includes a temporary device driver that functions as a small TSR program; it instantly assigns a drive designation based on the next available drive or partition, eliminating the need for you to alter the CONFIG.SYS or AUTOEXEC.BAT file on your PC. DiscXchange includes a built-in power supply and one 44-MB cartridge. It also comes with a carrying case and a removable power cord.
Price: $1649.
Contact: Interpreter Disc Products, Inc., 11455 West 48th Ave., Wheat Ridge, CO 80033, (303) 431-8991; fax (303) 431-9056.
Circle 1279 on Inquiry Card.

This Printer Remembers Your Favorite Fonts

The Facit P5160 laser printer prints at 16 ppm and comes with 1.5 MB of standard memory. You can expand the printer's memory to 4.5 MB in 1-MB increments.

Available with or without Adobe PostScript, the P5160 can support Hewlett-Packard LaserJet Series II emulations. You upgrade it by sliding out the controller board and inserting the appropriate new board.

The P5160 can remember up to four printer configurations of different font sizes, page drawers, and page lengths and can recall them at the push of a button. The standard 250-sheet drawer accepts sheet paper, laser labels, and transparencies as well as letter- and legal-size paper. A second 500-sheet drawer is available, as is a 70-envelope feeder.
Price: $3799; PostScript model PS-17, $4349; model PS-35, $4849.
Contact: Facit, Inc., 400 Commercial St., Manchester, NH 03108, (800) 733-2248 or (603) 647-2700; fax (603) 647-2724.
Circle 1277 on Inquiry Card.

Share a Flat Screen with a Friend

A monochrome graphics terminal, the flat-screen MC6 comes with a keyboard and provides simultaneous connection to two computers. Each user can choose a full-page or split-screen display.

The MC6 is compatible with ANSI, ASCII, and Enhanced PC keyboards. System compatibility includes Unix, VMS, PC MOS, and Concurrent DOS. The terminal has a serial RS-423/RS-422 port, an RS-423 port, and a PC-compatible port. Its 14-inch screen can display in green, amber, or white in full overscan and has a 76-Hz refresh rate.
Price: $679.
Contact: Link Technologies, Inc., 47339 Warm Springs Blvd., Fremont, CA 94539, (800) 448-5465 or (415) 651-8000; fax (415) 651-8808.
Circle 1276 on Inquiry Card.

The MC6 graphics terminal offers simultaneous connnection to two users.

Trick Your Mac into Thinking Big

If you've been wishing you could get a 20-inch picture on your 9-inch Mac monitor, you may find the TotalVision board to be just the ticket. From Technology Fusion, TotalVision transforms the internal display of your Mac Classic, SE, or Plus, making your computer think it's working with a larger screen.

TotalVision works in hardware pan, hardware flex, and hardware zoom modes. Its hardware pan feature expands the 512- by 342-pixel display to 1024 by 1024 pixels. As the mouse cursor touches the edge of the 9-inch screen, it pans across the 20-inch virtual desktop at hardware speed. The flex feature lets you see the full 8½-inch page width of documents without having to scroll back and forth; used with the pan feature, it shows a full two pages. Zoom lets you expand any portion of an image.

Price: $349.
Contact: Technology Fusion, Inc., 1667 Cole Blvd., Suite 400, Golden, CO 80401, (303) 278-1295; fax (303) 278-7215.
Circle 1280 on Inquiry Card.

TotalVision changes the Mac's internal display for big-screen benefits.

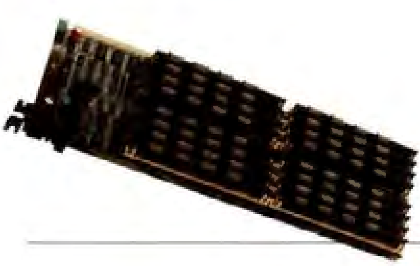
From Memory Board to Hard Disk In a Flash

An XT- and AT-compatible nonvolatile memory board, Flash Disk uses its DOS driver software to emulate a hard disk drive. The board's access time is 250 ns, according to the manufacturer.

Unlike ROM and EPROM boards, Flash Disk can be erased and programmed in the PC. The board's 16 SIMM sockets accommodate up to 16 MB of memory in 1-MB increments or up to 32 MB in 2-MB increments.

The standard two-slot board is available with 16 or eight SIMM sockets. The small one-slot board comes with four SIMM sockets. Read-only jumper-selectable sectors of the board provide data and virus protection.

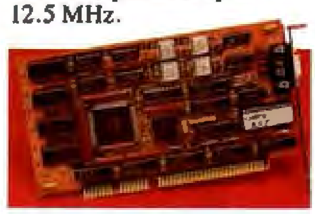
Price: Without memory: $695 with four SIMM sockets; $895 with eight SIMM sockets; $995 with 16 SIMM sockets.
Contact: Computer Modules, Inc., 2348C Walsh Ave., Santa Clara, CA 95051, (408) 496-1881; fax (408) 496-1886.
Circle 1281 on Inquiry Card.



A nonvolatile memory board, Flash Disk's modularity makes the expansion choice yours.

Ultra VGA on a Half Card

The MicroVGA 452 video controller board is a half-length AT-compatible card. With its XT form factor, the card fits into any PC 16-bit expansion bus slot with bus speeds of up to 12.5 MHz.



The card's Ultra VGA driver increases the usual 16 or 256 colors on a monitor to 742,813, with near-photographic quality, according to the company. It has a 60-Hz refresh rate and 512 KB of video RAM. Software drivers include Super VGA for Windows 3.0 and Ultra VGA for Windows 3.0 and Autodesk applications.

Price: $395.
Contact: Monolithic Systems Corp., 7050 South Tucson Way, Englewood, CO 80112, (800) 525-7661 or (303) 790-7400; fax (303) 790-7188.
Circle 1282 on Inquiry Card.

SPARC Up Your PC

The SPARC-based Opus Series 500 Personal Mainframe line of add-in boards lets standard PCs run SunOS and MS-DOS applications simultaneously. Sophisticated software engineering and board design allow the equivalent of a Sparcstation to reside on a single AT-size board, according to Opus Systems. The board, which runs in Windows 3.0 and supports Sun View, lets you use Sparcware applications without a high-resolution monitor and with your DOS software.

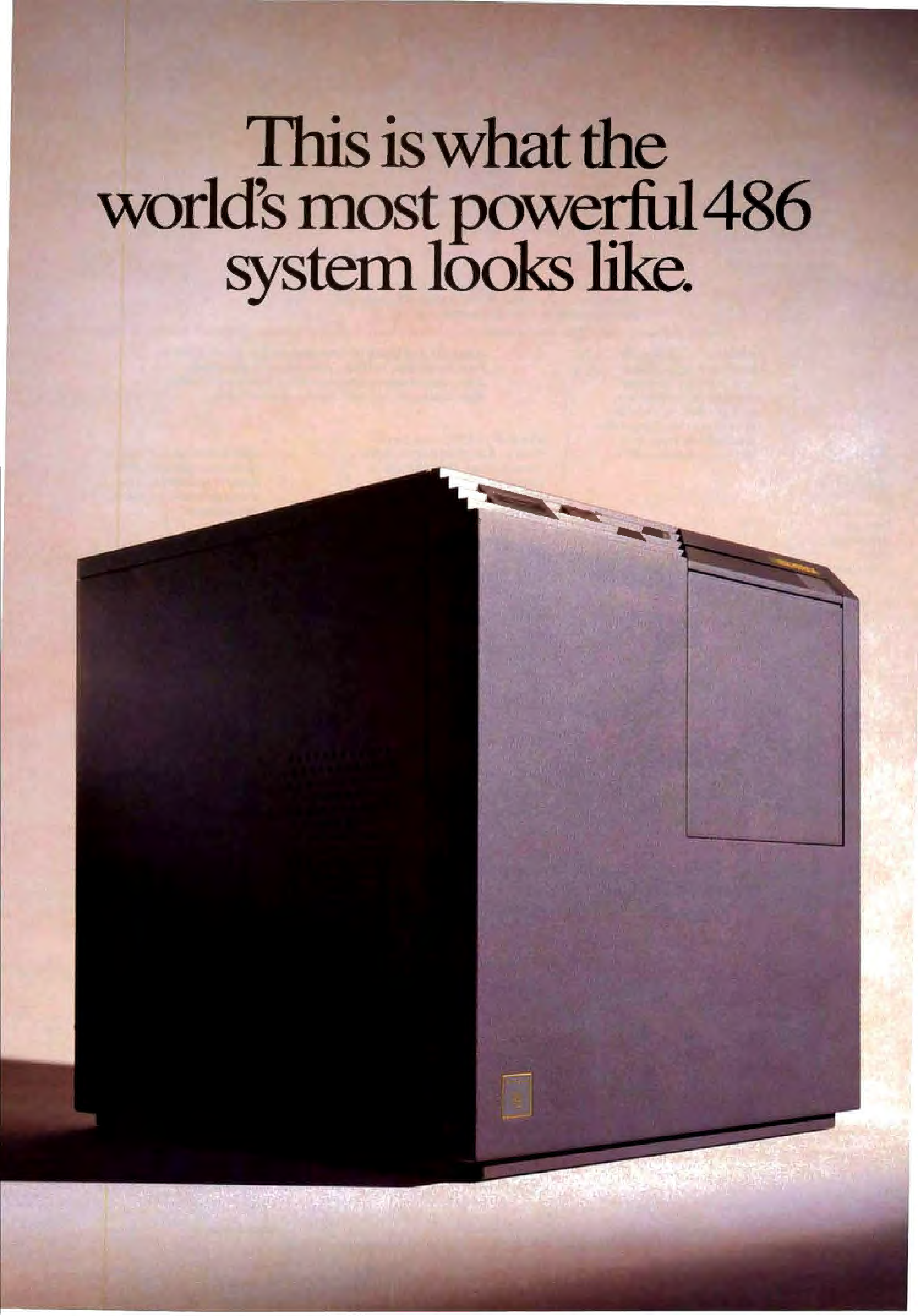
Price: $6495 and up.
Contact: Opus Systems, 329 North Bernardo Ave., Mountain View, CA 94043, (415) 960-4040; fax (415) 960-4001.
Circle 1283 on Inquiry Card.

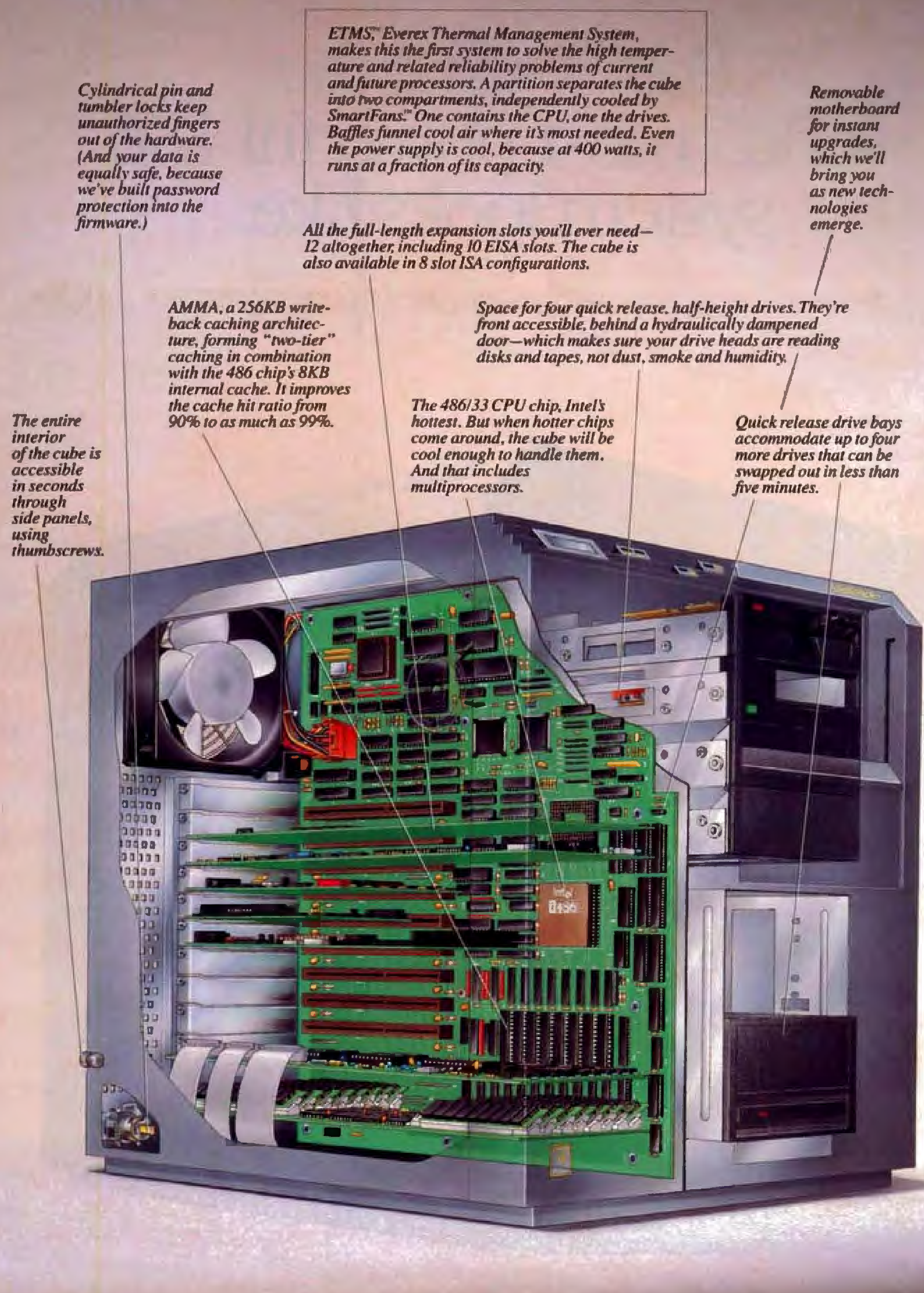
VGA Goes Video

TapeCaster, a half-slot card for your XT, converts your VGA output to NTSC or PAL video. Each version of the card provides a video representation of your monitor's screen as long as your computer is turned on.

The hardware-only approach of TapeCaster provides compatibility with professional-quality studio equipment as well as low-end VCRs. The board processes all VGA video modes to a maximum resolution of 640 by 480 pixels in 24-bit color. TapeCaster requires only power from your computer; it has no communication needs.

Price: $750.
Contact: Redlake Corp., 15005 Concord Cir., Morgan Hill, CA 95037, (408) 779-6464; fax (408) 778-6256.
Circle 1284 on Inquiry Card.


This is what the world's most powerful 486 system looks like.


ETMS,™ Everex Thermal Management System, makes this the first system to solve the high temperature and related reliability problems of current and future processors. A partition separates the cube into two compartments, independently cooled by SmartFans.™ One contains the CPU, one the drives. Baffles funnel cool air where it's most needed. Even the power supply is cool, because at 400 watts, it runs at a fraction of its capacity.
Cylindrical pin and tumbler locks keep unauthorized fingers out of the hardware. (And your data is equally safe, because we've built password protection into the firmware.)
Removable motherboard for instant upgrades, which we'll bring you as new technologies emerge.
All the full-length expansion slots you'll ever need—12 altogether, including 10 EISA slots. The cube is also available in 8 slot ISA configurations.
AMMA, a 256KB write-back caching architecture, forming "two-tier" caching in combination with the 486 chip's 8KB internal cache. It improves the cache hit ratio from 90% to as much as 99%.
Space for four quick release, half-height drives. They're front accessible, behind a hydraulically dampened door—which makes sure your drive heads are reading disks and tapes, not dust, smoke and humidity.
The entire interior of the cube is accessible in seconds through side panels, using thumbscrews.
The 486/33 CPU chip, Intel's hottest. But when hotter chips come around, the cube will be cool enough to handle them. And that includes multiprocessors.
Quick release drive bays accommodate up to four more drives that can be swapped out in less than five minutes.

And this is why.

Conventional system design can't cope anymore. The emerging technology is just too hot for it.

Enter the STEP Megacube.™ Designed from the ground up, the STEP Megacube is a 486™ system unlike any other. It incorporates ideas from the mainframe world, such as its caching architecture and thermal management. And it has performance and features that make it a perfect fileserver. Or a perfect multiuser system. Or a perfect graphics workstation.

A 486/33 CPU combined with Everex's proprietary Advanced Memory Management Architecture (AMMA™) gives it warp speed—20.8 MIPS. Space for eight drives gives it storage that will remind you of the Library of Congress. And twelve expansion slots give it more expandability than you can shake a peripheral at.

And if it happens to be an Everex™ peripheral, you could get a nice performance bonus. Because Everex graphics, networking and controller boards are designed to take full advantage of our STEP™ architecture for even better performance.

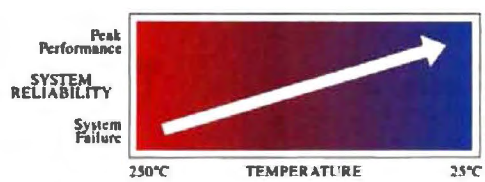
Combine all this with up to 64 MB of RAM—enough for the most demanding applications—and you wind up with a computer that can be configured for anything.

Even the future.

You see, the design breakthroughs of the STEP Megacube eliminate the upgradability problems inherent in other systems. Which means that when the next generation processors arrive—like the 50MHz 486, just down the road—all you have to do is swap out motherboards. No space problems. No overheating problems.

No obsolescence.

Performance-wise, this is a machine that will be hot long after others are cold and buried. In fact, as of now, there's no end in sight to the STEP Megacube's upgradability path.



The Everex Thermal Management System (ETMS) improves system reliability by reducing internal temperatures.

But really, that shouldn't be much of a surprise. After all, at Everex, our mandate is "Always innovate, never compromise." And that's exactly the approach we took when we built the STEP Megacube.

Granted it doesn't look like your typical 486 system. Fortunately, it doesn't perform like one either. To find out more about what it can do, give us a call.

For a free copy of the STEP Megacube Application Guide, call:

*1-800-368-STEP**

Introducing the STEP Megacube.

EVEREX

Circle 103 on Inquiry Card.

Macs and Suns As Partners

Bidirectional, peer-to-peer connection between Sun and Macintosh computers is available with Sun-Partner. The software lets Sparcstation and Mac users access and use files on each other's machines in the format and user interface that is native to each platform.

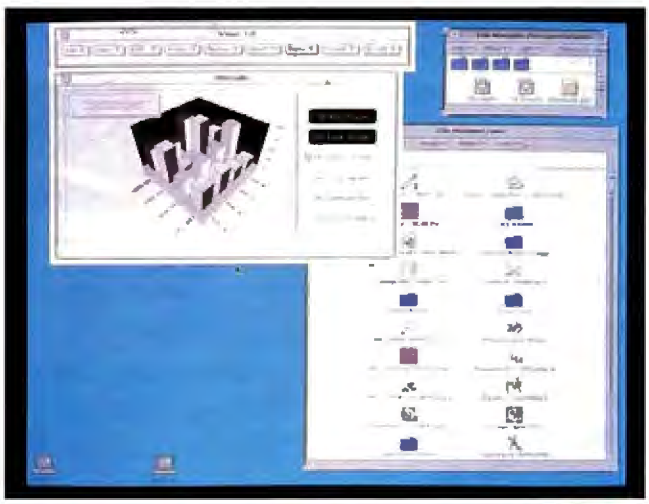
Sun-Partner permits all networked devices (such as printers and database servers) to be available simultaneously to both Sun and Mac computers from either Sun's OpenLook or the Mac user interface. The product creates a peer-to-peer network and supports applications that run on multiple platforms, support standard file formats, are divided or client/server based, or include translators.

Price: $695 per Sparcstation; LocalTalk card, $595; IPT's software for the Mac, $295.

Contact: Information Presentation Technologies, Inc., 5000 North Pkwy. Calabasas, Suite 304, Calabasas, CA 91302, (818) 347-7791; fax (818) 992-5580.

Circle 1290 on Inquiry Card.

Mac screen connected to a Sparcstation with Sun-Partner.



Sun Sparcstation screen connected to a Mac with Sun-Partner.

DDS DAT for AppleTalk and TOPS

A 1.3-gigabyte digital data storage, digital audiotape automatic mass-storage backup and restore system is available for AppleTalk and TOPS networks. MacBack DAT also backs up local Mac drives on the network.

MacBack DAT's intuitive menu lets you quickly select the files you want to back up and when you want to back them up. The unit's Autostart automatically carries out your instructions. The MacBack DAT transfers data at an average rate of up to 4.5 MB per minute over a SCSI bus and 2.5 MB per minute over an Ethernet system.

Price: $4995.

Contact: Advanced Digital Information Corp., 14737 Northeast 87th St., Redmond, WA 98073, (800) 336-1233 or (206) 881-8004; fax (206) 881-2296.

Circle 1291 on Inquiry Card.

A Choice of Adapters

Eight-bit, 16-bit, and Micro Channel 10Base-T adapters for the PC are available from Invisible Software. The Ethernet adapters use twisted-pair cables to provide a transmission speed of 10 Mbps.

Compatible with Novell NE1000 cards, the Invisible Ethernet 10Base-T/8 8-bit adapter lets you run Novell NetWare and Invisible's own Net/30 operating system. The Invisible Ethernet 10Base-T/16 16-bit Novell NE2000-compatible board is based on VLSI technology. The Invisible Ethernet 10Base-T/A adapter for the Micro Channel bus is NE/2 compatible. Each board includes a standard Ethernet 15-pin D-type connector as well as an RJ-45 connector for twisted-pair Ethernet connections.

Price: 10Base/8 and /16 adapters, $369; 10Base-T/A adapter, $469.

Contact: Invisible Software, Inc., 1142 Chess Dr., Foster City, CA 94404, (415) 570-5967; fax (415) 570-6017.

Circle 1292 on Inquiry Card.

An Adapter That's Three in One

The CN950E is a three-in-one adapter for EISA bus-based file servers and workstations. The card supports Ethernet thick and thin coaxial cabling as well as unshielded twisted-pair 10Base-T cabling.

Designed with dual-port, shared-memory capabilities, the CN950E provides data transfer at 10 Mbps. The card's software drivers let you work in a variety of networks, including NetWare 286 and 386, Lan Manager, Vines, and 3+Open.

Price: $599.

Contact: CNet Technology, Inc., 2199 Zanker Rd., San Jose, CA 95131, (408) 954-8000; fax (408) 954-8866.

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For a complete catalog of Sony storage products, call 1-800-433-3422.

SONY.

SONY COMPUTER PERIPHERAL PRODUCTS COMPANY

Sony Computer Peripheral Products Company, 655 River Oaks Parkway, San Jose, CA 95134

Circle 263 on Inquiry Card.

Answer the Phone While at Your Computer

The TeleDesk PowerPlus Workstation lets Centrex users concurrently combine telephone-call-handling activities with business applications in a Windows 3.0 environment. PowerPlus Workstations are compatible with NetWare as well as with Conveyant's LAN.

Whenever the workstation is in the telephone mode, you can instantly switch to an application that is running by pressing a hot key. When a call comes in, you return the unit to the telephone mode by again pressing the hot key. You can repeatedly switch between the applications without losing your place in either application, according to the company. PowerPlus uses a 386 PC with Windows 3.0 and a proprietary keyboard with an integrated handset.

Price: $15,000.

Contact: Conveyant Systems, Inc., 2332 McGaw Ave., Irvine, CA 92714, (714) 756-7100.

Circle 1294 on Inquiry Card.

The PowerPlus Workstation lets Centrex users do multitasking under Windows 3.0.

Take Control Remotely

PC-compatible, Remote Power On/Off gives you control over your programs, files, and printers at a remote, unattended location whether the remote system's power is on or off. The telephone-activated power-control unit includes four surge-protected power outlets for the central PC, its monitor, a printer, and a modem.

Remote-computing and file transfer software bundled with the unit gives users access to the central PC, allowing them to control its operations from afar. When the Remote Power On/Off controller detects an incoming call, it loads automatically and turns the system on. The controller automatically powers down the central system when work is completed.

Price: $219.95.

Contact: Server Technology, Inc., 2332-A Walsh Ave., Santa Clara, CA 95051, (800) 835-1515 or (408) 988-0142; fax (408) 988-0992.

Circle 1295 on Inquiry Card.

Prefabricated Networks Are in the Can

Three prefabricated 10Base-T networking kits make up the new LAN-in-a-Can line of products from Federal Technology. The products include two entry-level networks for three- and six-node networks and a prepackaged expansion kit to expand LAN-in-a-Can networks by groups of two.

The three-workstation kit contains three Exos 105 10Base-T Ethernet controllers, an Exos 5008 eight-port concentrator, 175 feet of cabling in preassembled lengths, and step-by-step installation instructions. The six-workstation kit includes an additional three controllers and 350 feet of cabling. The expansion kit has two controllers and 100 feet of cabling.

Price: Three-workstation kit, $1295; six-workstation kit, $1995; expansion kit, $549.

Contact: Federal Technology Corp., Exos Product Division, 207 South Peyton St., Alexandria, VA 22314, (800) 255-3967 or (703) 739-0500; fax (703) 739-0572.

Circle 1296 on Inquiry Card.

LAN-in-a-Can prefabricated network kits include step-by-step instructions.

A Modem That Means Business

A 9600-bps full-duplex modem, the Viva 9642e includes adaptive equalization capabilities that let it continue to perform in spite of weak phone-line signals and high noise levels. Designed for PCs and Macs, the V.32, V.42, and V.42bis modem virtually eliminates disconnects during long-distance calls, according to the manufacturer.

Providing synchronous and asynchronous transmissions, the Viva 9642e supports leased as well as dial-up lines. The device has a small LED screen on the front panel that displays eight status icons, including Modem Ready, Receive Data, Off Hook, and Transmit Data. It comes with Quick Link II communications software.

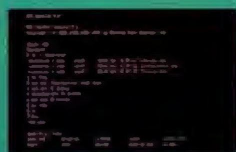
Price: $649.

Contact: Computer Peripherals, Inc., 667 Rancho Conejo Blvd., Newbury Park, CA 91320, (800) 854-7600 or (805) 499-5751; fax (805) 498-8848.

Circle 1297 on Inquiry Card.

Programmer's

MKS TOOLKIT



Does This Look Like UNIX to You? Of course it does, but it's not UNIX, it's the MKS Toolkit, a full emulation of the UNIX operating system. The MKS Toolkit brings the look and feel of UNIX to DOS or OS/2 on your PC. You'll get these powerful tools:

- •MKS KornShell
- •MKS vi editor
- •Awk Programming Language
- •Plus over 150 tools including grep, find, tar, ed, and sed.

The MKS Toolkit not only provides an excellent UNIX programming environment, but it is also ideal for new users trying to learn UNIX.

List: $249 Ours: $199

FAXcetera # [illegible]

DR. SWITCH-ASE

Dr. Switch-ASE turns any size dBase language application into a RAM resident (TSR) program. TSR's created with Dr. Switch-ASE occupy only 18K of RAM. Dr. Switch-ASE includes cut, paste, timer, alarm, macro playback and DOS shell functions. Supports Clipper S87/5.0, dBase III PLUS, dBASE IV, FoxBASE+ and all FoxPro versions. Dr. Switch-ASE can use both Expanded and Extended memory and is fully network compatible.

List: $179 Ours: $153

FAXcetera # [illegible]

TOOLS.h++ C++ CLASS LIBRARY

Tools.h++ is "The Standard" in C++ classes. Tools.h++ delivers all the essential classes including Strings, Dates, Times, BTree, complete Collection Classes, Regular Expressions, Linked Lists, Queues, Stacks, & more! All classes support isomorphic persistence. Version 4.0 provides Windows 3.0 DDE & Clipboard support, & DLL compiling. Tools.h++ is a great example of how to write true C++ code with smaller executables, code sharing, & effortless maintenance. Tools.h++ does your dirty work for you!

List: $199 Ours: $179

FAXcetera # [illegible]

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The fastest way to create Windows applications. Generates the Windows .EXE w/ complete source & production files (no royalties). Point & Click to define the user interface. Animate your design to instantly test its look & feel. Make changes on the fly without compiling. Custom code is preserved during code regeneration. A state-of-the-art programming tool. Supports C++.

List: $995 Ours: $795

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Watcom Fortran 386	929
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Zortech C++ 3.0	339
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Window Devel.Toolkit	539
Zortech C++ 3.0 w/	
WindowsMAKER Prof.	995

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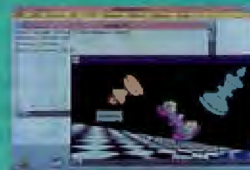

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NEWS

Alpha Aims to Empower MIS with RPL

Alpha Software, which made its mark with its Alpha Four relational database for people who don't want to struggle with dBase programming, hopes to have the same effect on the programming world with Alpha RPL (Resident Programming Language).

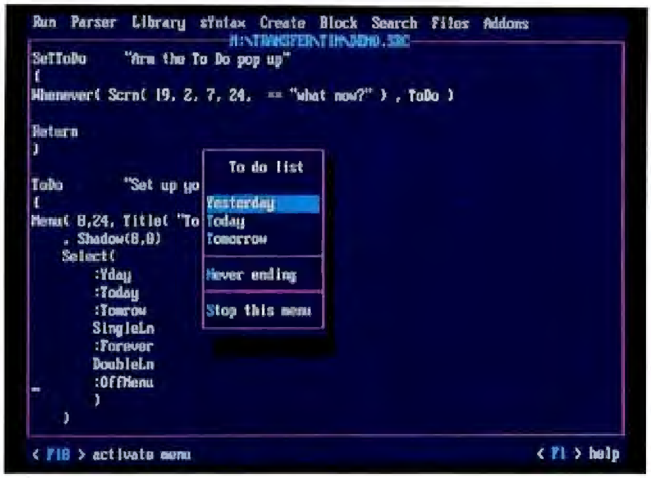
Alpha RPL lets you create memory-resident applications, integrate diverse DOS applications, and automate complex and repetitive tasks. It does this without requiring strong C or assembly language programming skills. You can use RPL to modernize awkward or outdated user interfaces. Alpha RPL can also read records from DBF files.

The Alpha RPL Mainframe Edition supports HLLAPI (High-Level Language Application Programming Interface), IBM's high-level protocol for mainframe sessions.

Price: $595; mainframe version, $995; mainframe run-time version, $95 to $149, depending on volume.

Contact: Alpha Software Corp., 1 North Ave., Burlington, MA 01803, (617) 229-2924; fax (617) 272-4876.

Circle 1298 on Inquiry Card.



With Alpha RPL, you can test procedures without leaving the editor. A pop-up menu, which was created visually, appears near the code that produces it, and which was generated by RPL. All of RPL's tools are memory resident, which means you can debug your RPL programs on top of the applications they are designed to control.

Debugger for System 7.0

Icom Simulations' TMON Professional, a multiwindow monitor/debugger, is designed to directly address the needs of System 7.0 developers. In addition to supporting the 680x0 family, the FPU, the paged memory management unit, and full 32-bit addressing capabilities, the tool is compatible with the virtual memory and the Process Manager of System 7.0, the company says.

Price: $249.95; upgrades, $100.

Contact: Icom Simulations, Inc., 648 South Wheeling Rd., Wheeling, IL 60090, (800) 877-4266 or (708) 520-4440; fax (708) 459-3418.

Circle 1299 on Inquiry Card.

An Alternative to ResEdit

The best things in life are free unless you're a Mac programmer tired of working with ResEdit.

Mathemaesthetics says Resorcerer 1.0 offers two main improvements—a more stable environment and a better user interface—over Apple's free ResEdit utility for editing Mac resource files. Resorcerer protects against the corruption of files and the loss of data by always working with a copy of the file. Changes aren't committed until you save the file.

Resorcerer contains dedicated editors for over 40 resource types, plus an extendable Custom Resource Editor for editing private and less common resource types. Each editor follows the documented format for each resource and has a single-window interface to make the job easier. The single-window editing environment makes all resources and their attributes available in one window instead of multiple open windows. And all the editors let you back out before committing local changes.

As you'd expect from a product that has to compete with something that's essentially offered for free, there are many other features. Resorcerer requires a Mac Plus with a hard disk drive and System 6.0 or higher.

Price: $256.

Contact: Mathemaesthetics, Inc., P.O. Box 67–156, Chestnut Hill, MA 02167, (617) 738-8803.

Circle 1300 on Inquiry Card.

Just One File Does It All

The Andsor 3.2 development system for creating accounting, management, inventory, manufacturing, and other business applications lets you create database applications where everything—procedures, data, screens, and menus—are stored in a single DOS file. The unified environment offers several advantages to developers, including no file restrictions, no memory management problems, no overlays, and better data integrity.

The Andsor system consists of one module that requires about 280 KB of RAM. The environment maintains in memory some of the objects from the disk database. At each moment, this memory object space is a logical subset of the entire object space of the application, the subset most needed at the time. Virtual memory management, combined with caching techniques, continuously adjusts this memory object space, giving you the illusion that each object in the database is always available.

Andsor continuously updates the database as the application executes. You don't have to worry about implementing complicated transaction management with commit/rollback logic.

Although a 286 system is recommended, the company says the application runs fine on an 8088. The system is network ready.

Price: $285.

Contact: Andsor Research, Inc., 390 Bay St., Suite 2000, Toronto, Ontario M5H 2Y2, Canada, (800) 766-1141 or (416) 245-8073; fax (416) 240-8473.

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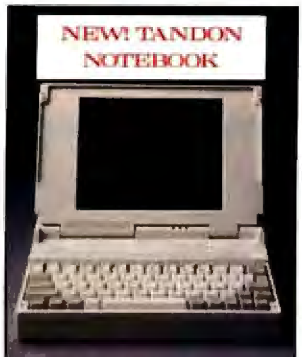

$3,495

LEASE: AS LOW AS $123/MONTH.

STANDARD CONFIGURATION
Microprocessor and Main Board: Intel 80386SX running at 20 MHz. Supports optional 80387SX math coprocessor.
Memory: 2MB standard.
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Video: Paper white VGA, non-glare CCFT backlit LCD, 32 grey shades. Supports external monitor.

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Tandon SL 386sx/20 Slimline

$1,999

LEASE: AS LOW AS $114/MONTH.

STANDARD CONFIGURATION
Microprocessor and Main Board: Intel 80386SX running at 20 MHz. Supports 80387SX math coprocessor.
Memory: 1MB standard.
Storage: 1.2MB OR 1.44MB diskette drive. 40MB IDE hard drive.
Video: VGA monochrome display.

Tandon SL 486/25 Slimline

$2,999

LEASE: AS LOW AS $105/MONTH.

STANDARD CONFIGURATION
Microprocessor and Main Board: Intel 80486 running at 25 MHz.
Memory: 2MB standard.
Storage: 1.2MB OR 1.44MB diskette drive.
Video: VGA monochrome display.

Call for information on our SL 486 Upgrade Package and additional options.

Tandon 386sx/N Network Station

$1,199

LEASE: AS LOW AS $69/MONTH.

STANDARD CONFIGURATION
Microprocessor and Main Board: Intel 80386SX running at 16 MHz. Supports 80387SX math coprocessor.
Memory: 1MB standard.
Video: VGA monochrome display.
Options: 1.44MB diskette drive. 40MB IDE hard drive. Additional options available. Please call for details.

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Tandon 386/33 Desktop

$3,199

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STANDARD CONFIGURATION
Microprocessor and Main Board: Intel 80386 running at 33 MHz. Supports 80387 or Weitek™ 3167 math coprocessors.
Memory: 4MB standard.
Storage: 1.2MB OR 1.44MB diskette drive. 110MB IDE hard drive.
Video: VGA monochrome display.

Call for information on our 386/25 Desktop.

Tandon 486/33 EISA Desktop

$7,299

LEASE: AS LOW AS $183/MONTH.

STANDARD CONFIGURATION
Microprocessor and Main Board: Intel 80486 running at 33 MHz. Supports Weitek 4167 math coprocessor.
Memory: 4MB standard.
Storage: 1.2MB OR 1.44MB diskette drive. 200MB IDE hard drive. EISA caching SCSI controller available.
Video: VGA monochrome display.

Tandon Tower 486/33 EISA

$7,699

LEASE: AS LOW AS $190/MONTH.

STANDARD CONFIGURATION
Microprocessor and Main Board: Intel 80486 running at 33 MHz. Supports Weitek 4167 math coprocessor.
Memory: 4MB standard.
Storage: 1.2MB AND 1.44MB diskette drives. 200MB IDE hard drive. EISA caching SCSI controller available.
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Tandon Tower 386/33

$4,199

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Project Management for the Rest of Us

Symantec's On Target project management program for Windows 3.0 is designed for managers responsible for multiple projects but lacking training in formal project management methods. The program's interface lets you pick a particular event, move it earlier or later in time, and connect it to other events or people.

On Target also has outlining capabilities, similar to those of Excel 3.0. A Force to One Page feature lets you squeeze any chart, no matter how large, onto a single page. As the program does this, it automatically adjusts the font sizes. On Target is LAN-compatible and supports file locking.

Price: $399.

Contact: Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014, (408) 253-9600; fax (408) 253-4092.

Circle 1302 on Inquiry Card.

On Target draws on familiar metaphors, such as spreadsheets, outlines, and bar charts.

Contact Management for All

Diamond Data Management, developer of the network-ready Prospector contact management program, has rewritten the program so that it's suitable for both the office and the laptop. The company says that the program's compact and variable-length file structure lets you store a large number of records in a relatively small space. By being network ready and compact, Diamond Prospector 1.10 lets a business use the same program on the road and at the home base.

The program has search and sort capabilities and a special video mode for hard-to-read laptop screens. Other features include a built-in word processor and the ability to automatically load a contact's city, state, and area code information when you provide the ZIP code.

Price: $195.

Contact: Diamond Data Management, Inc., 740 North Pilgrim Pkwy., Elm Grove, WI 53122, (414) 786-9000.

Circle 1303 on Inquiry Card.

Every Keystroke Saved Makes a Difference

Datacap, developer of the Paper Keyboard series of data-entry applications for the Mac and Windows on the PC, now offers a professional version for Windows that increases the number of forms it can process per minute. The new program also has an easier configuration process than the previous version.

Paper Keyboard Pro will process up to 16 pages per minute by supporting high-speed document scanners such as those from Fujitsu, Canon, Bell & Howell, Ricoh, and TDC, Datacap says. The program also supports lower-end scanners.

The program recognizes constrained handwriting, the type of block-letter printing often used to fill in forms. It combines optical character recognition and handwriting recognition to reduce the time operators spend keying in information during the data-entry process.

After an initial configuration, you can scan in documents and view an image of each completed form, fixing any recognition errors there on the spot. The new Pro version supports Dynamic Data Exchange for the automatic transfer of data.

Datacap says you can use the application for market research and other high-volume data-entry jobs.

Price: $1495.

Contact: Datacap, 5 West Main, Elmsford, NY 10523, (914) 347-7133; fax (914) 347-7136.

Circle 1304 on Inquiry Card.

Two Programs for the Canadian GST

Great American's Canadian Goods and Services Tax Kit works in the accrual-based One-Write Plus Accounting System 2.06D and the cash-based Money Matters 2.0 accounting program. The kit is for businesses that need to comply with the tax requirements introduced on January 1, 1991.

Price: $16.

Contact: Great American Software, Inc., 615 Amherst St., Nashua, NH 03063, (603) 889-5400; fax (603) 881-9337.

Circle 1305 on Inquiry Card.

M-USA, developer of the Pacioli 2000 accounting program for the PC, now offers a Canadian Goods and Services Tax version. Pacioli 2000, suitable for single-user or networking environments, includes eight modules in one system: general ledger, debtors accounts, creditors accounts, stock control, invoicing, purchasing, budgeting, and auditing.

Pacioli 2000 has a sample chart of accounts with up to 36 open on-line periods and five costing systems, including first-in/first-out and last-in/first-out. The program supports an unlimited number of users, multilevel password protection, and file and record locking.

Price: $99.95 Canadian.

Contact: M-USA Business Systems, Inc., 17440 North Dallas Pkwy., Suite 207, Dallas, TX 75287, (800) 668-0454 or (214) 931-0024; fax (214) 407-0914.

Circle 1306 on Inquiry Card.

Global Lab Counts the Objects

Data Translation says its Global Lab Image program for Windows 3.0 offers image-processing and analysis features normally found on more expensive dedicated image-processing systems. These features include spectrum editing, frequency analysis, and automatic object counting and measurement.

Automatic object counting helps when you need to count and measure tissue cells, defects in wafers, or other objects. After thresholding the image according to gray level, the software automatically counts and measures all objects on the screen. You can select a specific object in an image for measurement, and the program can automatically add numerical labeling and object tracing, to keep track of different objects.

To analyze the structure and shape of objects of interest in images or to remove unwanted detail, common morphological operations such as erosion, dilation, opening, and closing are available. You can customize morphological operators to search for objects based on size, shape, or vertical, horizontal, or tilted orientation. You can also use the program to perform precision frequency analysis, such as fast Fourier transforms, inverse FFTs, and spectrum editing operations.

The program supports the Data Translation QuickCapture frame-grabber boards for the 286 and the PS/2 Micro Channel architecture.

Price: $2495.

Contact: Data Translation, 100 Locke Dr., Marlborough, MA 01752, (508) 481-3700; fax (508) 481-8620.

Circle 1307 on Inquiry Card.

ProductOne can read in wireframe models in a variety of formats and shade them with proper perspective and lighting.

Render Engineering Drawings

Initially developed to help NASA visualize Venusian terrain from Earth-based radar data, ProductOne lets you render engineering 3-D models imported from a variety of programs. The program supports DXF, DesignCAD-3D, NASA PDS, LBL, and IMG CAD files, as well as TARGA, PCX, TIF, GIF, and other image file formats, according to its developer. ProductOne requires at least a 286 with a hard disk drive.

Price: $495.

Contact: Digital ChoreoGraphics, 1763 Orange Ave., Costa Mesa, CA 92627, (714) 548-1969.

Circle 1310 on Inquiry Card.

Jandel Brews Mathematically Precise Java

Java 1.4, a program for capturing, processing, measuring, and analyzing video images, adds image arithmetic for adding, subtracting, and averaging images on the PC. If you save images to disk, you can add, subtract, and average them with the current image in the frame-grabber buffer.

An image bit-map transform feature lets you transfer image pixel intensity modifications to and from the data worksheet and frame-grabber buffer.

Java collects images from a video camera attached to a microscope or mounted on a copy stand and accepts standard composite (RS-170/NTSC) video signal input from any source, plus predigitized computer images such as CAT, MRI, ultrasound, and others.

Price: $1495.

Contact: Jandel Scientific, 65 Koch Rd., Corte Madera, CA 94925, (800) 874-1888 or (415) 924-8640.

Circle 1308 on Inquiry Card.

A Chemical Bartender for the Lab

You may not want to have a drink of what this bartender pours. But InTend, the "laboratory bartender" for the PC, can at least keep you from crying over failed experiments due to calculation errors. InTend has three main functions: performing chemical and radioactive calculations; maintaining a database of chemicals used in the lab with their vendor and storage location; and storing and displaying hazards and special precautions for each chemical.

With InTend, you can enter the names of chemicals and the final volume and concentration needed, and the program will calculate the amount of each chemical to add. Ingredients can be solid, liquid, or stock solutions. The program handles unit conversions. When the recipe is completed, you can save it for future use.

If you enter any two of weight, volume, or concentration, InTend will calculate the third. Taking into account radiochemical decay, InTend calculates the volume of a radiochemical needed to prepare a stock solution of a specified concentration. It can also calculate the concentration from the number of radioactive counts per minute in a specified volume. You can modify InTend's database of chemicals, radiochemicals, and recipes.

Price: $150.

Contact: GraphPad Software, 10855 Sorrento Valley Rd., Suite 204B, San Diego, CA 92121, (619) 457-3909; fax (619) 457-8141.

Circle 1309 on Inquiry Card.

On-the-Fly CAD Cost Estimates

DesignBid 3.0—the program that tabulates building material, labor, and other costs as you design—can now automatically generate roof plans according to your parameters. The program generates all intersections of planes, including hips, valleys, and ridges. It also generates gables, dormers, overhangs, and internal edges for courtyards.

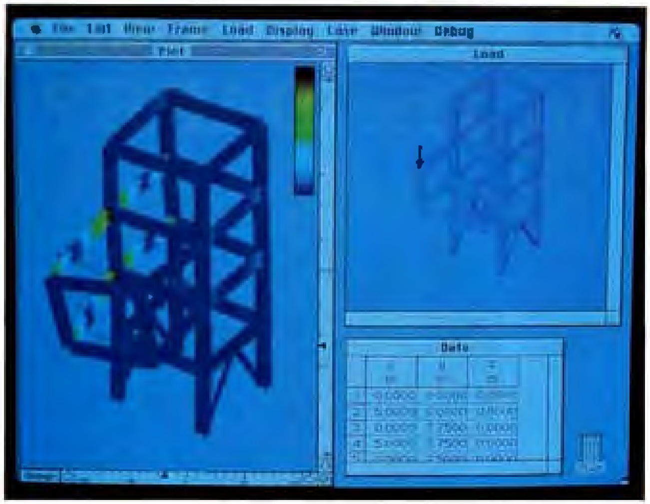
With DesignBid, you can choose building materials as you create designs, selecting from a pop-up inventory of items. Materials you select are automatically integrated into the design, and the program calculates cost estimates. If you change the design, the cost estimate changes with it. The new version also supports walk-through and fly-by viewing. It can generate 3-D rendered images from a 2-D drawing.

DesignBid runs on 386 DOS-based and Unix-based systems, as well as the Silicon Graphics, Sun Microsystems, and IBM RISC System/6000 series of computers.

Price: $5995 to $25,000.

Contact: Dickens Data Systems, Inc., 3850 Holcomb Bridge Rd., Suite 230, Norcross, GA 30092, (404) 448-6177; fax (404) 448-6878.

Circle 1007 on Inquiry Card.



Multiframe shows a load being applied to a structure in the right window, while showing in the left window an exaggerated deflection shape resulting from the load. The colored bar provides a minimum and maximum scale for the bend.

Mac Structural Analysis and Design

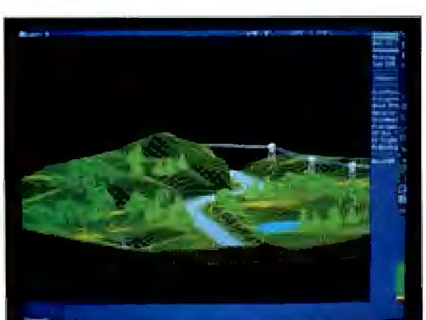
Multiframe, a new 3-D structural analysis and design program for the Mac, offers several interactive and visualization features, including the animation of the structural deflection. Multiframe can render structures in detail, complete with web and flange detail on members. It also produces color overlays of force and stress levels.

Multiframe lets you select areas to display, according to geometry, section type, and other criteria. In addition to the 3-D version, Multiframe is also available in a 2-D version for frame analysis. An optional module that integrates into Multiframe, called Section Maker, is for section-properties design and calculation.

Price: 3-D version, $1495; 2-D version, $895; Section Maker, $395.

Contact: Graphic Magic, Inc., 2-1645 East Cliff Dr., Suite 6, Santa Cruz, CA 95062, (408) 464-1949; fax (408) 464-0731.

Circle 1005 on Inquiry Card.



Landcadd's enhanced version of Quadrangle, a contouring and digital terrain modeling program, now supports breaklines for road and drainage channel design.

Landcadd's Civil Engineering Solution

With its new COGO & Development, Earthworks, and Plan & Profile modules, plus upgrades to its Quadrangle, Site Analysis, and Construction Details modules, Landcadd wants to be your one-stop civil engineering store for AutoCAD add-ins.

The COGO & Development module ($895), for designing subdivisions, roads, and commercial sites, includes coordinate geometry routines for horizontal road alignments with offsets, cul-de-sacs, and intersections. Earthworks ($795) works in conjunction with Quadrangle to produce cut-and-fill calculations using grid-to-grid surface comparisons, including daylight lines, shrink/swell factors, and user-defined subsites. Plan & Profile ($795) takes entities and trims them to produce the plan portion of a plan and profile sheet. Profiles are generated from triangulated irregular networks, contours, text files, and 2-D alignments. The module calculates area differences between existing and proposed profiles. You can also build sewer-design and transmission-line profiles.

The company has also upgraded Quadrangle ($795), its contouring and digital terrain modeling program, to include breaklines for designing roads or drainage channels. Site Analysis ($695) is now available as an Autodesk Development System application for binding with AutoCAD release 11. Construction Details has three subsets: Civil Design ($395), Site Design ($495), and Irrigation Design ($295).

Price: $2485 for all three new modules.

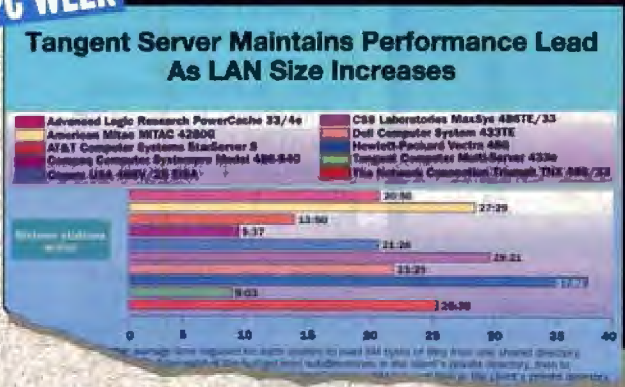
Contact: Landcadd, Inc., 7519 East Highway 86, Franktown, CO 80116, (303) 688-8160; fax (303) 688-8178.

Circle 1008 on Inquiry Card.

Once again, editors rave about the Tangent 486.

"...when the full 16 stations included in the test were active. The Tangent Multi-Server 433e was still the fastest..."
PC Week 1/7/91

PC WEEK



"A consistently strong performer across all tests, the Tangent model 433e stands out in this group." PC Magazine April 16, 1991

PC Magazine, April 16,1991

PC MAGAZINE EDITORS' CHOICE April 16, 1991 Tangent 433e

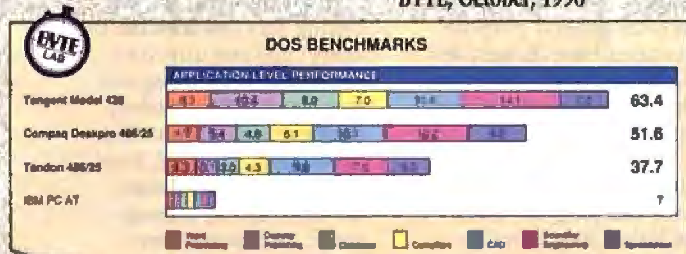
TANGENT COMPUTER INC.

Tangent Model 433e

by Bill O'Brien

Tangent Computer's foray into the realm of the EISA bus is represented by an investment-quality machine.

"The big winner is the Tangent..."
BYTE, October, 1990



When the editors got through writing about Tangent 80486 systems, they didn't leave us a lot to say. Except price. First, compare performance. Then compare price. What you'll see is that Tangent is the price-to-performance leader in 486 systems, with a range of models designed to fit any need.

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Circle 617 on Inquiry Card.

Zinc Steps Toward Platform Independence

Zinc Software has upgraded its Zinc Interface Library for C++ to let you create DOS text, DOS graphics, and Windows 3.0 applications from a single set of source code. Version 2.0 of the library includes an interactive design tool that creates persistent window objects.

Zinc says the new version is a step toward the company's goal of a platform-independent development tool. With the library, you can concentrate on program development while supporting three platforms from one set of source code. The interactive design tool reduces the time required to create the user-interface segment of the application.

By supporting object persistence, the interactive design tool lets you create an application screen—with menus, windows, input fields, and icons—and then save the objects on a disk.

By supporting three modes from a single source, the library lets you develop for 8086, 286, 386, and 486 systems. The library supports Borland C++ and Zortech C++.

Price: DOS version (supports text and graphics): $249 with source code, $199 without; DOS/Windows version: $399 with source code, $299 without.

Contact: Zinc Software, Inc., 405 South 100 East, Suite 201, Pleasant Grove, UT 84062, (801) 785-8900; fax (801) 785-8996.

Circle 1009 on Inquiry Card.

With version 2.0 of the Zinc Interface Library for C++, you can support three platforms from a single set of source code.

Graphics Library for C

A new 32-bit, 386 protected-mode extended graphics library supports graphics direct to hardware for a variety of IBM standard modes. Supported modes include EGA, VGA, MCGA, 8514/A, VESA/SVGA, Hercules Graphics Station Card GB1024, Truevision ATVista-4M, and WYSIWYG hard copy to Hewlett-Packard Graphics Language and PostScript devices or files.

Version 7.0 of the libhpgl.lib library supports mixed vector plotting and raster imaging, graphics viewports (i.e., partial screen windowing), user unit scaling, rotatable and scalable labels, and up to 1024-by 768-pixel images with 8-, 16-, or 32-bit graphics cards. The library comes with full source code in C and Phar Lap 386|ASM, plus sample code. Royalties are not charged for distribution of compiled composite code.

The library is available for the following 32-bit C compilers: Intel DPMI 386/486 C Code Builder Kit; MicroWay VCPI NDP C-386 2.x/3.x; Watcom C 8.0/386; and Zortech DOS 386 C++ 2.1, using the Phar Lap Tools.

Price: $200.

Contact: Gary R. Olhoeft, P.O. Box 10870 Edgemont, Golden, CO 80401, (303) 279-6345 or (303) 877-3697; "golhoeft" on BIX.

Circle 1011 on Inquiry Card.

C++ Class Libraries

Microtec Research's new Capsule set of reusable C++ class libraries includes general-purpose container base classes, application classes, and stand-alone applications derived from the base classes.

The base classes encapsulate flexible data structures and program blocks for linked lists, circular lists, stacks, queues, keys, data and hash tables, binary trees, graphs, error detection, and registry, the company says.

The application classes and programs illustrate how to use the base classes, and you can use them in your own applications. Applications include a PostScript graph-display class, a mapping class for string-to-numeric tag conversion, a stand-alone reverse Polish notation stack-based expression evaluator, a sorted-list generator, and a Capsule test suite with test programs for lists, graphs, display graphs, and binary search.

The library is compatible with AT&T C++ 2.1 and compatible source code files on DOS and Unix.

Price: $495 per CPU.

Contact: Microtec Research, Inc., 2350 Mission College Blvd., Santa Clara, CA 95054, (800) 950-5554 or (408) 980-1300; fax (408) 982-8266.

Circle 1012 on Inquiry Card.

C Library for Novell NetWare

Automation Software Consultants' Network C Library, which features more than 300 functions and provides access to NetWare system services and statistics, now supports Turbo C in addition to Microsoft C. The library provides tools for developing commercial NetWare applications or utilities for a network.

You can access the following services with the library: file and directory management, locking and synchronization, bindery management, accounting, messaging, printing, connection and workstation services, queue management, and transaction tracking.

Price: $225.

Contact: Automation Software Consultants, Inc., 124 Venice Ave., Cincinnati, OH 45140, (800) 669-0842 or (513) 677-0842.

Circle 1010 on Inquiry Card.

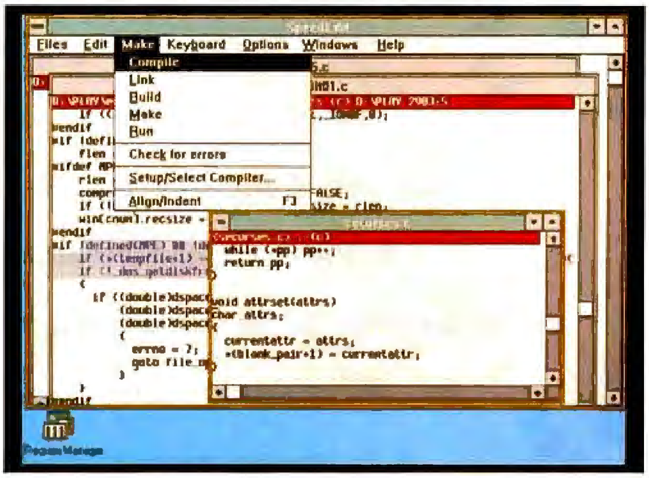
NEWS

SpeedEdit for Motif and Windows 3.0

The full-screen SpeedEdit text editor and program development system runs as a native application under the X Window System/Motif for HP-UX and SCO Unix, as well as Windows 3.0. Bradford Business says the system, which is also available for nonwindowed DOS, OS/2, Unix, SunOS, and Hewlett-Packard's MPE and MPE-XL operating systems, lets you easily move among dissimilar environments. The SpeedEdit system for Motif and Windows offers scroll bars, pull-down menus, list boxes, and multiple windows while letting you compile and test applications from inside the editor.

SpeedEdit is language sensitive. If you're writing in C, C++, Pascal, COBOL, FORTRAN, assembly, or Hewlett-Packard's System Programming Language, SpeedEdit performs its text alignment and indentation properly, the company says. SpeedEdit can search and modify groups of files as if they were one file, including search and replace using regular expressions, according to Bradford Business.

Except for the Windows and Motif versions, SpeedEdit runs without a windowing system. However, SpeedEdit can be command driven, menu driven, function key driven, or control key driven. You can redefine control sequences, function keys, commands, and menus. You can also add and enhance menus. Each version, though based primarily on the same source code, is a separate product.



You can compile and test your applications from within SpeedEdit.

Price: For PC-based systems, $295; for single-user Unix workstations, $395.
Contact: Bradford Business Systems, Inc., 23151 Verdugo Dr., Suite 114, Laguna Hills, CA 92653, (714) 859-4428; fax (714) 859-4508.
Circle 1013 on Inquiry Card.

A Launchpad for Windows

Cognetic's CodePad editor for Windows 3.0 lets you view and edit multiple source windows with files in overlapping windows. CodePad lets you choose from five fonts to get the one best suited for your eyes and monitor. If you have the Windows Software Development Kit, you can mark Windows system calls in source code, press a hot key, and get SDK hypertext help for that topic.
Price: $99.
Contact: Cognetic Systems, Inc., 12534 Pinecrest Rd., Herndon, VA 22071, (703) 476-7154.
Circle 1015 on Inquiry Card.

Visual Programming Plus Database

The VZ Programmer applications development tool incorporates a GUI construction kit, a persistent object management system, and C-/C++-based software component libraries.

Version 2.0 of VZ Programmer for Windows provides cross-platform compatibility with VZ Programmer 2.0 for OS/2 Presentation Manager. It includes a graphical object editor and integrated debugging.
Price: Windows version, $595; OS/2 version, $1295.
Contact: VZ Corp., 57 West South Temple St., Salt Lake City, UT 84101, (801) 595-1352; fax (801) 328-4404.
Circle 1016 on Inquiry Card.

Text Editing for PM, Windows, and X Window

Emerging Technology, developer of the EDIX full-screen, character-based editor for DOS, Unix, and VMS, now offers multiwindowing editors for Windows, OS/2 Presentation Manager (PM), and the X Window System running Motif on Sun Sparcstations. The GUI version, called EDIX/gs, supports subprocess execution, multiple editing windows and buffers, regular expression search and replace, keystroke and command record/playback, and customization via the macro processor.

Through subprocess execution, you can write a program in one buffer and capture compiler errors in another. You can edit in up to four windows at once, including the same file simultaneously in four windows. You can edit up to 12 files at once in EDIX/gs buffers, the company says. A proprietary paged memory that sits on top of Windows' and OS/2's memory managers not only lets you edit large files but speeds up performance by up to 10 times in Windows and by 15 percent in OS/2, the company says.

The regular expression search-and-replace facility lets you search for wildcard characters, sets and ranges of characters, anchored strings, and paired patterns such as { and }. The undo/redo commands work on a number of commands.
Price: Windows and PM version, $245; Unix version, price undetermined [expected to ship in September].
Contact: Emerging Technology Consultants, Inc., 3405 Penrose Place, Boulder, CO 80301, (303) 447-9495; fax (303) 447-9241.
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NEWS

WHAT'S NEW • PROGRAMMING TOOLS

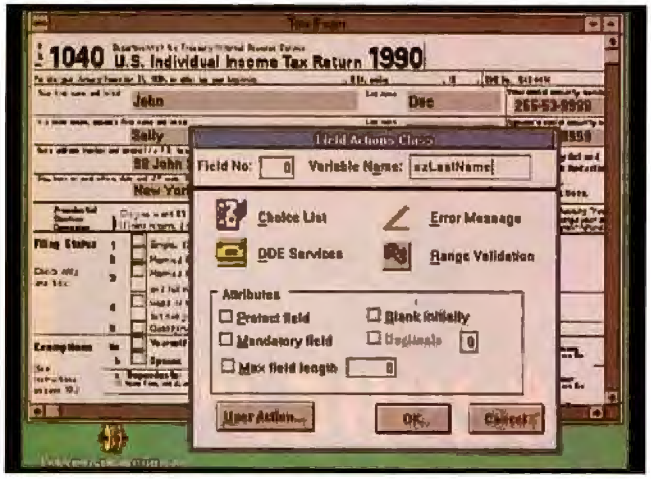
Prototyping and Development for Windows

ProtoView Development is now shipping version 3.2 of its ProtoView Screen Management Facility and version 1.10 of its ProtoGen Application Generator for prototyping and development of C applications in Windows 3.0. As with previous versions, the new version of ProtoView includes a WYSIWYG screen painter, application screen-flow animation and code generation, a dynamic link library of 175 high-level screen management functions, and a second DLL of data-entry field control objects with source code.

The new version includes enhanced support for Dynamic Data Exchange conversations between ProtoView dialogues and other Windows applications. Customizable toolboxes and palettes let you design sophisticated Windows dialogues and data-entry screens, the company says. Support for Windows 3.0's Multiple Document Interface allows you to display multiple copies of a screen under a common menu.

The screen painter's customizable workbench lets you choose which tools are available at any given time. By loading a new workbench, you can change the set of control objects and tools. You can also establish a set of tools for a given project and distribute the workbench to the individuals working on the project.

Other new features include multiple range checking for data-entry fields, support for bit maps and icons within push buttons, currency control for 26 currencies, and date control for six international formats with full validation.



The ProtoView Screen Management Facility lets you place data-entry fields over a screen image of a familiar form and apply a variety of actions to the individual fields.

Code generated by ProtoView and ProtoGen is also C++ compatible.
Price: ProtoView, $695; ProtoGen, $199; both, $894.
Contact: ProtoView Development Co., 353 Georges Rd., Dayton, NJ 08810, (908) 329-8588; fax (908) 329-8624.
Circle 1017 on Inquiry Card.

Fast Floating-Point C Functions

A library of C functions called Fast Floating Point, for scientific/engineering or windows graphics applications, has library operations that in some cases can rival a math coprocessor in speed, Triakis claims. Based on the sign-logarithmic number system, the library includes trigonometric, logarithmic, integer conversion, and exponential functions; square root operations; and a tool for tabulating virtually any f(x) to single precision, the company says. The integer conversion functions are provided for fast graphical display.

The package includes two libraries: one for use on any 80x86 processor, and the other for use on the 386 and 486. The functions are compatible with most versions of Microsoft C and Borland C. The company doesn't charge a royalty for the functions.
Price: $59.
Contact: Triakis, 1011 Duchess Rd., Bothell, WA 98012, (206) 486-8282; fax (206) 883-2740.
Circle 1019 on Inquiry Card.

GFA-BASIC for DOS and Windows

GFA says its implementation of GFA-BASIC for Windows 3.0 lets you use the functions of the Microsoft Software Development Kit, obviating the need to write lines upon lines of C code. The GFA-BASIC interpreter, editor, and protected-mode runner for both DOS and Windows are available now. The compiler will ship later this fall, the company says.

The DOS and Windows versions are the first of four planned platforms. Versions for OS/2 and Unix will be available later this year, the company promises.

When a GFA-BASIC command creates a graphical window or other action, it will interface with DOS Systems Application Architecture (SAA), Windows, OS/2 Presentation Manager, or X Window System/Motif automatically, GFA says. This implementation provides portability across all platforms.

The Windows version has more than 500 independent commands, plus 400 commands and functions for Windows. The commands let you use the Multiple Document Interface, load bit-map files, use the Clipboard and Dynamic Data Exchange, and run dynamic link libraries. The Windows version also supports EMS and runs in real or protected mode.

The DOS version has over 500 independent commands and more than 70 commands and functions for graphical and operating-system operations that are SAA-compatible. The graphics commands let you include menu bars, windows, alert boxes, and pop-up menus; the commands replace pages of complex coding that would normally be required, the company claims.
Price: For Windows: 286 version, $449; 386 version, $495; the compiler will be sent free of charge to registered users when available. For DOS: 8088/286 version, $249; 386 version, $295.
Contact: GFA Software Technologies, Inc., 27 Congress St., Salem, MA 01970, (508) 744-0201; fax (508) 744-8041.
Circle 1018 on Inquiry Card.

WordStar's $700 Laptop Bundle for $295

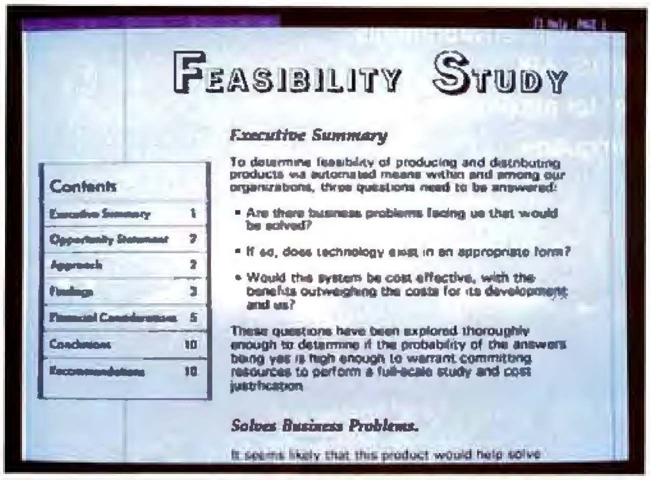
WordStar's new Laptop Collection includes the WordStar Laptop Edition, Traveling Software's LapLink Special Edition, and Campbell Services' OnTime scheduling software. The WordStar Laptop Edition offers page preview, style sheets, a built-in spelling checker and thesaurus, pull-down menus, TelMerge communications software, a telephone and address list manager, and other features.

The program works on any laptop with 640K bytes of RAM, a CGA or better display, and two floppy disk drives or one floppy and one hard disk drive.

Price: $295; $89.95 for registered users of WordStar.

Contact: WordStar International, Inc., 201 Alameda del Prado, Novato, CA 94949, (415) 382-8000; fax (415) 883-1617.

Circle 1021 on Inquiry Card.



The WordStar Laptop Collection supports footnotes, endnotes, indexing, and a table of contents.

Two WordPerfect Utilities

The Top Banana offers 89 general business and office forms for WordPerfect 5.0 and 5.1 in its package called The Forms. Each Forms package is personalized, with your company name, address, and telephone number, when you install it. You can add a black-and-white logo, scanned from your letterhead, for an additional $29.

Price: $89.

Contact: The Top Banana, Inc., 1501 East Chapman, Suite 261, Fullerton, CA 92631, (714) 525-0454.

Circle 1024 on Inquiry Card.

Proportionally spaced fonts take up space on your screen. If you're working with large type in WordPerfect, this means you often need to scroll left and write to read a sentence in a paragraph. A new version of ScreenExtender, the utility for WordPerfect 5.0 and 5.1 that eliminates the need to scroll as you edit a proportionally spaced document, is faster and more readable, and requires less memory. Stairway Software says it reduced ScreenExtender's memory requirement from about 84K bytes to about 40K bytes, depending on your video display.

You can choose from up to 25 screen sizes, display up to 128 characters per line, and change screen sizes whenever you want. ScreenExtender 2.0 displays boldface, underlining, italics, small caps, extra-large type, and other type modes as you edit.

Price: $99.95.

Contact: Stairway Software, Inc., 700 Harris St., Suite 204, Charlottesville, VA 22901, (800) 782-4792 or (804) 977-7770.

Circle 1025 on Inquiry Card.

It's True: Verity Does Windows

Verity, publisher of the Topic intelligent document-retrieval software for networked computing environments, now supports Windows 3.0 with its front-end client support for Topic databases on DOS, OS/2, Unix, and VMS.

Verity says its Topic and Topic Real-Time programs are based on concept retrieval, where you build a knowledge base of retrievable objects called Topics. Topics intelligently searches and retrieves documents and files that contain relevant information on a particular subject. Topic supports direct manipulation of queries, results, and documents within Windows.

Price: $795 per Windows client; other clients: Mac or DOS, $795; OS/2, $1000; Unix, $1500; Topic servers: $15,600 to $150,000, depending on the platform.

Contact: Verity, Inc., 1550 Plymouth, Mountain View, CA 94043, (415) 960-7600; fax (415) 960-7698.

Circle 1023 on Inquiry Card.

New Windows Word Processor Is Just Write

Symantec's new Windows word processor is designed primarily for executives who need an easy way to create simple memos or sophisticated documents.

JustWrite 1.0 has many features found in word processors that retail for nearly $500, such as multiple columns, graphics, text, table frames, support for Dynamic Data Exchange, and table-of-contents indexing. But one of JustWrite's biggest selling points is its ability to fit into the mix of other word processors and applications in a corporate environment.

JustWrite will automatically detect almost any word processing file format on the market and, likewise, save the document back to its format automatically. This simple import/export feature is designed to help someone who doesn't do a lot of work on a PC.

The program's document templates and style libraries are designed to let you quickly create a professional-looking document. Other features include direct access, query, and sort of Q&A and dBase files; networkable file locking; and a messaging system for sharing documents on Novell, LAN Manager, or 3Com networks.

Price: $199.

Contact: Symantec Corp., 10201 Torre Ave, Cupertino, CA 95014, (408) 253-9600; fax (408) 255-0981.

Circle 1022 on Inquiry Card.

UP TO NOW OBJECTS WERE MOSTLY TALK. NOW THEY'RE HANDS-ON.

Everybody has been talking about objects. But until now, you had to be a C++ programmer with a big budget to get your hands on them.

Today, information *is* power. And the personal computer is enabling a transition of that power from computer professionals to "information professionals" whose primary expertise is in engineering, management, finance and production.

Until now, the software tools available to information professionals have been based on the notion of rows and columns, rather than on the more natural and powerful idea of objects. This meant these new professionals were left with useful information in a form they couldn't use.

Introducing Mind's Eye.
A New Tool For A New Age.

Mind's Eye, the first object-based information management software system allows you to integrate the separate functions of business management principles, financial modeling, graphics and engineering. And Mind's Eye requires no sophistication in a complex computer language.

Instead of relying solely on cumbersome numerical data bases, Mind's Eye lets you translate that jumble of information into recognizable objects which link all the components graphically. So you can see issues and solutions in a comprehensive and coherent overview. Just the way your mind does.

Look at what Peter Coffee said in the March 4th issue of PC Week:

"Mind's Eye is a superior decision-support tool for vertical markets and in-house applications. Users will reap rich returns from their graphics hardware investment. The Mind's Eye screen provides a wealth of interactive feedback, far more than typical mouse/menu designs."

What You Perceive You Can Create.

With the simple point and click of a mouse, Mind's Eye allows you to create a system of objects quickly and easily. Then with its simple, yet powerfully articulate structure, you can describe their properties and relationships.

And the objects you create can be visually amplified with drawings. Pictures. Or both.

You can also include free-form verbal descriptions of each object. And assemble these complex data structures into an application for those who maintain the database and derive information and analyses from it.

Mind's Eye allows you to create unlimited "what if" management models in business, manufacturing, engineering, production, quality management and sales beforehand. So you can test your vision. Change variables and analyze those changes. And control down the road what you have in mind now.

But the best thing about Mind's Eye is its simplicity. In an age of increasing complexity, Mind's Eye lets you get back to basics. With it's ability to seamlessly link large amounts of complex data into clear, easily accessed graphic objects, pulldown menus and easy-to-read project trees, you'll be able to use your computer the way you should have all along.

Who We Are Depends On Who You Are.

Because Mind's Eye is an extension of the way you personally retrieve, use and manage data, it can be quickly configured to your individual thought processes and tasks, informational needs, management style and corporate or business requirements. Whether you're a design engineer or system engineer or involved in financial modeling, project management, production, process control, quality control or LAN design, there are no limits to Mind's Eye's virtuosity. Or yours.

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Mind's Eye can now run your PC the way you want it to. At a price that's readily affordable – only $695.00.

We're so confident that Mind's Eye is everything we say it is, we're offering you the complete Mind's Eye software package – not a demo disk – for a 30 DAY FREE TRIAL.

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Give us your VISA or MasterCard number and we'll send out Mind's Eye right away. Keep it and we'll bill your charge card. Return it within 30 days, and you're free and clear.

Mind's Eye is IBM AT/PS-2 compatible (80286/80386/80486). 640 K RAM minimum required, 1 MB or more recommended. EGA/VGA/8514A monitor. PCDOS/MSDOS 3.X or higher required.

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Circle 613 on Inquiry Card (RESELLERS: 614).

Graphing and Analysis Added to GP Manager

Great Plains Software says version 6.0 of its Accounting Series for PCs has a new system manager that incorporates the more-than-70 graphical analysis reports of the Executive Advisor. Previously, the Advisor had only been available as a separate module.

The company says the new system manager, with added graphical reporting, analysis, and a macro keystroke recorder, functions as the control center for an entire accounting system. When activated, the keystroke system lets you record transactions and automate repetitive entries and tasks.

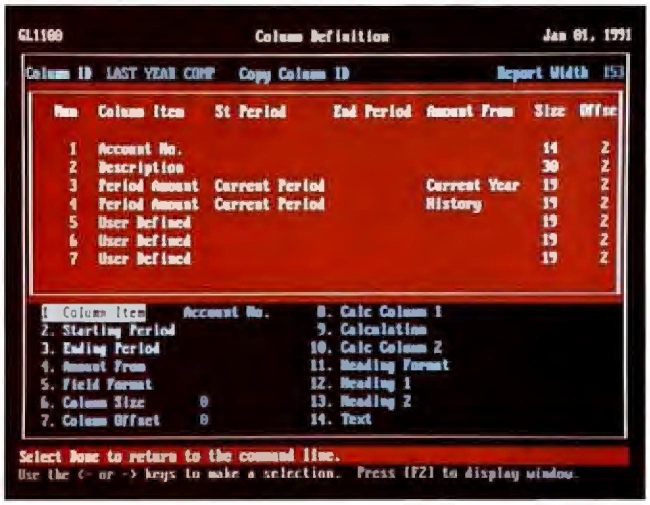
You can now customize Great Plains menus to list only important tasks or launch other applications, third-party links, or keystroke routines. Version 6.0 also adds unlimited budgeting and history, letting you save multiple budgets for current and prior years.

An automatic transaction allocation feature lets you post a single sales account and allocate the information automatically to all departments. This feature allows for unlimited allocation amounts, up to 100 accounts per allocation, and an amount breakdown by percentage, the company says.

Price: System Manager module: for single user, $295; for multiuser system with up to four workstations, $1195; most other modules, $795 each.

Contact: Great Plains Software, 1701 Southwest 38th St., Fargo, ND 58103, (800) 456-0025 or (701) 281-0550; fax (701) 282-4826.

Circle 1026 on Inquiry Card.



The Great Plains General Ledger with Financial Report Generator module lets you define financial statements of up to 20 columns.

Entry-Level Windows Accounting

Progressive Solutions says its four-module, entry-level Windows accounting package is powerful enough to accommodate any size general ledger, yet it offers an easy way to do double-entry accounting. The four modules include accounts payable, accounts receivable, general ledger, and a reporting module.

The release will also include an accounting module for novices. This module will have fill-in-the-blank journal entries and documentation covering basic accounting principles.

A collection screen in Progressive Accounting will display current aging data and let you view collection information by customer. A dial-it function will let you dial a customer's phone number for a selected invoice.

Price: $129.

Contact: Progressive Solutions, 8640 M Guilford Rd., Suite 228, Columbia, MD 21046, (301) 865-3201.

Circle 1028 on Inquiry Card.

Nonaccountants Take Care of Business

A new five-module double-entry accounting package for nonaccountants includes general ledger, accounts reconciliation, financial utilities, accounts receivable, and accounts payable for under $200.

Called Takin' Care of Business, the program lets you keep multiple years of information on-line for comparison purposes, and you can reprint reports at any time. You can also correct or delete mistakes without entering reversed transactions.

Takin' Care of Business was available previously in stand-alone modules.

Price: $149.95.

Contact: Hooper International, Inc., P.O. Box 50200, Colorado Springs, CO 80949, (719) 528-8990; fax (719) 528-8997.

Circle 1027 on Inquiry Card.

Value Pack for Cash-Based Businesses

Great American now offers a Business Value Pack for cash-based small businesses. The Pack includes the One-Write Plus Money Matters program for small businesses plus a payroll module. With the Pack, you can produce printed payroll checks, W-2 forms, and tax reports. You can also compute gross wages, federal and state taxes, and FICA deductions. If you buy the pack, the company will send you a $20 rebate.

Along with the Value Pack, Great American says that a new version of @Accounting, which provides a seamless interface between its One-Write Plus Accounting System and Lotus 1-2-3, now supports Quattro, Quattro Pro, SuperCalc 5, and 1-2-3 releases 2.01, 3.0, and 3.1. The program enables you to seamlessly export data from your accounting program into a spreadsheet for what-if analysis, graphing, and other manipulations. Previously, @Accounting was exclusively compatible with 1-2-3 release 2.2.

Price: $159.90.

Contact: Great American Software, Inc., 615 Amherst St., Nashua, NH 03063, (603) 889-5400; fax (603) 881-9337.

Circle 1029 on Inquiry Card.

Print or Fax, It Makes No Difference

RightFax, a multichannel, autorouting fax server for networks, lets you fax the output of any software application as easily as you can print it. When you send output to a predefined network printer, RightFax prompts you for the information required to send the fax.

Once the fax is on its way, RightFax will handle the chores of adding cover pages, letterhead, and custom graphics, and redialing busy phone numbers. You can place signatures anywhere on the fax. RightFax verifies that the fax was sent or alerts you to possible transmission problems, Cracchiolo & Feder reports.

RightFax lets you fax from within your application and can send and receive faxes on up to eight phone lines simultaneously. When sending faxes, output can appear as either Epson FX-80 or Hewlett-Packard Printer Command Language printer output.

The program's Structured Query Language reporting features let you create detailed reports for usage tracking and client billing.

RightFax works on DOS- and OS/2-based networks, including LAN Manager 2.0, 3Com 3+Open, LAN Server, and Novell NetWare. It requires a dedicated PC (a 286 or higher) with a LAN adapter board and one to four Brooktrout TR112-LL, TR112-LD, or TR112-DD fax boards. RightFax works with the HP LaserJet, DeskJet, or compatible printers for incoming faxes.

Price: Two-channel software-only configuration, $1495; each additional two-channel upgrade, $495.

Contact: Cracchiolo & Feder, Inc., 4400 East Broadway, Suite 600, Tucson, AZ 85711, (602) 327-1357; fax (602) 327-7456.

Circle 1030 on Inquiry Card.

Laptop Fax on the Go

GoFax provides a convenient way to send faxes directly from any laptop or notebook personal computer, without requiring a fax board or other external peripherals.

As long as you have a Hayes-compatible modem, you can tag or capture any word processing, spreadsheet, or graphics file for faxing.

When you activate the program, it requires 48K bytes of memory. To transmit the fax, you select a name from the speed-dial log, and away it goes. Once you send the file, it goes to an AT&T service bureau, which reroutes it to the proper destination. To send the fax, you dial an 800 number, so you don't incur phone charges.

Maximum cost per fax is $3 for the first page and $2.50 for each subsequent page.

Price: $69.95.

Contact: Ibis Software, Inc., 90 New Montgomery, Suite 820, San Francisco, CA 94105, (415) 546-1917; fax (415) 543-0346.

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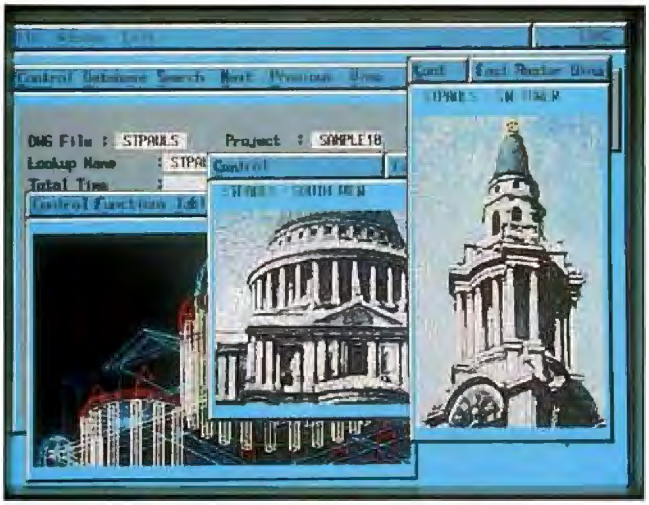
For exhibit information: (617) 449-6600, ext. 4023.

Manage AutoCAD Drawings

Personal EDMS Plus, a drawing and data management system for AutoCAD, organizes, manages, and tracks drawing files with a log of drawing changes and revision notes. You can attach important design information, descriptions, raster images, and photos to related AutoCAD drawings.

The database's GUI displays and manages AutoCAD drawing files and a variety of raster images. You can link building or site photographs and images of existing blueprints to a related drawing file.

Personal EDMS Plus creates and displays a raster image of each drawing file as part of every drawing record for fast image viewing, ACS Telecom says.



Personal EDMS Plus can display captured photos and video images, such as the photo of Saint Paul's cathedral at right.

Price: $595 with plotter spooling; $495 without.
Contact: ACS Telecom, 25825 Eshelman Ave., Lomita, CA 90717, (213) 325-3055; fax (213) 325-3059.
Circle 1032 on Inquiry Card.

Convert and View AutoCAD Files

AutoSight's Access 3.0 lets you view, convert, and analyze changes in AutoCAD .DWG, .HPGL, .DXF, and .PCX formats. The program enables you to scale images to fit a page. The network version supports password .DWG file locking. The compare/analysis capability lets you quickly check for changes in your CAD drawings, according to AutoSight.
Price: $495; 10-user network version, $1395.
Contact: AutoSight, Inc., P.O. Box 362086, Melbourne, FL 32936, (407) 242-5885; fax (407) 255-1052.
Circle 1034 on Inquiry Card.

JERRY POURNELLE

DREDGING THROUGH THE CHAOS

Jerry pulls new CD-ROMs, database programs, and utilities out of the Chaos Manor pileup

I don't quite know how it happened, but the chaos is getting worse. The Great Hall is almost volumetrically filled with software and hardware, test stands, typing tables, and stuff stacked on the floor. Every flat surface—the desk, tables, tops of monitors, chairs, the steps of the ladders needed to reach the upper bookcases, even the couch—is covered with disorderly piles of stuff. It used to be in some kind of order, but no longer. There's just too much of it.

Now I understand, plenty of you wish you had the problem of too many machines and too much software, especially since I get paid to write about it, so I don't expect much sympathy; but it really is a problem, and lately it has gotten completely out of hand. Today, I could not find—and still haven't found—a software package I had selected to write about. I know it's within 15 feet of where I sit, but for the life of me I can't find it, which means it will have to wait until next month, and by then there will be so much more stuff here that I may never find it. Alas.

Worse: I can't solve this by throwing away everything not worth writing about. I've already *done* that. Every item here has got past my preliminary cut, in which I eliminate things that are too specialized, are too expensive, have no distinguishing characteristics, or look boring. Much of the stuff here really ought to get into a column, mine or another, but I haven't either the room or the time to do all of it.

All of which means that once again it's short-shrift time: a myriad of short reviews. Alas, some items can't be dealt with that way. For some of this stuff, in Damon Runyon's words, "A story goes with it."

I'll do what I can. One thing stands out: if the 1991 recession affects the small computer world, you'd never guess it from looking around Chaos Manor.

It's Three-Sixty

In April, I mentioned Harpoon, the naval war game/simulation based on the Larry Bond game that Tom Clancy used in writing *The Hunt for Red October*. Unfortunately, I listed the wrong publisher for it. It comes from Three-Sixty. The mistake is worth rectifying since Harpoon is a very good naval-warfare simulator, certainly the best I have seen. Now that the Navy has decided that they don't want my 6-foot 5-inch son to go into aviation—it seems there's a good chance the ejection mechanism would take his knees off—and are sending him to surface warfare school, I have even more interest in Harpoon.

When I finally got past Three-Sixty's voice-mail system (the only human I've managed to reach all day; I sometimes think every human being left in the computer world has been replaced by a voice-mail simulacrum), I found that they're going to do a simulation of the B-52H, which is interesting for me: bringing the tail-gunner station into the main cabin from the aft end of the aircraft was the first professional job I had in the aerospace business. The engineers did the work; my job was playing around with the human interface. I'm looking forward to what Three-Sixty will do with this. If it's like Harpoon, it should be great.

American Heritage vs. OED

In the above I wanted to use the word *simulacrum*, but I wasn't sure how to spell it. Alas, neither is the spelling dictionary in Q&A Write, Word Finder, or the hard disk version of *The American Heritage Dictionary*, which I keep on-line and can open in a Desqview window.

I do have it spelled properly: I was able to look it up in the CD-ROM version of the *Oxford English Dictionary*. To do that, I had to get the OED disc down, insert it into the carrier, insert that into the Hitachi CD-ROM reader, open a Desqview CD-ROM window, access the OED software, and finally look up the word. That all took longer than simply walking over to the lecture stand, where I keep a desk copy of *The American Heritage Dictionary*, and look it up there. It didn't take a *lot* longer, however, which actually surprised me.

The moral of the story is that I sure wish I had a good CD-ROM or on-line *complete* version of the *The American Heritage Dictionary*. This isn't the first time I've wanted a word that's not in the electronic versions.

continued

ILLUSTRATION: STEVE TURK © 1991

Mind's Eye

I first saw an early version of this program at Comdex last November. I was impressed at the time. Now I have the shipping copy running here, and I'm even more impressed. Mind's Eye is a non-Windows multilink database. That doesn't tell you much, so I'll start over.

Mind's Eye was developed by consultants to the Naval Air Station at Patuxent River. They needed management tools for the commanding admiral, so they developed the following:

Consider a map of the base. It shows every building. Now imagine that you can put that map on-screen. Each building can have a number of attributes: its name or number; when it was built; what it's for; location of fire hydrants and fuse boxes; a scanned image of the building's photograph, displayable on-screen; when it was painted, and what that cost; a repair record; and so forth—whatever you think of.

Those attributes can be entered by hand, or they can be imported from other databases, including Paradox, dBase II, and some popular spreadsheets. Once the data is in Mind's Eye, the database can be searched in the usual manner: all buildings concerned with research and painted after 1983, or whatever. The output can be a traditional list, but it can also be the original base map with the buildings on the hit list highlighted. Click on the building and get the attributes.

There's also a spreadsheet capability built into the program. You can model an industrial process with this. The company did that for one of their demonstrations, modeling a raw materials processing line. Not only can the program show such things as bottlenecks—if you want to increase production, what will be the limiting system—but it can then show you a picture of that machine or installation.

You could use this program to keep employee records, complete with photographs, or fingerprints for that matter.

The neat part about Mind's Eye is that it doesn't take a programmer to get it working. You might need some assistance setting up the scanner and getting scanned images into the machine, but after that, making an object-oriented database is pretty straightforward. I sure wish I had some way to get pictures of all my books and their locations in this. . . .

Mind's Eye doesn't do Windows, but it doesn't have to. It runs fine with Desqview (if you have big Desqview windows). If you need a program like this, you should definitely look this over. Recommended.

Looks Great, Less Filling

Traveling Software has improved LapLink III once again: it comes with new cables that are far lighter and considerably less bulky. I'm still carrying the Zenith Z-386 SX most places, and it's big enough without fat cables. The new "designer cables" come in neat colors (as if you care), but mostly they're thin and light. There's even a 25-foot serial cable that's smaller than the older 6-foot cables were. Otherwise, everything works just about the way you'd expect it to: I've yet to need the LapLink manuals for using LapLink itself.

LapLink III also comes with Traveling Software's Device Driver, which lets two computers share resources, such as hard disk drives or printers; you will need the manual to use that. As a temporary network, though, the LapLink Device Driver works quite well. It's not quite as painless as LapLink—you have to put something into CONFIG.SYS—but it's not needlessly complicated.

We use LapLink III all the time here. I've got a nine-pin cable from the COM1 serial port of my Cheetah 386. It generally connects to the USRobotics Courier HST external modem; I can simply unplug the modem and plug in the LapLink cable to charge up my laptop or squirt stuff over to another machine. When I get a new machine, about the first thing I do is install LapLink so I can transfer my favorite utilities to it.

There's also a three-wire cable set; that is, DeskLink with its cables attaches to the serial port of your machine and has a telephone jack for allowing the cable sets to be connected by ordinary telephone extension wire. This lets us connect downstairs and upstairs machines 50 and 100 feet away. Clearly, all file transfers on a long, thin wire like that are serial.

There aren't many people who don't need LapLink and DeskLink. There's a LapLink Mac version, too.

Corel Driver

I said last time I'd been told that the Corel driver can run both the Pioneer CD-ROM Minichanger and the Pioneer optical read/write disk drive off the same Corel Optical Disk Interface Board. It's all true, and it costs no speed and almost no memory. Also, last time, we had some kind of difficulties with the automatic setup. I don't know what those were. Adding the Minichanger to the optical read/write disk drive running off the Arche Legacy 486/33 turned out to be no problem at all: run the installation program and go to the CD-ROM drive.

continued

There are a few notes. First, this is a SCSI daisy chain, which means that each device has to have a unique SCSI ID. The Pioneer drives come set as ID=0. Little DIP switches on the back change that; on Corel's advice, I set the Minichanger CD-ROM DIP switches 2 and 3 to ON, making this ID=1.

Also, the SCSI daisy chain requires that the first and last devices (physical first and last, not logical) be *terminated*, meaning that they have some small terminal resistors installed. The middle devices must *not* be terminated. The SCSI card is the first SCSI device (and thus must be terminated). The Pioneer optical read/write disk drive has a small plate on the back; remove it, and the terminator resistors are exposed. That makes it easier to remove its terminal resistors than it would be to get at the ones in the CD-ROM drive, so the optical read/write disk drive became the middle device.

A caution here: you *must* use the Corel driver cable to connect to the Corel SCSI card. The cable furnished with the Pioneer CD-ROM drive comes from an outfit called Future Domain, and using that cable to connect to a Corel card will blow the drive. The Corel cable is identical to the one used by Apple, and you can use Apple Mac stuff to connect up to Corel; just don't use the Future Domain cable that comes with the Minichanger.

Otherwise, it's straightforward. The result is nifty: six CD-ROMs and the optical read/write disk drive, which can function as either a WORM (write once, read many times) drive or a removable read/write drive, all running off one drive card, and all device drivers in high memory.

The Minichanger is slower than the latest Hitachi CD-ROM (single) drive, and by quite a lot; on the other hand, having six CD-ROMs on-line is quite a thing, and getting at any one of them is as fast as it is with the older Hitachi drive or the Denon drives. In the future, I'll install all this on a 386 server and access it with LANtastic; that will give me six CD-ROMs and the big Pioneer optical read/write disk drive.

All this works with QEMM-386 and Desqview, too.

I've been testing the Pioneer optical read/write disk drive all month, and so far I can't make it glitch. I still can't run Wing Commander, a disk-intensive program, off the optical disk, but the program is intact: if I copy it from the optical disk to the hard disk, the program runs fine. "Timing errors" is all I can get anyone to say.

But except for Wing Commander, all my other programs (e.g., word processors) run just fine off the optical read/write disk drive. I can live with that. I still want a WORM copy of anything that's really vital, but I'm more inclined to trust optical read/write than I was a month ago. More next month.

Mind you, the same Pioneer drive functions as both optical read/write and WORM (you put a different cartridge in, depending on which you want it to be); and it is *very* convenient having that enormous read/write drive available to hold dictionaries, CD-ROM-access software, and the hundreds of megabytes of stuff that seem to accumulate on all my disk drives.

This all works under DR DOS 5.0. It will also work with MS-DOS 3.3 and 5.0. I presume it would work with MS-DOS 4.0x, but I don't like DOS 4, so I didn't try that.

continued

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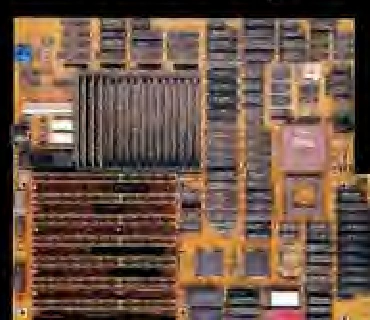

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Impressionism

Whatever else Quanta Press does, they sure work at publicizing their releases. First there arrived a really nice poster about French impressionism. Then came a T-shirt with a silk-screen copy of Van Gogh's *The Siesta*, signed "Vincent." Then some other stuff. Eventually there arrived a CD-ROM, Coate's Art Review, Volume One, Impressionism.

The contents of this thing are wonderful; everyone who has seen this likes the idea of having a library of CD-ROM paintings available. There's a history of impressionism, biographical materials, and a large number of VGA or Super VGA images of impressionist works. The retrieval software is TextWare, and it's right on the CD-ROM; no floppy disk is needed or supplied. There's also a very short tutorial printed in a booklet that comes with the CD-ROM. It's all you need to get up and running, and it took me no more than a few seconds to have Coate's Art Review (text and images from Alfred B. Coate, Ltd., of New York, Paris, London, and Milan) on-screen.

My first attempt to retrieve an image failed, but that was my fault: several batch files are on the CD-ROM, so that you can invoke the program as ATI, TSENG, VIDEO7, etc., if you have a Super VGA card from one of those manufacturers. The first batch file is 2DICE, for Paradise Super VGA, and I hadn't noticed that awful pun, so I invoked the program as 2DICE. The result, of course, was that the vanilla VGA card in the Arche Legacy 386/33 could make nothing of the video image when I tried to get one on-screen. Exiting the program and invoking it as VGA fixed that.

TextWare works, but it's *slow*, and some of it is counterintuitive. That is, if you know what you're looking for, TextWare will find it rather efficiently. Type in *Van Gogh*, and you will quickly have a list of some 30 items. Each item is called a *card*, and it contains about the amount of information you might put on a 5- by 8-inch index card; in addition, a card may have an image attached to it. The biography of Van Gogh has his picture available; press F8, and it will appear on-screen.

That's how I was able to find out the title to the picture on the T-shirt; searching for Van Gogh produced 28 cards. One was entitled *The Siesta*, which seemed to be an appropriate title for what I was wearing, and sure enough, that was it. I learned that the original was painted in oil on canvas in 1889/1890 and hangs in the Musée d'Orsay.

I also used it to search for Renoir, my favorite of that period. The biography tells me that, unlike most of the impressionists, Renoir was popular and successful in his lifetime: people *liked* what he painted. The CD-ROM has about 100 of his paintings on it, some I had never seen or heard of; and while the quality of the image on-screen isn't what you'd get in a good silk-screen reproduction, it's more than good enough to show you what the painting's about—enough that I'm going to find a good silk screen of a couple of them I didn't know about.

That's the good news.

The bad news is that TextWare will drive you insane if you want to browse. The booklet says that to browse, you type INDEX at the prompt. I don't advise that. The result is a wait of several minutes as the CD-ROM furiously flashes its busy light, and then a list appears that begins by telling me in how many cards the number 1 can be found, and proceeding

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TechFax offers relief for insomniacs.

Say you're pulling an all-nighter and need help. Dell has pioneered a service called TechFax. Anytime, 24 hours a day, you can pick up the phone and call the Dell technical library on our automated TechFax line. Detailed information on your Dell system will be faxed right back to you automatically.

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DELL COMPUTER CORPORATION

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on through numbers up to 1833 and 1879, and presumably beyond that; I gave up, because after several PageDown operations, the system pauses and the busy light flashes, and you've got another long wait.

I once complained about TextWare's index and got a letter from them saying that if I were to type in a letter, the software would take me to that. I felt quite sheepish. I shouldn't have: typing in a letter produces no result whatever.

The pamphlet also says you can exit the index and reenter with a command like "index a," and it will show you the words beginning with *a*. It will, too, provided that you're willing to wait 3 minutes while it builds up the index. Scroll down a few screens, and you can wait another minute while it accesses the disk again. Incredibly boring.

In other words, TextWare soon removes all temptations to simply browse through the disk.

There's another problem. If you press F4 to try to generate a report, you will lock up your system, because TextWare will try to write to the CD-ROM and can't do it. There's no recovery from it but to reset. There is a procedure for changing the filename. It's a bit counterintuitive: you type "report" instead of a name you want the system to search on. Apparently it traps some keywords.

The text and images on Coate's Art Review are really nice, and if you know what you're looking for—and to some extent you can find out by reading the on-disk history of impressionism—the retrieval software is adequate. I'd sure have liked it better if I could browse.

Trantor T338

Another way to connect a SCSI CD-ROM drive is with the Trantor T338: this is a device smaller than a hand-held calculator. It plugs into the printer port of your PC and has two outputs. One is the normal parallel port, to which you can connect your printer. The other is a SCSI port that will drive Pioneer, Denon, and other true SCSI systems, including the Pioneer Minichanger and optical read/write disk drive.

The result is that you could, if you liked, have your entire work environment with you on trips: take an optical device with you in your checked luggage, connect it to your laptop machine, and have CD-ROM, WORM, and enormous optical cartridges.

Theorist

Of course, every time I get unhappy with the Mac, something like Theorist comes along. This is a program that might be written for Windows or a special bit-map application system on PCompatibles, but so far that hasn't really been done. That is, you can get MathCAD and other such programs for the PC, but the fact is that the Mac environment really does lend itself to mathematical experiments and programs of this kind.

Theorist is one of those programs that I would have killed for when I was in high school or college. You put in equations pretty well as they look on paper; and whammo!, it solves them. It will also graph the results.

It does matrices. In the 1950s, we spent months writing a program to invert matrices so we could do a factor analysis. This has it all built in: matrices, integrals, summations, statistics....

On the Mac IIfx this runs like the wind. It's a bit slower on a Mac SE, but it's still faster and better than anything I had until very recently.

It's easy to install, easy to use. Theorist is the kind of thing that makes me glad that I do keep a Mac around. Recommended.

Dycam

The gadget of the month is Dycam, but it's a great deal more than a gadget. It's a camera—one you can carry around with you, about the size of the Pentax IQ camera I carry and considerably smaller than a Polaroid. You charge it—its batteries need recharging after you take about 75 pictures—and go shoot. The camera has a 70mm (mild telephoto) lens. It has a pretty small aperture, so you need fairly good light, but there is an automatic flash.

Pictures are stored in the camera's RAM. When you've shot 32 of them, go connect the camera to your Mac or PC serial port and download them. We've got this one connected to the Mac IIfx, and it really works about that simply. The images aren't wonderful, but they're all right. They're plenty good enough to put into a PageMaker file. Roberta intends to use this to get some pictures into the next edition of the LA Opera Association newsletter; she's now the editor. This thing should be a real boon for newsletter producers.

More on this next month, but I can certainly recommend that you give this a look; and if you see me at trade shows with an odd-looking camera, this is it. In the past I used the Polaroid to take snaps of stuff I wanted to remember for the column, but this looks to be just as good—and a very great deal cheaper than Polaroid film.

continued

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Nautilus

It had to happen: a magazine on CD-ROM. Nautilus is the first I've seen.

The one I have is for the Mac. The introductory disc has such things as pictures of the editorial staff, some digitized speech, games, and tips on using the Mac. There's said to be a PC version available later this year.

I do know that I've not regretted the time I have spent playing around with the Nautilus CD-ROMs. Alas, Nautilus is in one way like my favorite magazine, *The World and I*: everything I have seen so far is pretty good, but there's no way I will have time to read it all. On the other hand, to complain that you get more than your money's worth is a strange complaint indeed. Get the free introductory disc. You won't regret it.

Life and Death II: The Brain

If you have any interest at all in neurosurgery, get this. It will tell you more than any set of books you'll ever find. The Software Toolworks warns you about 10 times that this is a *game*, and that you must not take anything you read here as authoritative. But the fact is that they give you as much as I got in the medical school classes I took many long years ago. Sure, it's broad-based, and medical students would want a lot more depth; but frankly, I'd give a copy of this to any medical student on the theory that it couldn't possibly hurt.

This program gives you a sort of animated role-playing game in which you can pick a name—naturally, I picked Dr. Frank N. Stein—for your character, who is an intern in a modern hospital. There are classes on various neurological disorders and a neurology textbook, if you need it (you will). You then start getting patients and killing them off, because you are actually in on-the-job training here. My first patient had an allergy. I ordered a CAT scan, and the dye marker that was used killed her. I found myself in the CAT scan room watching the technicians sit around eating pizza and discussing the case.

Don't try anything you learn here at home, but if you're much interested in modern neurology, this is no bad introduction; and if you're not squeamish, it's a fairly interesting game to boot.

MultiScope

If you do programming and you don't know about MultiScope, find out. I confess I don't do as much programming as I used to; you could say "none" and you'd be close to right, alas. Still, I do try to keep my hand in, and I talk to programmers and watch some of what's going on.

I have no problem at all recommending MultiScope as the real programmer's debugger. This program will look at C, FORTRAN, Modula-2 (it came out of the Logitech Modula shop), assembly, Microsoft Pascal, and Microsoft BASIC. It provides run-time and postmortem debug sessions. It will also run remotely so that you can run your code from a distant machine, sort of like a bomb squad keeping a telephone link to a distant blockhouse. It has Windows and character interfaces.

Indeed, it's a bit of a dilemma: most of the programmers I know use this (generally, those who don't have some special reason having to do with programming environment). MultiScope had a few growing pains, but even in its earliest days it was pretty good; now, there's a bug-fix revision that's even better.

If you do serious programming, you want to look at this. Recommended.

continued

Crunch!

Nothing crunches numbers like the Advanced Math Co-Processors from Integrated Information Technology. They really speed up graphics, CAD/CAE, spreadsheets, and other calculation-intensive applications.

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INTEGRATED INFORMATION

Available at most local dealers.

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ITEMS DISCUSSED

Corel Optical Disk Interface Board $495
Corel Systems Corp.
Optical Products Division
1600 Carling Ave., Suite 190
Ottawa, Ontario,
Canada K1Z 8R7
(613) 728-8200
fax: (613) 761-9177
Circle 1154 on Inquiry Card.

DeskLink $169.95
LapLink Mac $149.95
LapLink III $149.95
Traveling Software, Inc.
18702 North Creek Pkwy.
Bothell, WA 98011
(800) 343-8088
(206) 483-8088
fax: (206) 487-1284
Circle 1155 on Inquiry Card.

Dycam $995
Dycam, Inc.
9588 Topanga Canyon Blvd.
Chatsworth, CA 91311
(818) 998-8008
fax: (818) 998-7951
Circle 1156 on Inquiry Card.

Harpoon $59.95
Three-Sixty
2105 South Bascom, Suite 380
Campbell, CA 95008
(408) 879-9144
Circle 1157 on Inquiry Card.

Impressionism CD-ROM $129
Quanta Press
2550 University Ave. W, Suite 245N
St. Paul, MN 55114
(612) 641-0714
fax: (612) 644-8811
Circle 1158 on Inquiry Card.

Life and Death II: The Brain $49.95
The Software Toolworks
60 Leveroni Court
Novato, CA 94949
(800) 234-3088
(415) 883-3000
fax: (415) 883-3303
Circle 1159 on Inquiry Card.

LIST75G.ARC
registration $25
registration and manual $30
Buerg Software
139 White Oak Cir.
Petaluma, CA 94952
(415) 991-0644
fax: (707) 778-8728 (for orders only)
Circle 1160 on Inquiry Card.

Mind's Eye $695
Mind's Eye, Inc.
18 Shangri La Dr.
Lexington Park, MD 20653
(800) 622-6746
(800) 522-2807 (technical support)
Circle 1161 on Inquiry Card.

MultiScope Debuggers
OS/2 .... $449
Windows $379
DOS $179
MultiScope, Inc.
1235 Pear Ave., Suite 111
Mountain View, CA 94043
(800) 999-8846
(415) 968-4892
fax: (415) 968-4622
Circle 1162 on Inquiry Card.

Nautilus
single disc $14.95
monthly subscription $9.95
Nautilus
7001 Discovery Blvd.
Dublin, OH 43017
(800) 365-1639 (subscriptions)
(614) 766-3150
Circle 1163 on Inquiry Card.

Theorist $399.95
Prescience Corp.
939 Howard St.
San Francisco, CA 94103
(415) 543-2252
Circle 1164 on Inquiry Card.

Trantor T338 .... $179
Trantor Systems, Ltd.
5415 Randall Place
Fremont, CA 94538
(415) 770-1400
fax: (415) 770-9910
Circle 1165 on Inquiry Card.

LIST

The shareware of the month is LIST, a file-viewing and browsing utility by Vernon Buerg. It's really nifty. LIST comes in several flavors, all in the same LIST75G.ARC file available by downloading from BIX or another BBS. You can also order directly from the author. LIST will handle *enormous* files. It searches for text strings. It filters for ASCII. It prints files. It marks and extracts.

Get this. You won't understand how you lived without it.

Winding Down

The book of the month is Jack Cohen's *The Privileged Ape, Cultural Capital in the Making of Man* (Parthenon Publishing, ISBN 0-940813-80-7). Jack is the physiology professor who helped Larry Niven and me create the alien in *Legacy of Heorot*; he is one of the most interesting people I've ever met. The book is dense, but if you have any interest in cultural evolution, you will love this.

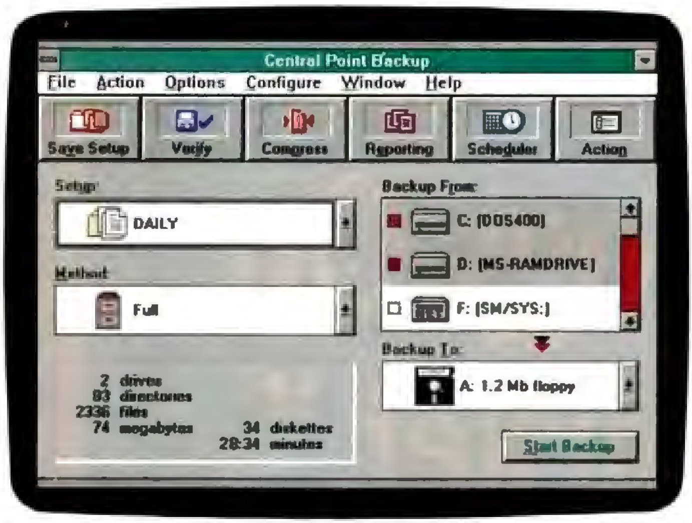
The computer book of the month is Patricia Hartman's *Paradox 3.5 for Nonprogrammers* (Windcrest/McGraw-Hill, ISBN 0-8306-3415-0). Even if you're a programmer, you may like it. I strongly recommend Q&A for people who need a very simple flat-file database, and Paradox for those who need a full relational database. This book makes it easier to go from one to the other—and also to tell which you need. Fair warning, it's a bit dry; on the other hand, there are lots of examples.

The game of the month is Secret Missions for Wing Commander. I sure wish Microprose would come out with some updates to Railroad Tycoon; as it is, I still find I play Wing Commander and Railroad Tycoon more than anything else. On the other hand, there are about 40 games out in the chaos stream, and those are the ones I thought I might like.

This made only a small dent in the stuff. Now I think I am going to fling a bunch of it to make room for more. I'm certainly not participating in the 1991 recession. ■

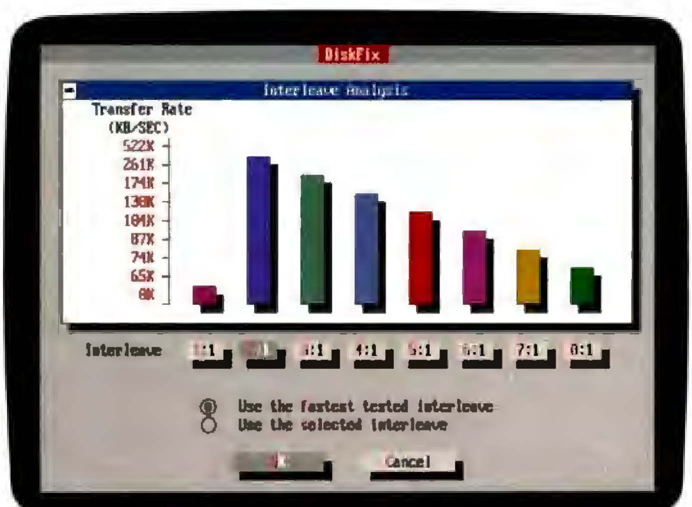
Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on BIX as "jerryp."

Introducing PC Tools™ 7.0.

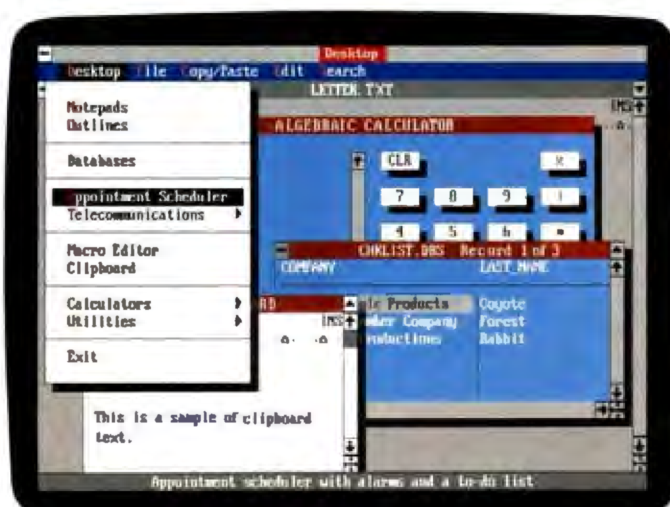


DOS and Windows Backup. Only PC Tools gives you award-winning backup for DOS and Windows in one box. Both programs use the same keystrokes and file formats so you can move to Windows without a hitch.

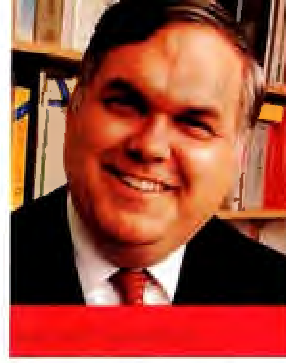
File Find with Viewers. Locate files across multiple disks by name, content or Novell attribute. View data from 37 popular programs. Launch, copy, rename, delete, and change attributes. Operates from the command line.



Disk Maintenance and Repair. To help avoid disk crashes and optimize data transfer, our DiskFix™ now does non-destructive, low-level reformatting. DiskFix solves dozens of other disk problems as well.



Desktop Manager. Now includes network-compatible work-group calendars, a dBASE-compatible database. Telecommunications with advanced MCI Mail support, notepads, calculators and more.



WAYNE RASH JR.

MANAGING THE LAN

People can do wonderful things working on a LAN, but someone has to be in charge of it: the network manager. The network manager can use a number of important tools to do his or her job. A few personal attributes, such as vast patience, are also necessary. The tools are usually referred to collectively as "network management tools." This is not an area for catchy names.

The range of products that purport to be for network management is very broad. In fact, it covers everything from simple utilities provided free with your network operating system to devices such as Network General's Sniffer that have prices extending well into five figures. The field also includes hardware devices that are built into everything from network interface cards to the little LEDs that appear on the hubs in some LANs.

What's Network Management?

Part of the reason for such a variety of network management devices is that there's no solid description of what constitutes network management. To make matters even less clear, it's a very complex process. For that reason, network managers are likely to buy anything that promises to make their job easier.

The reason for this consternation about the actual meaning of network management is twofold. First, it is indeed a complex job, and it's made more complex because networks are very much a custom product—no two networks are exactly alike. Second, vendors of network operating systems don't include very comprehensive management tools with their software, so the process is a lot harder than it ought to be.

When you look at the way some organizations run their networks, you can see why the description of network management gets even more confused. In some companies, the task of managing the LAN is divided between communications specialists and the help desk. This means that the help desk fields questions about the use of the LAN while the communications specialists do things like replace defunct hubs and search for broken cables. In other companies, these jobs are combined, while in some, the jobs are addressed in only the vaguest of manners.

Management Directions

In an effort to add a little structure to the wilderness of LAN management, I'm going to divide up the LAN management universe. The division will be a bit arbitrary, in that some products will fit into more than one place. If I'm going to make sense of the field, though, I'll just have to take that risk.

Keeping track of the users. Part of the LAN management process is monitoring the users—deciding what software they should have access to, what software they should not be able to use, and keeping track of who is doing what. Part of this is for security purposes, and part is to maintain copyright integrity. In addition, some software is metered, so that you can only have a certain number of users having access to the software at one time. Often, access is controlled through the use of menus that restrict a user's ability to reach the command level on a network disk.

Four key points to network management and why they are important

Helping the users. In most organizations, the network overwhelms users. They use it with great reluctance, and they frequently have problems. This part of network management includes the help desk and perhaps the information center, depending on how your company is organized. Its job is to help the people who use the LAN.

Keeping things running. A LAN is a complex collection of hardware, software, and wiring. Because of this complexity, things sometimes go wrong. Part of managing the network is finding out when something breaks, and fixing the problem before any data is lost. This requires constant monitoring and frequent diagnostic efforts.

Keeping things up-to-date. With everything else you have to do, there's always the daily, weekly, and monthly backups, new users to add, directories to create and kill, and other routine management tasks that only the manager can do.

Managing the Users

For many network managers, the task of network management involves keeping people from using any more

ILLUSTRATION: MARK STEARNEY © 1991

ITEMS DISCUSSED

Automate Anytime $149
Complementary Solutions, Inc.
4470 Chamblee-Dunwoody Rd.,
Suite 202
Atlanta, GA 30338
(404) 454-8033
Circle 1222 on Inquiry Card.

Close-Up LAN .... $395–$1995
Norton-Lambert Corp.
P.O. Box 4085
Santa Barbara, CA 93140
(805) 964-6767
Circle 1223 on Inquiry Card.

Direct Access Network $595
Fifth Generation Systems, Inc.
10049 North Reiger Rd.
Baton Rouge, LA 70809
(504) 291-7221
fax: (504) 295-3268
Circle 1224 on Inquiry Card.

NetRemote $395
LAN Support Center $395
(You need both to get the database)
Brightwork Development
766 Shrewsbury Ave.
Jerral Center W
Tinton Falls, NJ 07724
(800) 552-9876
(908) 530-0440
fax: (908) 530-0622
Circle 1225 on Inquiry Card.

Network Inspector ..... $199 per LAN
Tiara Computer Systems, Inc.
2700 Garcia Ave.
Mountain View, CA 94043
(415) 965-1700
Circle 1226 on Inquiry Card.

Network Management Console $2295
Advanced Network Management Console $5500
SynOptics Communications, Inc.
501 East Middlefield Rd.
Mountain View, CA 94043
(415) 960-1100
Circle 1227 on Inquiry Card.

Remotely Possible .... $299–$2299
Avalan Technology
747 Washington St.
Holliston, MA 01746
(508) 429-6482
Circle 1228 on Inquiry Card.

Sniffer $24,000
Network General Corp.
4200 Bohannon Dr.
Menlo Park, CA 94025
(415) 688-2700
Circle 1229 on Inquiry Card.

Wide-Area Network Management System
Model 1 (50 users) $5995
Model 2 (400 users) $11,995
Model 3 (over 400 users) $19,995
cost per node $219
XcelleNet, Inc.
1800 Century Blvd., Suite 700
Atlanta, GA 30345
(404) 804-8100
Circle 1230 on Inquiry Card.

of the network than they can avoid. This means that they restrict users to menu access only, and they restrict what can be seen on the menus. In some cases, there is good reason for restricting the users in such a way. Institutions that deal with sensitive information, such as medical facilities and financial services organizations, are good examples of groups in which access to much information is restricted by privacy rules.

Many network operating systems, including Novell NetWare and Microsoft LAN Manager, come with support for menus. If you want to, you can force users into the menu system when they log onto the network, and keep them there until they leave. The problem is that power users just hate menus and will do anything they can to get away from them, including avoiding the network.

Menu systems also have another reason for their existence: to keep track of who is using what software and how much they use it. In some organizations, this sort of monitoring can take on Orwellian overtones, but more frequently it's simply a way to make sure that the company employees are using only the number of copies of a software package as have been paid for.

A good example of such a package is Direct Access Network from Fifth Generation Systems. It lets your network manager develop custom menus, tracks computer and software usage, and lets the network management control access by controlling what you can do through the menu. The advantage of products such as Direct Access Network over the stuff that comes free with the network is that it is usually a lot easier to set up, and it keeps track of usage information better. There are other ways to accomplish this, even through office automation packages such as WordPerfect Office (see "The Growth of Groupware," November 1990 BYTE), which have menus for access and the ability to track usage.

Helping the Users

You must do more than control the users. More often, you'll need to help them. The problem is that the users who most need help are the same ones who are least able to describe the problem they are having with the network. If you plan to help them, you need to see what they are up to when they are having problems.

In a small organization, the network manager can simply stop whatever he or she is doing and visit the troubled user to see what's up. In a larger organization, this is difficult to do. Part of the problem is that the assistance is probably coming from a help desk rather than an individual who is free to move around the company. Also, in some companies, the distances can be fairly significant, making the physical presence of the manager difficult to arrange.

What's really needed when the manager (or the help desk) is working with the users is a way of looking over their shoulder without having to be there. That way, they can see what keys are pressed and see the responses on the screen. In many cases, this ability would solve a user's problems in seconds, increasing productivity for both the user and the manager. This ability also has great potential for informal training, because the manager could take over the user's computer briefly and demonstrate the proper way to accomplish a task.

This is one area in which the third-party marketplace has provided a wealth of products. It seems that nearly everyone who makes a network product also has a product that lets you look at another user's computer remotely. This is probably because they've had to develop such a product themselves in the course of their own testing, and they decided to sell it. Whatever the reason, though, there are plenty of packages available.

All the remote-access packages work in much the same way. The workstation to be monitored must be running some sort of remote-access software. This is a TSR package that provides access to the

network management staff. Normally, this program simply resides in memory and stays out of the way. When the user calls for help, though, the help desk personnel can attach their console to the user in such a way that they can see the user's screen and control his or her keyboard.

The way these things normally work is simple: The user calls up the help desk and explains the problem. Where possible, the help desk staff answers the question, but when the answer isn't obvious from the description, the help desk staff gives the address of the user's workstation to the program and attaches the console. At that point, they can see the user's screen and watch what's happening. Usually, just watching what the user is typing and seeing what error messages appear is enough to solve the problem.

One product, NetRemote from Brightwork Development, contains a database so that the network management staff can track trouble histories. Others have different features. Avalan Technology's Remotely Possible, for example, works with Microsoft Windows, even to the extent of supporting the use of the mouse remotely. Norton-Lambert's Close-Up LAN will echo host screen images to several computers at once, which can help in LAN-based training. All will let you monitor remote users in trouble.

Getting Physical

While handling users probably takes up more time than any other task for the network supervisor, tracking down problems with the network hardware can be much more vexing. Part of the problem is that LANs can have some bizarre failure modes, not all of which are obviously related to the item causing the failure. The other part of the problem is that the network hardware and operating software are closely related, and it's not always clear which one is causing the problems.

Fortunately, this is one area in which the manufacturers of network hardware can help a great deal. Because the network hardware itself is intimately involved in the running of the network, this is a logical place to locate network management hardware as well. SynOptics was one of the first companies to embed network management capabilities into their hardware, although other companies have followed their lead.

With SynOptics equipment, you can get a complete picture of your network's physical components. Cards in the SynOptics concentrators contain LEDs that allow visual monitoring, while remote monitoring of all equipment is supported by a comprehensive Windows-based package. SynOptics' Network Management Console is capable of diagnosing even catastrophic network failures. It's a superb solution for even the biggest LANs. When coupled with a comprehensive software management package, such as the XcelleNet Wide-Area Network Management System, it should provide a complete management solution.

If your LAN doesn't use SynOptics equipment, you can still keep an eye on its operations. Tiara sells Network Inspector—a monitoring and diagnostic package that supports some of the functions of the SynOptics package, though less completely and with less flexibility. Still, for smaller LANs, it should provide plenty of support.

Finally, there is the ultimate LAN management tool, the legendary Sniffer from Network General. This device, which is a specialized expansion card and special software installed in a Compaq portable, is legendary because it

costs more than some companies can afford, and because there's virtually nothing in physical-layer diagnostics that it can't do. If you manage a really big LAN, a Sniffer is mandatory.

Routine Management

The most difficult part of network management is the one usually thought of as the most simple. Keeping track of the routine actions, from setting up new users to making sure the backups happen, is the one area where there are few flashy tools, little drama, and, perhaps for that reason, little improvement.

If there is an area in which network management falls down, it is in the daily chore of making sure that all the fundamental activities take place. Fortunately, help is on the way, at least for a few of the critical functions.

Backing up the file server is an example of one task that frequently slips unless one staffer is assigned that task specifically and then monitored to see that it happens. One new package that I'll talk about at a later date is Complementary Solutions' Automate Anytime. This product can be set so that a particular task, such as a tape backup, can be invoked automatically at a given time.

The Management Challenge

The single greatest problem with managing your company's LAN isn't related directly to hardware or software; it's related to personnel. If there is a single pervasive failing among companies that install networks, it is that they refuse to take management seriously. As unlikely as it may seem, it's not at all uncommon for an organization to spend hundreds of thousands of dollars on LAN hardware, and even more on installation, training, and software, and still refuse to assign a full-time employee to keep it running.

The reasons for this vary, of course. Some companies assign a person the task of management but don't allow him or her the time to do the job because network management is considered a collateral duty. Others assign a nontechnical employee to the job, probably to keep costs down. In a few cases, organizations give supervisor privileges to all users, which lets them do anything they like to the network and, in the process, ensures the early demise of any data integrity.

While a small LAN probably doesn't need a full-time administrator, it does need a fully trained and capable person handling the assignment. Big LANs do require full-time administrators and may require many people. Complex networks with remote sites, heavy processing requirements, and mainframe connectivity require more people than a LAN that just supports word processing and E-mail.

LANs exist as a way to transfer and safeguard your company's information. But to do that, they require supervision and help, regardless of size. ■

Wayne Rash Jr. is a contributing editor for BYTE and a principal and technical director of the Network Integration Group of American Management Systems, Inc. (Arlington, VA). He is coauthor of two books for business network users: The Executive Guide to Local Area Networks *and* The Novell Connection. *You can contact him on BIX as "waynerash," or in the to.wayne conference.*

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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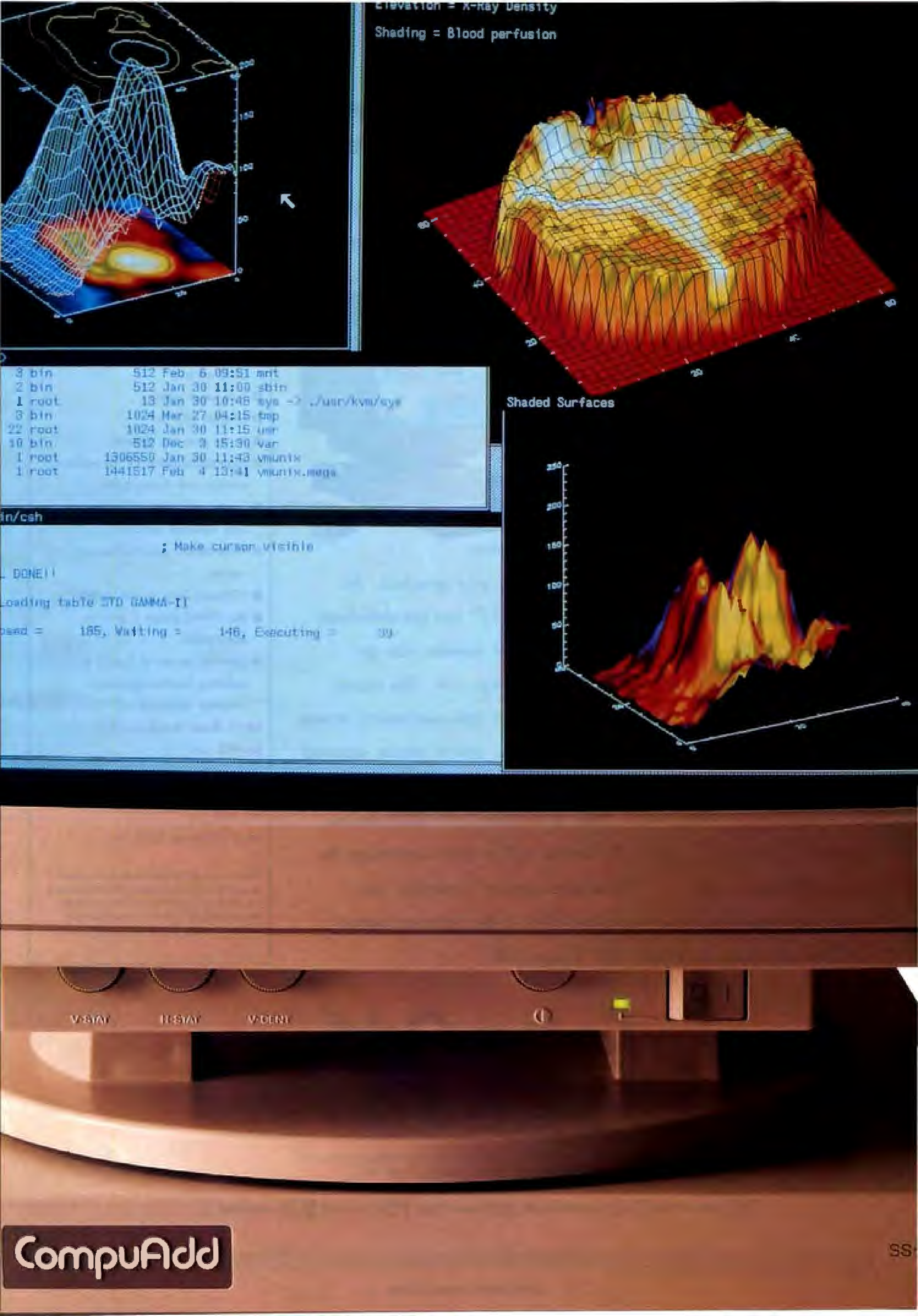

Elevation = X-Ray Density
Shading = Blood perfusion
Shaded Surfaces
3 bin 512 Feb 6 09:51 mnt
2 bin 512 Jan 30 11:00 sbin
1 root 13 Jan 30 10:46 sys -> ./usr/kvm/sys
3 bin 1024 Mar 27 04:15 tmp
22 root 1024 Jan 30 11:15 usr
10 bin 512 Dec 3 15:30 var
1 root 1306550 Jan 30 11:43 vmunix
1 root 1441517 Feb 4 13:41 vmunix.mega
; Make cursor visible
DONE!!
Loading table STD GAMMA-II
165, Waiting = 146, Executing = 39
CompuAdd

BYTE columnists, staff, and contributors debate the issues

DO COMPUTERS SAVE TIME?

Roundtable is a forum in which BYTE editors, columnists, and contributors debate key issues that affect how you purchase and use hardware and software. The "conversations" take place on BIX, where you can participate in the round.table conference.

KEN SHELDON: A friend and I got to talking about how much time you can spend customizing your system. It put me in mind of the guys I knew in high school who spent all their time working on their cars but never actually seemed to go anywhere. Then there are the musicians who get so caught up in the technology of their electronic gadgetry that they never make any music.

I wonder if the same thing doesn't happen with computers. Do we spend so much time adjusting the screen colors, setting up batch files, and making sure we have the optimum number of buffers in our CONFIG.SYS file that we get less done than if we couldn't do those things? And if that's the case, what can we do about it?

WAYNE RASH JR.: The problem I have is that I keep wondering what Windows would look like with different wallpaper or with a different desktop pattern. So I change them, then look at them for a while, then I load the desktop pattern, and maybe modify the Critters pattern again, and then pick a different wallpaper to go with it, and when I then find another wallpaper pattern I like, then the desktop has started to look tacky, so I move the icons around on the desktop, and then I rearrange the windows so that they pop open in different areas, and I take an icon and put it somewhere else, and then I decide that maybe the three-dimensional Excel pattern might look nicer, so I try that, but it doesn't, so I take a look at the other one, and. . . .

Well, you get the idea.

TOM THOMPSON: The whole trick is to set up the desktop and then leave it alone. For example, I've got a number of permanent folders located in specific spots on my desktop. They never move; when I have to add or remove something, I know right where to go. The transient stuff (beta software, software under review, and articles in progress) goes in another area. It may not work for everyone, but it does for me. Now, if you really want to waste time, check out some of those screen savers.

LARRY LOEB: The deeper question is not whether your desktop is neat but whether it would be simpler not to use the computer at all. For example: I've got to add a column of numbers. Let's say the Mac is on already. I could call down a calculator, but I may just use the calculator that's on my watch rather than get up and go to the computer. Now, the calculator on my watch is a computer. It's convenient to use. And it adheres to the principle of zero abstraction inserted between the worker and the work. I just add the numbers. No loading of an operating system or fiddling around with files.

My point is this: Any general-purpose computer will take longer to set up and do useful things than one that is specialized for the work you want to do. Maybe we need more specialized, smaller computers.

DON CRABB: I agree to a point, Larry. That point, unfortunately, is often hard to pin down. Small, individual-function computers are great for very definable tasks like those you delineated, but what happens when you need to ratchet-up your work a notch? With most of these unifunctional devices, you're stuck. You either have to then take your work to a general-purpose computer, do it by hand, or search around for some specific unit that can do the little bit extra—all of which waste time and money. A good example of small, specific computers that have tried to add additional layers of functionality are the Sharp Wizard and Casio B.O.S.S. series. Each can do more than your calculator watch, and each does less than any general-purpose computer. However, the

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LARRY LOEB
Consulting Editor

RICH MALLOY
Managing Editor, News & Technology

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Contributing Editor

KEN SHELDON
Senior Editor, Features

TOM THOMPSON
Senior Editor at Large

penalties extracted for this combination include keyboards that are too small to touch-type on, software that is expensive for what it provides, and screens that don't always show enough of what you need to look at.

I would like to see technology move in the direction of true computing building blocks. I would like to see modular systems that can start out as your watch and be built up with new modules to become general-purpose computers. This way we wouldn't lose the ability to keep with us the smallest necessary subset of the computer that we needed at that moment, yet keep the full computing power available just by plugging into it.

LOEB: I agree that the organizer-style hybrid computer influence is growing. Users must believe that this sort of combo is saving them time or they wouldn't be selling as well as they are. One important point about reduced-function computers (RFC to the acronym-minded) is that they are usually portable—they come to the work wherever it is. You don't have to go to the computer to get work done (computer on a desk is what I mean).

The Z88 I'm using to type this on is an RFC; it has limited software and an eight-line display, but it is very portable and has adequate horsepower for BIXing. These buggers can save you time. You may just have to define sharply what tasks you do and optimize the computing solution from what's available.

SHELDON: I think this is related to another aspect of the "Do computers save time?" question. I suspect that each of us has been asked by a noncomputer user if they couldn't save a lot of time by "computerizing" something they do routinely, not recognizing the investment that they already have in their current way of doing things and the sizable investment that would be required to computerize the task.

JERRY POURNELLE: Computers let you do well what you barely could do at all; and yes, they take up time, because they let you do it so much better than you could before. Example: My publisher and I are doing *Spartans*; I turned the book in at the very last minute. He set the type using Ventura Publisher and a Hewlett-Packard LaserJet III printer, proofread in-house, fixed, accepted last-minute changes from me (on disk, or actually on BIX), and got it all out to the printer.

SHELDON: "Computers let you do well things that you barely could do before." I like that; has the ring of a Pournellian Law in the making. The problem, of course, is that the ability to do so many new things means that there are myriad new ways to get bogged down and tangled up in your tools, or the output from them. That means we have to work smarter; being able to find 1500 references to "DOS extender" on BIX won't help you if you then have to read each one of the entries to find the information you need.

RICH MALLOY: It's true that computers let you do things well that you could not do before. But the other side of the equation is that computers also let you do mistakes that you couldn't do before. Witness everyone's first memo produced under desktop publishing, with its myriad fonts and type styles rendering it almost unreadable.

But I think that the issue here is how

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ROUNDTABLE

computers allow you to waste time in ways you could not do before. There is sometimes a temptation to create a perfect set of macros that will do everything you need done automatically. Unfortunately, this perfect set of macros must deal with an imperfect world. It is easy to get caught in a trap of constantly modifying the macros to take care of every possible situation, and the result is often a system that overwhelms the underlying software (and yourself) and wastes a great deal of time.

What you must always keep in mind are two factors: how much time the system will save, and how much time it will take to set the system up. If the time saved is not much greater than the time spent for setup, the system is not worth setting up at all.

POURNELLE: Pournelle's Fifth Law: A job not worth doing is not worth doing well.

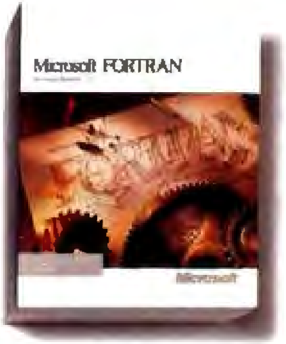
SHELDON: The latest issue of *Harvard* magazine has an article called "Revenge Theory," which postulates that our high technology is trying to get back at us. Here's a paragraph that relates to our discussion:

"When spreadsheets were laborious, people did them as seldom and as cautiously as possible. Now recalculations can be done much more easily, but at the cost of having to do them much more often, and of learning to use the software."

FRED LANGA: The name is tongue-in-cheek, but the idea's solid. It's an attempt to explain a number of things: For example, a superhighway is built to ease traffic congestion, but because the new highway makes it easier to get around, it actually encourages more driving and increases overall traffic.

Or: Federal Express introduces attention-getting envelopes for low-volume, high-priority overnight mail. Soon, you are getting so many of the envelopes that they lose all urgency. Then along comes faxing of ultra-high-priority messages. Soon, there's a fax glut and you find 35 feet of paper hanging out of your fax machine every morning.

Or, as Ken pointed out: Computers make an onerous task much easier, but instead of freeing up time, we use the time to do more iterations of the onerous task. "Painless revisions" is one of the main benefits of using computers. But if you frazzle yourself by doing 900 revisions of a project up to the minute before deadline, is it really painless? ■



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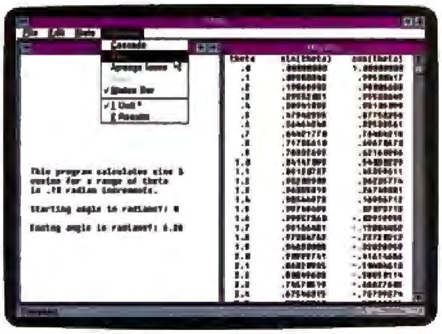

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- Complete online documentation for the FORTRAN language and all compile and link switches.
- DOS and OS/2 run-time libraries are compatible with other Microsoft languages.
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- 100% ANSI 77 compatibility and numerous IBM®, VAX® and ANSI 8X extensions.
- New BYTE keyword emulates VAX data types.
- Language Extensions include DOUBLE COMPLEX variables, precision and maxexponent inquiries.

PROGRAMMER'S TIPS

- *Use the new /MW option with the FL command to invoke the QuickWin library. For example: "FL/MW MYAPP.FOR" is all it takes to make MYAPP a Windows-based program.*
- *Use the ALLOCATE statement to dynamically size arrays and to access more than 16MB of memory on a 386.™*

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FEATURE

ASCII Goes Global

Two standards aspire to be the "international ASCII," containing all the world's written characters. Are they headed for collision, or consensus?

KENNETH M. SHELDON

The world is getting smaller every day. As it does, it's becoming increasingly evident that ASCII is no longer sufficient for computing on a global scale.

ASCII—the American Standard Code for Information Interchange—is the code that underlies all communication with computer hardware and software—sort of the DNA of computer talk. Each ASCII code—a series of seven 0s and 1s—represents a letter of the alphabet (*a* to *z* in uppercase and lowercase), a digit, a punctuation mark, or an instruction that controls peripheral equipment such as a modem (see figure 1). As a 7-bit code, ASCII has space for 128 characters (2^7).

In 1977, ASCII was certified by ANSI, and the ISO adopted an almost identical code as ISO 646. The ISO later added a 1-bit extension to ISO 646 that provided space for another 128 characters ($2^8=256$). Known as Latin1, this 8-bit code includes letters required by European languages such as French, German, and Spanish (for example, é, ü, and ñ). (Note that while the acronym *ASCII* is often used to refer to an 8-bit code, this is not technically accurate—true ASCII is a 7-bit code.)

Countries in Africa and the Near and Far East adopted ISO 646 and "localized" it to their native character set, or developed similar standards under the auspices of groups such as the European Computer Manufacturers Association (ECMA) and the Japanese Industrial Standards Committee. Several standards evolved to represent the thousands of characters in the various Chinese, Japanese, and Korean writing systems. Individual hardware and software manufacturers also developed their own standards.

For companies doing business internationally, the existence of so many different character-encoding standards was becoming a nightmare. Something had to be done.

A Byte Is Not Enough

In 1983, the ISO began developing a new standard for character encoding, ISO 10646. ISO 10646's original mandate was to develop a 2-byte (16-bit) character set, with room for 65,536 characters—surely enough for all the characters we'd ever need. The ANSI committee working on the new 16-bit standard hoped to make it compatible with all the current international standards. The first 128

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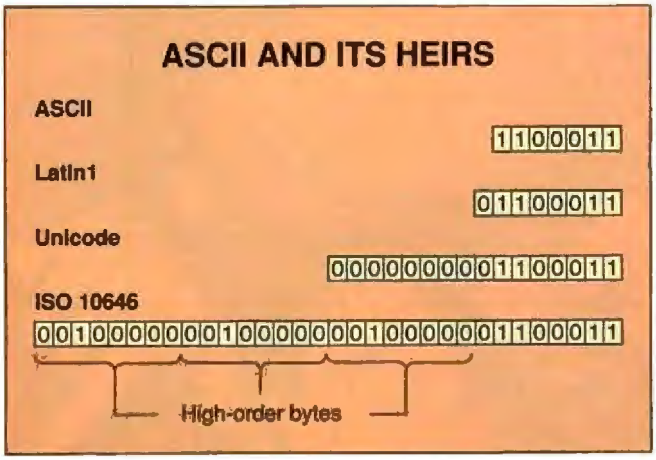

Figure 1: *ASCII codes are 7 bits long, so ASCII can represent 128 possible characters. Latin1 (the "European ASCII") adds a bit, providing for 256 characters. The proposed Unicode is 16 bits long, providing for 65,536 characters. Characters in the ISO 10646 standard would be 4 bytes (32 bits) long, although the standard proposes compaction methods that would let you send only 1, 2, or 3 bytes when the initial byte (or bytes) would be redundant.*

characters would be good old ASCII, with other character sets following.

Two problems quickly surfaced, however. First, each of the already-existing international standards included control codes, which controlled peripheral equipment by sending messages such as "carriage return" or "formfeed." There were a couple of arguments for retaining those codes. Much of the current communication equipment looks for those control codes—essentially parsing the data stream—to decide what to do with the data it receives. Also, removing the control codes would render the new code incompatible with the codes already in use around the world. The problem was this: Setting aside spaces for all characters that could possibly be interpreted as control codes used up 40 percent of the 65,536 available spaces, before any characters had been assigned.

The other problem had to do with the characters in the Chinese, Japanese, and Korean writing systems. Among the world's writing systems, these contain by far the largest number and variety of characters. Although these languages do use alphabetic systems, the largest number of characters are *pictographic* ("picture writing") or *ideographic* ("concept writing"). These terms can be somewhat misleading. The most accurate term for them is *logographic*, or "word writing," meaning that each character represents a word.

Most Japanese and Korean characters are derived from Chinese and are referred to as Han characters (from the Chinese Han dynasty). In many (although not all) cases, these characters not only look more or less the same, they also mean the same thing in all three scripts. For example, the character for "water" is identical in Chinese hanzi, Japanese kanji, and Korean hanja scripts.

BYTE ACTION SUMMARY

Adoption of a multilingual standard for character encoding will make life easier if you're doing business internationally. Depending on your computer, you may have to buy new software to take advantage of the standard, although most users won't see any differences.

To save space, the 10646 committee considered developing a unified Han character set, in which no character would appear more than once. The shared Han characters would be listed together, and characters unique to the individual systems would appear separately. This scheme would remove thousands of very similar characters and allow the character sets of all nations to exist in a single 2-byte code. However, although China agreed to this proposal, Japan and Korea objected.

To resolve the issue, the committee decided to include all characters from each of the languages, even when that resulted in the apparent duplication of many thousands of characters. Suddenly, 2 bytes wasn't going to be enough to contain all the characters in the code.

For over a year, the committee wrestled with expanding the size of the code set. Would 3 bytes be enough? Was 4 too many? Finally, the group decided to go with a 4-byte (32-bit) code set—with enough room for 4 billion characters and codes.

Let's Get Small

Some in the computer community objected. Four bytes for every character? Didn't that add a lot of overhead to communications? Instead of sending 1 byte for every character, we'd be sending 4; it would take four times as long to send a text file.

Not so, suggested one member of the committee. Since the first 3 bytes of any alphabet's assigned codes would be the same, you wouldn't need to transmit them for each character. For example, the letter *c* in ASCII is 01100011. Under ISO 10646, it would be similar, but with 3 bytes (each of which is 00100000) in front of it:

00100000001000000010000001100011

(In 8-bit code, 00100000 represents a space. Why not just use zeros in those first bytes? Because 00000000, in 8-bit code, is a control code—nul—and the committee had already decided against using any codes that could be misinterpreted as control codes.) Similarly, the letters *a* and *t* would look like their current ASCII counterparts, with the same 24 bits in the 3 high-order bytes.

Committee members suggested several compaction schemes (not to be confused with compression schemes). For example, in the case above, a sending modem could tell the receiving modem, "From now on, assume that the first 3 bytes of every character are 00100000," and then proceed to send the 8-bit codes for *c*, *a*, and *t*. At that point, the modems would essentially be operating in 1-byte mode. The same technique could be used regardless of what language you were writing in, since all characters in that part of the code would have the same first 3 bytes.

"Too complicated," said some outside the committee, adding that such schemes could introduce integrity problems. They preferred a scheme in which each code was the same length at all times. The effort to develop a single, international character set was beginning to stall.

Unicode: Back to the Basics

In 1987, Joe Becker and Lee Collins of the Xerox Palo Alto Research Center and Mark Davis of Apple began trying to develop a code that was simpler and more consistent than ISO 10646, yet still incorporated all the characters necessary for international computing. Becker and Collins had worked together on the legendary Xerox Star computer (forerunner of the Macintosh). Among the Star's many innovative features was a 16-bit multilingual coding standard. "After a decade of working with that standard, we knew what we had done right and what we had done wrong," says Becker.

Becker and Collins began to discuss multilingual issues with Davis, manager of the international system software group at Apple. At that time, much of Apple's multilingual efforts were font-oriented, rather than based on the underlying character codes. Meanwhile, Xerox was beginning to move toward publicly available platforms, rather than designing all its own machines and operating systems as it had in the past. Both companies were looking for a public industry-standard coding.

Becker and Collins saw an opportunity to design a new generation of encoding that would take into account their experience with multilingual systems, yet would also involve other companies. To describe the new standard, Becker coined the name *Unicode*, for "unique, universal, and uniform character encoding."

Becker, Collins, and Davis formed the core of the group working to develop Unicode. Representatives of other companies soon joined the discussions: Metaphor Computer Systems, the Research Libraries Group, Microsoft, Sun, Adobe, Claris, Next, and Pacific Rim Connections. Many of the people working on Unicode became members of the ISO 10646 group and worked within that group to influence it in the direction of Unicode. Unicode members also presented the case for a 2-byte coding system to other U.S. and international corporations (including IBM and Microsoft), users groups such as Share (a group for users of IBM mainframes), conferences such as Uniforum, and developers' conferences. Unicode was beginning to look like a strong contender in the race to replace ASCII.

In January 1991, the Unicode consortium was incorporated as Unicode, Inc. In addition to the companies mentioned above, Aldus, Go Corp., Lotus, and Novell had joined the ranks. The culmination of the group's efforts was Unicode 1.0—the initial specification for a code intended to someday contain every written alphabet known to humans.

Unicode Principles

Shortly after the formation of Unicode, Ken Whistler of Metaphor (and secretary of Unicode) outlined the code's design goals in a paper presented at Share 76 in San Francisco. Among those goals were the following:

- *Completeness*. Unicode was intended to eventually cover the full range of characters used in text creation, including some alphabets whose characters are not even completely agreed on, as well as "dead" languages like Sanskrit and other linguistic fossils.
- *Simplicity and efficiency*. Every Unicode character code is exactly the same length (16 bits), and each represents a character—there are no control codes or embedded escape sequences to confuse computers or make it harder to parse a stream of characters.
- *Unambiguity*. Each code represents a single character, unambiguously. A problem with reading a single character shouldn't carry forward so that the characters following it become garbled.
- *Correctness*. Every character encoded in the standard should be a real character, recognized by experts in linguistics.
- *Fidelity*. Textual data shouldn't lose anything when it is being converted into or out of preexisting character-

THE MANY CHARACTERS OF UNICODE

Codes	Characters	Examples
65,025 to 65,536 (FE00–FFFFh)	**Compatibility area**	
59,392 to 65,024 (E800–FDFFh)	**User area**	
16,384 to 59,391 (4000–E7FFh)	**Chinese/Japanese/Korean ideographs** Unified Han characters **Future use**	丰 乇
12,288 to 16,383 (3000–3FFFh)	**Chinese/Japanese/Korean auxiliary** Alphabets and punctuation	ㄳ の ㅗ
8192 to 12,287 (2000–2FFFh)	**Symbols** Punctuation, Mathematical operators, technical symbols, dingbats	; π ©
0 to 8191 (0000–1FFFh)	**Alphabets** English, Latin1, European, Extended Latin, Phonetic, Greek, Cyrillic, Armenian, Hebrew, Arabic, Ethiopian, Devanagari, Bengali, Gurmukhi, Gujarati, Oriya, Tamil, Telugu, Kannada, Malayalam, Sinhalese, Thai, Lao, Burmese*, Khmer*, Tibetan, Mongolian*, Georgian	a ê ¥

Figure 2: *Unicode's first 8192 spaces contain standard alphabetic characters from around the world. (The very lowest Unicode spaces are compatible with the current ASCII standard.) The next block (4096 spaces) is for punctuation, mathematical operators, and various symbols. After that come 4096 spaces reserved for Chinese, Japanese, and Korean nonideographic alphabets and punctuation, and a large space for unified Han characters (see text for explanation). The user area is for users to implement as they see fit under private agreements, and the compatibility area is to help developers convert to Unicode. An asterisk indicates that, while space has been reserved, the actual characters are still to be defined.*

encoding standards. When you send an *a*, the receiver should get an *a*.

Of course, no design is going to be perfect and meet all its goals. Says Whistler, "If we were designing a car, we would want it to be high performance and at the same time get great gas mileage; be stylish and yet practical; be rugged and reliable and yet inexpensive; be roomy and luxurious and yet easy to maneuver and park. These criteria may conflict—but that doesn't mean that automotive engineers must throw up their hands and say it is impossible to design a good car."

These guidelines led to Unicode, a 16-bit code with room for 65,536 characters. (Note one exception: To maintain compatibility with ASCII, Unicode reserves spaces for the initial control codes of the original ASCII standard, although these codes are not used in Unicode.) Unicode distinguishes between a character's code and its *glyph*—what it actually looks like. A character's glyph may change somewhat, depending on the font you use, but the essential shape will always remain the same.

Figure 2 shows how Unicode's codes are assigned. The first 8192 spaces are allotted to standard alphabetic characters, with spare room for ancient characters that may be added later. (Getting Unicode released in a timely manner meant having to omit some scripts for the time being. "Hopefully, leaving out the Burmese script and Egyptian hieroglyphics for now is not going to seriously inconvenience too many implementers—but gosh, we'd love to include those, too," says Whistler.)

The next 4096 codes are for punctuation, mathematical operators, technical symbols, shapes, patterns, and even dingbats (decorative characters that can represent religious symbols, smiling faces, chess pieces, and so on). These are followed by 4096 spaces reserved for Chinese, Japanese, and Korean alphabets (as opposed to logographic characters) and punctuation.

The largest portion of the code space has been set aside for the unified Han characters—some 27,000 characters, as specified by the Chinese National Standard GB 13000. There's also room for future expansion of other code sets, in case linguists decide that additional characters need to be added to preexisting scripts. Finally, Unicode includes 5632 spaces in a private user area, for users to implement as they see fit under private agreements, and 495 code points in a compatibility area designed to help developers convert to Unicode.

A Tale of Two Standards

The advent of Unicode means that there are now two proposed standards for multilingual character encoding, with some significant differences: ISO 10646 stores characters in 4 bytes (although compaction methods would let you use 1, 2, or 3 bytes); Unicode characters are always 2 bytes (16 bits) long. Unicode eliminates duplicate Han characters; 10646 does not. ISO 10646 leaves spaces for all control codes from previously established international code sets—some 28,672 spaces; Unicode reserves spaces only for the 65 control codes in ASCII. ISO 10646 provides codes for accented letters; Unicode provides these codes, but it also assigns a code to each accent mark and creates compound letters by combining the accents with unaccented letters. There are also differences in the way the two standards handle bidirectional text (i.e., writing that flows from right to left, such as Hebrew and Arabic).

What do these differences boil down to? Ken Whistler says it's basically a disagreement on how to encode characters. "It's not enough to simply identify a character and give it a number.

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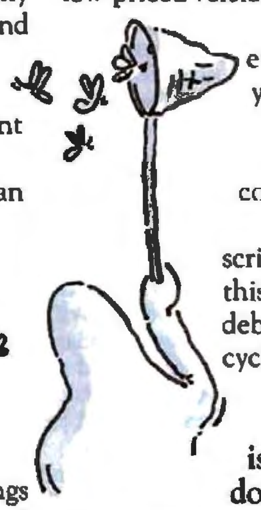

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In the past, it may have been feasible to do this with small character sets, but that's not feasible when what you're trying to do is develop a worldwide international coding standard that will work for all scripts."

Whistler notes that even ASCII, which is fairly stable and understood by everybody, has no coherent concept of a line-ending or paragraph-ending marker. That's why, when you send E-mail with carriage returns and linefeeds in it, different receivers may interpret those characters differently and the message can get garbled. "The other things are architectural issues that are big problems, but they pale against the problem that the entire coding scheme is broken," says Whistler.

Jerry Andersen, a senior programmer with IBM and chairman of the U.S. committee helping to develop ISO 10646, admits that "the emphasis on Unicode has been entirely on a code for the future. The emphasis on 10646 was certainly a code for the future, but there has been also a consideration of migration and compatibility."

International Implications

What effect will a multibyte standard have on the computing industry? Supporters of both Unicode and ISO 10646 hope that such a standard will make it easier to sell systems internationally. The typical workstation vendor sells approximately half its units overseas, according to Unicode board member Bud Tribble, vice president of software engineering for Next. Tribble says that Next sells an English version of its system, a European version that supports 14 languages, and a kanji version for Japan. "This is really untenable for me as a software designer, and also probably for any user who wants to mix languages—which is becoming more and more important." Tribble sees the day when companies will be able to develop an international system that can be shipped to Europe, the U.S., Japan, or China with no modifications other than to the content of the text.

For developers of systems software, the adoption of a multibyte coding standard could mean rewriting a fair bit of code. "Migration of old software to use Unicode is a potentially big cost, but that should only happen in circumstances where there is already a need to deal with multiple character sets," says Whistler. He adds, "Unicode is basically a better character-encoding design, and that will make the cost of original software writing lower than trying to implement on a character set which does not have a good processing code design." Several members of the Unicode consortium have already announced that upcoming versions of their software (including system software from Microsoft and Apple) will implement Unicode, although none have announced specific dates. For users, a multibyte standard will mean new versions of your favorite applications—even if you don't plan to use any non-English characters—although the actual changes required to create those versions could be minimal.

What about hardware? Don't larger character codes mean a need for more RAM and hard disk space? Yes, but not all that much more. According to Bud Tribble, only about 10 percent to 20 percent of the RAM on a running system is used for character storage. "If you have an 8-megabyte system and you're using 7 MB, going to Unicode is going to make you probably have a working set of 7.7 MB, and probably not cause you to go out and buy more memory," he says. True, a pure ASCII text file will double in size—but fewer and fewer files are pure text these days. "For a Word document with some graphics, you would expect a 20 percent to 25 percent increase in the file size," says Tribble. Besides, says Joe Becker, "storage space is getting cheaper and cheaper every year," and the benefits of a multilingual computing system outweigh that expense.

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What benefits? Well, for example, with a single international standard, you could send E-mail to Japan and know that it would arrive without being garbled. Even within the U.S., you could transfer a text file between a Macintosh and a PC compatible without having characters transmogrified in the process.

One way or another, a multibyte encoding scheme appears inevitable. Ed Hart, an engineer in the Applied Physics Lab at Johns Hopkins University, represents Share in the committee developing ISO 10646. Says Hart, "By the mid-1990s, a lot of products are going to have this stuff available."

Bridges and Barriers

The various national committees are now voting on ISO 10646. In April, the working group reporting to the U.S. committee recommended that the U.S. vote against 10646. That's not as negative as it may appear, though, according to chairman Jerry Andersen. "You are required to say, 'Here are the technical changes which, if made, would change my vote to a positive.' "

Besides detailing these changes, the committee made other recommendations, including two possible ways to resolve many of the issues in a single move. The first involves adopting Unicode as a subset of 10646. The second is an ECMA proposal to modify 10646 to resolve outstanding points of disagreement.

In the long run, Andersen thinks the negative U.S. vote will be viewed as constructive, since it could help bring the two standards into line with each other. Unicode certainly seems to have sped up the process of developing a multilingual code. "The original efforts to fix 10646 were getting nowhere," says Whistler. "They're under much more pressure to fix it now, precisely because it looks like Unicode is going to fly."

However, the barriers to adoption of a single multinational standard may be more economic, cultural, and political than technical. "There's a lot of conservative opinion in the world, a lot of nations which aren't at the cutting edge," says Becker. "They are saying, 'I don't want to replace all my computers.' From that point of view, they wish to play it safe." Whistler adds, "Some of the people involved in the standards process are looking to migrate to an international standard without having to change anything."

Cultural issues can be even thornier. "Europe lives and dies by standards because of the language and cultural differences," notes Ed Hart. Cultural issues are particularly sensitive in the Far East; for example, the Japanese standards process is driven in part by the traditionally conservative Ministry of Culture.

Both sides of the character debate agree that having two international standards for character encoding would be bad news. "I believe it will be very difficult for users if they have to work with two codes," says Ed Hart. That's something no one wants. "It's generally conceded by everybody involved that having one standard would be better than having two," says Whistler. "If we have to have two, it would be best to have them as much like each other as possible." ■

Kenneth M. Sheldon is BYTE's senior editor for features. He can be reached on BIX as "ksheldon."

FOR MORE INFO

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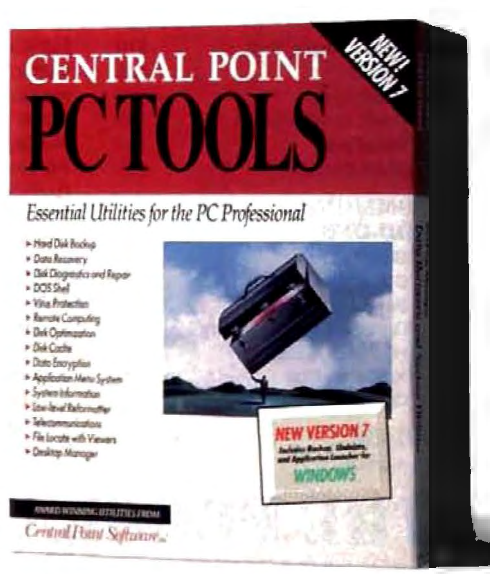

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FEATURE

The Right Graphics Tool for the Job

To paint, to draw—perchance to publish? What's the difference between all those graphics programs, and which should you be using for your projects?

G. Armour Van Horn

Suppose you have to do a drawing, or create a floor plan, or design something on your computer. What software do you use? Often, you use whatever you happen to have handy—whatever program you're familiar with that will get the job done. But is it the best tool for the job?

The range of traditional tools for creating illustrations, plans, or publications (e.g., pens, brushes, and rulers) has always been great. The advent of computer graphics tools has complicated matters, however, and software advertising that makes each product look as if it's capable of doing all things for all people hasn't made life easier. No single tool will produce all projects well; it doesn't matter how wonderful your hammer is—you need to cut boards as well as pound nails into them.

There are several categories of tools available for creating graphics elements. Each is analogous to a group of traditional tools, and each has added features that were once done only in the darkroom or at the print shop.

Rasters and Vectors

All software products that produce graphics elements can be divided into those that work with raster images or bit maps (i.e., arrays of dots that have color assigned to each of them) and those that edit or create vectors (i.e., lines).

Raster devices are like a TV screen—every dot is represented by a value in a map of the screen. Paint programs, scanners, and screen-capture utilities all produce raster files. A vector, on the other hand, is a mathematical concept defined by a starting point (expressed as a coordinate set), a direction, and a length. When you draw lines with a pen, you are essentially using vectors; and this is true of drawing programs, CAD programs, and digitizing pads. On a raster device, two side-by-side points on a diagonal line are actually mapped one full row away; on a vector device, they are mapped side by side.

A program may use all rasters, all vectors, or a combination of the two. Artwork that you scan into your system starts as a raster image and usually ends with raster devices. Most laser printers, including PostScript and Printer Command Language printers and their clones, accept vector information, although it all becomes raster information at the page or imaging drum. Illustration software can include bit maps when printing to such devices. CAD systems that drive plotters or numerical-control machine tools start and end with vectors.

Raster images exist only at one resolution. If the original

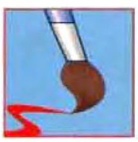
ILLUSTRATION: DAVID CHEN © 1991

image is at 72 dots per inch, it will always have that resolution, even if you display it at another resolution. Resizing a bit map can result in interference patterns (called *moiré*) between the dots in the original and the available dots at the new scale. This happens if the reduction of the image is not an integer proportion (say, one-half or one-quarter) of the original size.

Vector files, on the other hand, are displayed at the resolution of the display device: 72 dpi on-screen, 300 dpi on a laser printer used for proofing, and 1270 dpi or 2540 dpi on an imagesetter. A vector image will always be as well defined as the capabilities of the display or output device.

While raster images may be easier to produce in some circumstances, their commercial use is limited to situations in which you know the final resolution or when you are editing at a much higher resolution.

Painting with Bits



Paint applications work with bit-mapped graphics and can manipulate individual bits or small ranges of bits. These programs (e.g., MacPaint) were the first graphics programs available for microcomputers and were fairly crude (although they've improved over the years). The output resolution and scalability are generally limited to the resolution of the original image.

Such software is analogous to oil and acrylic paints, pastels and charcoals, and air brushing; in fact, tools such as these are part of the toolbox in paint software. These applications suggest themselves first to any design that would have been rendered in one of these traditional tools (and the files produced are certainly less fragile than pastel sketches). Although illustration software would be a better choice for designing a logo for reproduction, because of scaling difficulties, a paint program would be the quicker way to experiment with a new company logo.

Text handling in paint programs tends to be primitive, but it is still more flexible and easier to use than the way text was traditionally added to drawings—either by photographic methods in the darkroom after the artist was through or by rubbing down transfer lettering. If you're going to add a lot of text to a piece, it's probably best to transfer the graphics to a page-layout program.

Unlike a rendering made by a traditional paint tool, which was usually continuous tone and could be reproduced only after photographic processes reduced it to a halftone, a bit-mapped element already consists of spots on a grid. Scaling it to match output requirements can be a problem, though, and each program imposes its own limitations.

Beyond the high end of paint programs lies image-editing software (e.g., Silicon Beach's Digital Darkroom, Adobe Photoshop, and Letraset's ColorStudio). These were developed specifically to manipulate the images produced by scanners and to operate at relatively high resolution. The main limitation to their use is that output files are huge and you need the fastest processors to get reasonable performance.

Before computers came along, very few people could do photo retouching. It was handwork requiring a great deal of skill. But image-editing software lets you remove offending objects from scanned photographs or combine elements from two different photographs.

You "lasso" a section with an imperfection and fill that area with smooth color or blend the contents of the area to reduce the impact of the flaw. Travel brochures, for instance, have always had power lines retouched out of photographs—a practice that will probably become more common as more computers are equipped with this software and users gain experience. This capability allows fascinating creative possibilities but has raised some spirited ethical discussion in the newspaper and magazine worlds. Image editing isn't ever going to be a "killer app" like spreadsheets or word processing, but it will sell a lot of disk drives and other mass-storage devices.

Because of the high resolution of these files, you need to choose halftone resolution and angles that do not result in moiré patterns. You may need to do significant experimentation, though, to get the best results.

Drawing a Line

Drawing programs (e.g., MacDraw) work with vector graphics but can import bit maps for tracing (explained below) or as a component to be placed in the graphic. Drawing files are small and relatively simple, and work is scalable, with resolution limited only by the output device you select.

Most drawing programs on the Mac or under Windows support PostScript output directly and as Encapsulated PostScript (EPS) files, which you can place in layout programs. The Macintosh programs provide excellent handling of unmodified text through fonts installed in the system. The latest versions of these—Adobe Illustrator and Aldus FreeHand—even let you convert fonts to editable outlines. This is handy if, for example, you want to import just a few letters and edit them to create a company logo.

Windows drawing applications (e.g., Corel Systems' CorelDraw, Computer Support's Arts & Letters Graphics Editor, and Micrografx's Designer) include font outlines, but you should treat them as individual graphics elements rather than as type. The result is great flexibility in modifying type shapes, although adding a significant amount of text to an illustration can slow you down when it comes to redrawing the screen and printing the image.

Drawing software works with single drawings; you can use them as single-page layout programs in some cases. You can usually create a page larger than the printer and let the software break the large image into tiles that each fit one page. Software that supports this shows the page breaks on-screen when dealing with drawings larger than a single page. Unfortunately, the actual page sizes are not easily controlled by the artist.

File formats used by drawing programs can be frustrating. You can transfer EPS files between platforms, but you can't edit them—unless and until something called "Editable PostScript" (a proposal made by Adobe's John Warnock) becomes available. Windows programs can pass vector information as Windows metafiles through the Clipboard or as actual files. On

BYTE ACTION SUMMARY

For many one-shot illustration projects, a simple paint program will suffice. Drawing programs are helpful for repeated tasks or those that reuse elements. If you are designing something that you plan to build, you owe it to yourself to consider a CAD package. Desktop publishing and presentation packages are invaluable if you do those sorts of tasks often.

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Tips for Professional Publications

If you're in the business of producing professional publications, here are some criteria to keep in mind when choosing graphics tools.

Input Format
If you are going to start a project from scratch, input format is really not an issue. But if you have large amounts of graphics or text already prepared, their format can and should influence your software choices.

For example, if you have good illustrations available as reflective art (as opposed to slides or film, which must be backlit) and the text is in WordPerfect, your most likely path is to scan the illustrations, touch up scanning artifacts (and possibly add some text) in an image editor, and import the bit maps and text into a desktop publishing package such as Aldus's PageMaker.

Output Needs
Your final output needs may dictate the tool you choose. Illustration software doesn't normally support oversize electrostatic plotters, CAD software doesn't commonly output to slide cameras, and paint programs never operate milling machines. On the other hand, CAD and illustration software can drive vinyl sign cutters, which are really specially adapted pen plotters.

Modularity
If you're going to reuse images, you should produce them in a format compatible with the greatest number of possible destinations. This makes it easier to use the images for other purposes and makes slower hardware more useful.

For example, if you create a graphic with illustration software using Encapsulated PostScript and place it in a presentation package, it will be available for you to use in other programs. That won't necessarily be true if you create it in the presentation program.

Step and Repeat
One of the classic printer's tasks is to take a single image and reproduce it on a sheet several times: Business cards, bumper stickers, and concert tickets are all printed in this way.

Either bit-map or vector software lets you select and move an object or component, but the vector options let you enter the movement numerically. When this is done in concert with a duplicate or clone command, step and repeat ceases to be an expensive outside process and becomes an easy option in illustration or CAD software. You can also do it in page-layout software by placing multiple copies of a graphic or text block.

Mass Storage
Computer graphics tools have changed the ease of storing and recycling individual graphics elements. If you have ever priced a 25-drawer, 25- by 37-inch storage unit (Foster Manufacturing lists one at $1715), you won't whimper about the cost of a 600-megabyte hard disk drive. If you've ever needed to reprint a brochure, only to find that the screened stat of the customer standing in front of his building is dirty (or stolen for some other job)—and the photographer is retired and the customer is in London and the deadline is tomorrow—the ability to resend that file to an imagesetter or export a copy of the scanned and cropped photograph is priceless.

Similarly, cataloging and archiving engineering drawings is more easily accomplished with disk files than with fragile vellum. And multiple revisions do not result in increasingly tattered originals, while the operating system keeps track of revision dates for those who might forget. Don't be chintzy with hard disk storage if you're going to be storing a lot of images.

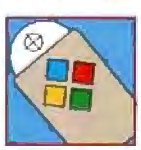
the Macintosh, the PICT format serves the same purpose. Adobe Illustrator is the closest thing to a cross-platform standard, because it is available on the Macintosh and PC compatibles, and because several other packages read or output files in Illustrator format.

What if you want to incorporate a scanned image of an object (say, a logo) into a drawing program and then manipulate it—change it in some way. You need a tracing tool. Tracing software detects the edges of images in a bit map and generates either Bézier or polygonal curves, which you can then edit using illustration software. This is essentially the way designers used to copy logos from a business card to a brochure, for example; they blew the image up as far as it would go, dropped a sheet of tracing paper over it, and started tracing.

The human eye, though, has a much better ability to discriminate the edges of an image than does the average computer tracing tool. Every variation in a line that the scanner sees produces Bézier control points. Low-contrast images cause the tracing program to find additional shapes that your eye won't even see. Several times, I have scanned an image for tracing and subsequently removed over 95 percent of the points generated by the tracing software. Although the ability to trace a bit map is very helpful in the course of developing an image, you generally won't be able to use such images directly.

What's the upper limit on what you can do with a drawing program? Suppose you're remodeling your home. For sketching room designs and deciding about furniture placement, illustration software is a natural extension of the proverbial napkin and back-of-envelope drawings. To produce final drawings for a contractor, though, you need a CAD program. Carpenters and building inspectors need that "real world" base.

Designing in the Real World



Like illustration software, CAD software works with vector information, but the coordinates are based on physical entities in the real world (e.g., inches and feet), rather than purely on graphics entities in the hypothetical world of a drawing. Unlike the options mentioned earlier, CAD software is designed to let you extract the vector information to nongraphics equipment—such as drills, mills, and routers—for computer-assisted manufacturing.

Text handling in CAD programs is traditionally dismal, although this is changing, due, partly, to the influence of the

DUE TO THE STRONG GRAPHIC CONTENT OF THIS PROGRAM, USER DISCRETION IS ADVISED.

We don't want to infringe on anyone's freedom of expression. But Charisma gives you so many graphic possibilities in one powerful, Windows-compatible program, we felt a warning was necessary.

Limit the number of fonts used to no more than two per presentation. Be consistent and use underlines, italics or bold type for emphasis.

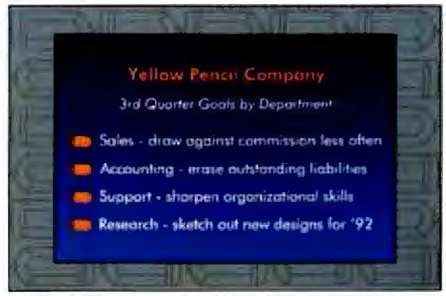
Once you try it, you'll understand why. Charisma's extensive word and data charting functions, real drawing capabilities and total user control make it the most complete graphics solution for business. Unfortunately, some people have trouble resisting the temptation to use every Charisma feature on every presentation. That's understandable. When you have access to 16.8 million colors, more than 40 fully editable fonts, thirteen drawing tools, a library of 2200 clip art images and the ability to turn any graphic element into a bullet, it's easy to get a little too enthusiastic.

Break out information logically and understandably with a variety of chart types. Then use the Harmony Palette for a unifying blend of just the right colors.

It's just as easy to get overly excited about the way Charisma lets you assemble entire presentations without switching between word processing, graphics and spreadsheet programs. Plus you see the results of your creativity immediately, since Charisma doesn't make you go back and forth between text and graphic screens. And with more than 30 import and export filters for graphic formats—including Harvard Graphics—Charisma gives you more power and control than ever before.

Add visual interest and keep audience attention focused with freeform illustrations or custom edited clip art. One graphic per chart works best.

But you shouldn't expect any less from a program designed specifically to take full advantage of the Windows environment. Now, even without overdoing it, you can output the most provocative business graphics you've ever seen to 35mm slides, overheads and handouts. Or make your point with SlideShow, Charisma's on-screen graphics presentation utility that includes dozens of transition effects.



As you lay out word charts, use a template that provides maximum readability. Add spark to presentations by turning any graphic element, even your company logo, into a bullet.

Its strong graphic content prompted *InfoWorld's* Michael J. Miller to say, "Charisma offers the greatest flexibility in creating and editing charts that I've seen."

We think you'll agree.

Call 1-800-733-3729, ext. 5050 (3710 in Canada) for your free working model of Charisma*.

800-733-3729

*Allow 4-6 weeks for delivery. Micrografx, Inc. 1303 Arapaho, Richardson TX 75081 · (214) 234-1769 (customers outside North America please dial extension 3710). Micrografx has offices in Los Angeles, Paris, London, Munich, Sydney and Copenhagen.

Circle 184 on Inquiry Card.

ITEMS DISCUSSED

Adobe Illustrator 3.01 .... $595
Adobe Photoshop 1.07 .... $895
Adobe Systems, Inc.
1585 Charleston Rd.
P.O. Box 7900
Mountain View, CA 94039
(800) 833-6687
Circle 1135 on Inquiry Card.

Aldus FreeHand 3.0 .. $595
PageMaker for Macintosh 4.01 .... $795
PageMaker for PC 4.0 .... $795
Aldus Corp.
411 First Ave. S
Seattle, WA 98104
(206) 622-5500
fax: (206) 343-4240
Circle 1136 on Inquiry Card.

Arts & Letters Graphics Editor 3.1 .... $695
Computer Support Corp.
15926 Midway Rd.
Dallas, TX 75244
(214) 661-8960
fax: (214) 661-5429
Circle 1137 on Inquiry Card.

Charisma 2.0 .... $495
Designer 3.1 .... $695
Micrografx, Inc.
1303 Arapaho
Richardson, TX 75081
(800) 733-3729
(214) 234-1769
fax: (214) 234-2410
Circle 1138 on Inquiry Card.

ColorStudio 1.11 ...... $995
Letraset Graphic Design Software
40 Eisenhower Dr.
Paramus, NJ 07653
(800) 343-8973
(201) 845-6100
Circle 1139 on Inquiry Card.

CorelDraw 2.0 .... $695
Corel Systems Corp.
1600 Carling Ave.
Ottowa, Ontario, Canada
K1Z 8R7
(613) 728-8200
fax: (613) 761-9176
Circle 1140 on Inquiry Card.

Digital Darkroom 2.0 .... $395
Silicon Beach Software, Inc.
9770 Carroll Center Rd., Suite J
San Diego, CA 92126
(206) 628-2320
Circle 1141 on Inquiry Card.

Model 502 Classic 25-drawer slim-line cabinet $1715
Foster Manufacturing
414 North 13th St.
Philadelphia, PA 19108
(800) 523-4855
Circle 1142 on Inquiry Card.

Oasis 1.0 .... $795
Time Arts, Inc.
1425 Corporate Center Pkwy.
Santa Rosa, CA 95407
(707) 576-7722
fax: (707) 576-7731
Circle 1143 on Inquiry Card.

PerForm Pro $495
Delrina Technology, Inc.
1945 Leslie St.
Don Mills, Toronto, Ontario, Canada
M3B 2M3
(800) 268-6082
fax: (408) 356-9570
Circle 1144 on Inquiry Card.

PowerPoint for Macintosh 2.01 .... $395
PowerPoint for Windows 2.0 .... $495
Microsoft Corp.
1 Microsoft Way
Redmond, WA 98052
(800) 426-9400
(206) 882-8080
fax: (206) 883-8101
Circle 1145 on Inquiry Card.

Macintosh. Another factor influencing text handling is the growing use of vinyl sign-cutting plotters. These are modified pen plotters, in which a cutting tool is used in place of a drawing pen and pressure-sensitive vinyl is used in place of paper. The plotter cuts letter shapes and symbols in the vinyl. You peel the background away and apply the resulting image to form a sign.

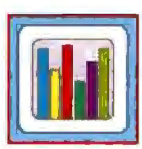
These specialized plotters can be as expensive as laser printers ($1500 to $15,000) but can be useful in certain settings. Signs that are produced in large volumes are normally screen printed using art that is blown up from an illustration—a process that involves the expense of photographic film and screen preparation. But if you often need signs in small quantities, the combination of CAD software and a sign cutter could save you money.

CAD software also offers the best and most natural environment for digitizing tablets. If you are using a tablet to perform tasks such as copying objects from blueprints or transferring rough drawings into the computer, CAD software reads exact coordinates, whereas paint software just maps from the sides of the image. (Interestingly, Time Arts' Oasis, a Macintosh paint program, works with digitizing tablets to let you vary the *expression* of your input—such as the width of a line—depending on how hard you press on the tablet.)

CAD software supports the widest range of output devices, and most CAD software (including PC software, programs on most Unix systems, and even CATIA—which runs on IBM mainframes) supports one of two file standards: DXF and IGES. Outside of CAD, only word processing software can transfer files across such a wide range of platforms.

The range of applications for which CAD is used is so great that, in addition to the general-purpose programs, a host of extensions were written either as stand-alone applications or as additional modules that work within the most popular CAD packages. For example, third-party offerings written in AutoLisp to extend AutoCAD's range constitute a small industry. These include design applications for steam systems, PostScript driver extensions, and ship building.

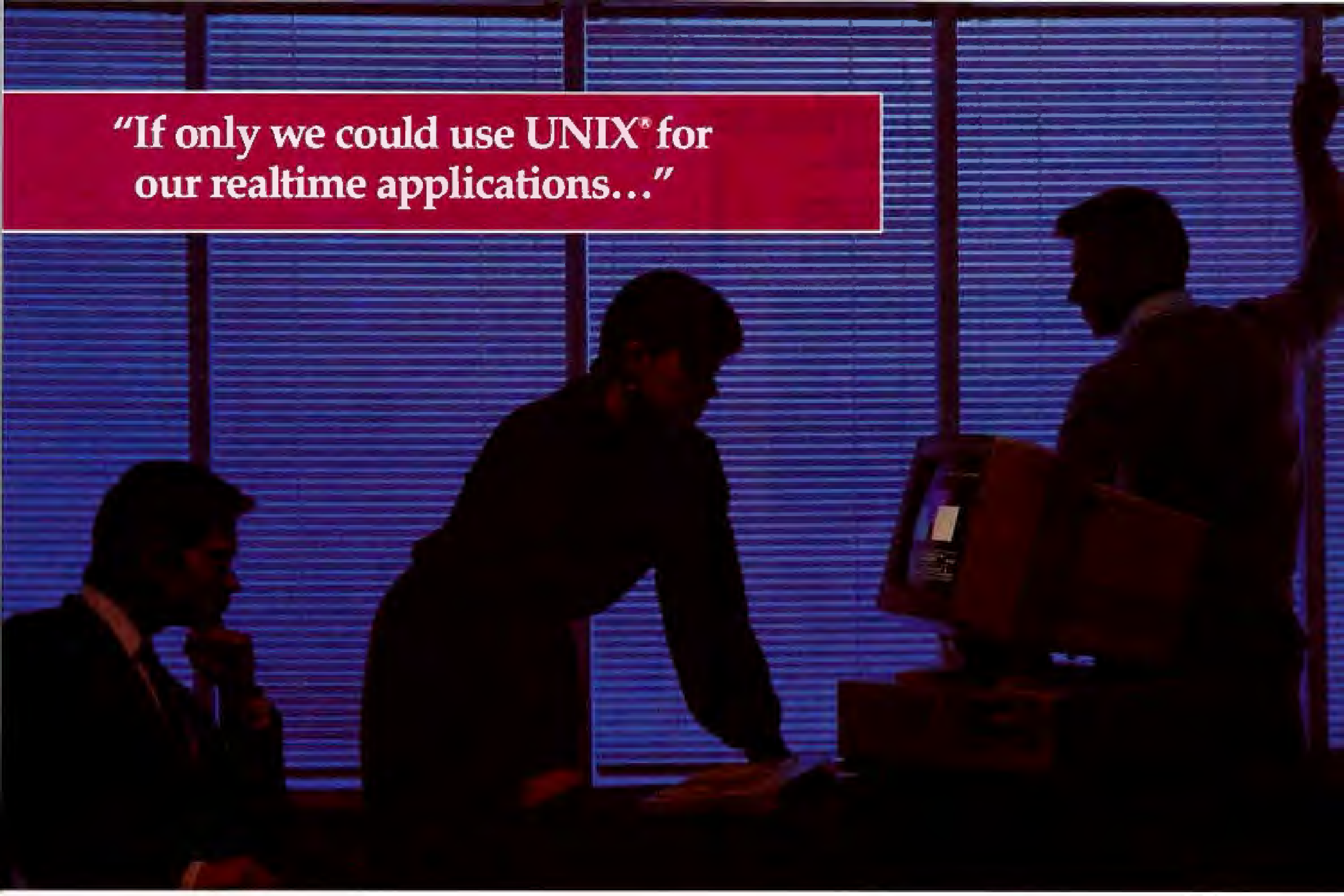
Now Presenting



If you need to do a single, simple chart or graph, a paint program will probably suffice. For larger, more frequent, or more complex presentations, though, you're better off with a presentation package.

Presentation programs combine limited drawing, word processing, and outlining utilities with strong connections to slide-recorder output. Such software is typically organized as a speech-writing tool with graphics support; each slide is represented as an element in an outline and as a full-screen image.

Generally, presentation packages let you create charts based on the numerical data contained in a worksheet, which looks like a stripped-down spreadsheet. You can import data from a fully featured spreadsheet; or, using spreadsheets that contain graphing tools (e.g., Lotus 1-2-3 or Microsoft Excel), you can import a finished graph as an image. Micrografx's Charisma and Microsoft's PowerPoint are packages that can accept the underlying data or the complete graphics formatting from Excel charts. Whether or not you can import graphics or text from other software depends on the individual program; output to



Dennis Ritchie, legendary developer of the UNIX Operating System, puts it very simply: "The reason the original UNIX operating system was so small and elegant was because we did things that we really wanted to do."*

Although conventional UNIX has grown (literally) beyond Ritchie's original vision, many people still look to this classic OS to do what they want to do.

But not if they want realtime performance. UNIX has unequalled power as a development tool, but you can forget about running realtime apps on conventional UNIX systems. They're simply too big and too slow.

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UNIX systems come in more flavors than ice cream. Which is why IEEE's POSIX standard is now such an important safeguard of portability.

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*"Who is the Real Dennis Ritchie?" UNIXWORLD, January 1991, p. 46.

Circle 235 on Inquiry Card (RESELLERS: 236).

other packages is generally not supported except through Clipboard functions such as those provided by the Macintosh and Windows—and they tend to limit the size of what you can cut and paste.

Unique to presentation software is the slide-sorter view, in which many reduced slides (sometimes called *thumbnails*) appear on the screen. You can drag each to another position with a mouse, which lets you rearrange a presentation depending on your audience. When you rearrange the charts, the software automatically rearranges the outline. This would be very difficult—if not impossible—to do with paint or illustration software.

Making Pages

Paint and illustration programs may be fine for simple posters, announcements, and so forth. But when you start combining images and text, dealing with multiple columns, or having more than a single page, it's time to move up to page-layout or desktop publishing software.

Desktop publishing software combines limited drawing and word processing tools with powerful typographic capabilities. Most programs support a wide range of file formats for importing graphics and text—with or without formatting codes that you may have added during editing. Exporting files is not as great a concern, and you can usually save your edited text to a separate file for other purposes. Page-layout software is generally output to a laser printer for rough or "proof" copy and to a high-resolution imagesetter for final copy.

Although the most common use of such programs is probably for creating brochures and newsletters, the combination of their file handling facility and text handling precision makes them a natural choice for posters and high-quantity signs. Aldus's PageMaker and its competitors were, after all, designed specifically to support the printing process.

Creating forms is a special kind of desktop publishing. For a one-shot project, you could use an illustration package, but a desktop publishing program would be more versatile. For frequent use, you may prefer a dedicated package such as Delrina Technology's PerForm Pro, which has design capabilities, links to dBase format, and includes other advanced features.

Making Your Choice

For any craftsperson, a toolbox is a very personal thing. Your style, your work, your finances, and your ambitions will all affect what goes in your toolbox. Like a carpenter with a hammer, saw, and ruler, you make investments in different tools and commit yourself to keeping those tools and your skills sharp. Before, the range of graphics projects you could "build" had few limitations; now, with computer options, your choices are even greater. Choosing among the options requires an understanding of what each tool can accomplish, how each one operates, and the requirements of the job at hand. If you are involved in publishing professional-looking documents, constraints such as input and output format will necessarily affect your choices. (See the text box "Tips for Professional Publications" on page 126.)

Take some time to make sure you're using the right graphics tool for the project you're doing. Forcing projects into the wrong mold or redoing projects because they no longer meet today's need are hideous wastes of time. Your time is worth more than the cost of buying the appropriate tool. ■

G. Armour Van Horn is a writer and graphics consultant. He can be reached on BIX as "vanhorn."

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1991 Readers' Choice Awards

BYTE's readers select the cream of the crop of hardware and software for PC-compatible, Macintosh, and Unix systems

BYTE's readers are among the most knowledgeable in the computer field. That's why, in addition to our annual awards—chosen by our editors and presented each January—we also ask you, our readers, what products you consider to be the best for daily business use.

Here are the winners. This year, we added several new categories to our list, including *Hardware Product of the Year* and *Software Product of the Year*. The winning products range from new releases to tried-and-true standbys—including several products that won a readers' choice award last year. If you're planning to make a purchase from one of the categories listed, it makes sense to check out the product chosen by our readers as the most useful one of its class.

You'll find a complete list of the winning products, prices, and company addresses on page 134. Note that, because of the speed with which technology overtakes us, several of the products recommended by our readers have been superseded by newer versions. In those cases, we list the price for the most recent version.

The envelopes, please.

1991 BYTE READERS' CHOICE AWARD

READERS' CHOICE HARDWARE

HARDWARE PRODUCT OF THE YEAR
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READERS' CHOICE SOFTWARE

SOFTWARE PRODUCT OF THE YEAR
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DESKTOP COMPUTER
Northgate Elegance 486/33

MASS-STORAGE DEVICE
Iomega Bernoulli Transportable

MODEM
Hayes V.42 Smartmodem

MONITOR
NEC MultiSync 4D

NETWORK ADAPTER
Eagle NE 32

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Compaq Systempro 486/33

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Toshiba T1200XE

PRINTER
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VIDEO BOARD
Western Digital Paradise VGA 1024-256

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Autodesk AutoCAD 11

CAD/MACINTOSH
Claris CAD 2.0

CONTACT MANAGER/ PERSONAL INFORMATION MANAGER
Lotus Agenda 2.0

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Novell NetWare SQL

DATABASE MANAGER/DOS
Borland Paradox 3.5

DATABASE MANAGER/ MACINTOSH
Claris FileMaker Pro 1.0

DESKTOP PUBLISHER/DOS
Aldus PageMaker for Windows 3.01

DESKTOP PUBLISHER/ MACINTOSH
Aldus PageMaker 4.0 for Macintosh

DESKTOP PUBLISHER/UNIX
Frame Technology FrameMaker 3.0

E-MAIL/WORKGROUP
WordPerfect Office 3.01

GRAPHICS/DOS
Corel Systems CorelDraw 2.0
GRAPHICS/MACINTOSH
Adobe Illustrator 3.0

NETWORK OPERATING SYSTEM/DOS
Novell NetWare 386 3.1
NETWORK OPERATING SYSTEM/MACINTOSH
Novell NetWare 1.2

NETWORK UTILITY
Novell LANalyzer

OPERATING SYSTEM/ENVIRONMENT
Microsoft Windows 3.0

OPTICAL CHARACTER RECOGNITION
OCR Systems ReadRight 2.01

PROGRAMMING LANGUAGE/PROGRAM DEVELOPER/DOS
Borland Turbo C++ 1.0

PROGRAMMING LANGUAGE/PROGRAM DEVELOPER/MACINTOSH
Claris HyperCard 2.0

PROGRAMMING TOOLS
Borland Turbo Debugger and Tools 2.0

PROJECT MANAGER
Microsoft Project for Windows 1.0

SPREADSHEET
Borland Quattro Pro 2.0

UTILITY (Tie)
Central Point PC Tools Deluxe 6.0
Symantec Norton Utilities 5.0

WORD PROCESSOR/DOS
WordPerfect 5.1
WORD PROCESSOR/MACINTOSH
WordPerfect 2.0 for Macintosh ■

FOR MORE INFORMATION

Note: *Versions and prices listed are the lastest available at press time.*

Adobe Systems, Inc.
Illustrator 3.0, $595
1585 Charleston Rd.
Mountain View, CA 94041
(800) 344-8335
(415) 961-4400
fax: (415) 961-3769
Circle 1105 on Inquiry Card.

Aldus Corp.
PageMaker for Windows 3.01, $795
PageMaker 4.0 for Macintosh, $795
411 First Ave. S
Seattle, WA 98104
(206) 622-5500
fax: (206) 343-4259
Circle 1106 on Inquiry Card.

Autodesk, Inc.
AutoCAD 11, $3500
2320 Marinship Way
Sausalito, CA 94965
(415) 332-2344
fax: (415) 331-8093
Circle 1107 on Inquiry Card.

Borland International, Inc.
Paradox 3.5, $795
Quattro Pro 2.0, $495
Turbo C++ 1.0, $100–495
Turbo Debugger and Tools 2.0, $149
1700 Green Hills Rd.
Scotts Valley, CA 95067
(408) 438-8400
fax: (408) 438-0389
Circle 1108 on Inquiry Card.

Central Point Software, Inc.
PC Tools Deluxe 6.0, $149
15220 Northwest Greenbrier Pkwy., Suite 200
Beaverton, OR 97006
(800) 445-2110
fax: (503) 690-8083
Circle 1109 on Inquiry Card.

Claris Corp.
CAD 2.0, $899
FileMaker Pro 1.0, $299
HyperCard 2.0, $199
5201 Patrick Henry Dr.
Santa Clara, CA 95052
(408) 727-8227
Circle 1110 on Inquiry Card.

Compaq Computer Corp.
Systempro 486/33, $16,999–$22,999
P.O. Box 692000
Houston, TX 77269
(800) 231-0900
Circle 1111 on Inquiry Card.

Corel Systems Corp.
CorelDraw 2.0, $695
1600 Carling Ave.
Ottawa, Ontario,
Canada K1Z8R7
(613) 728-8200
Circle 1112 on Inquiry Card.

Eagle Technology (a business unit of Anthem Electronics, Inc.)
NE 32, $1295
1160 Ridder Park Dr.
San Jose, CA 95131
(408) 453-1200
Circle 1113 on Inquiry Card.

Frame Technology Corp.
FrameMaker 3.0, $995–$2500 (depending on license type)
1010 Rincon Cir.
San Jose, CA 95131
(408) 433-3311
Circle 1114 on Inquiry Card.

Hayes Microcomputer Products, Inc.
V.42 Smartmodem, $599–$1199
P.O. Box 105203
Atlanta, GA 30348
(404) 441-1617
Circle 1115 on Inquiry Card.

Hewlett-Packard Co.
LaserJet III, $2395
19310 Pruneridge Ave.
Cupertino, CA 95014
(800) 752-0900
Circle 1116 on Inquiry Card.

Iomega Corp.
Bernoulli Transportable, $1259
1821 West 4000 South
Roy, UT 84067
(801) 778-1000
Circle 1117 on Inquiry Card.

Lotus Development Corp.
Agenda 2.0, $395
55 Cambridge Pkwy.
Cambridge, MA 02139
(617) 577-8500
Circle 1118 on Inquiry Card.

Microsoft Corp.
Windows 3.0, $149
Project for Windows 1.0, $595
1 Microsoft Way
Redmond, WA 98052
(800) 426-9400
Circle 1119 on Inquiry Card.

NEC Technologies
MultiSync 4D, $1499
1255 Michael Dr.
Wood Dale, IL 60191
(800) 366-3632
Circle 1120 on Inquiry Card.

Northgate Computer Systems, Inc.
Elegance 486/33, $5700
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Circle 1121 on Inquiry Card.

Novell, Inc.
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NetWare 1.2, $895–$5495
NetWare 386 3.1, $3495–$12,495
NetWare SQL, $595–$1495
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(801) 429-7782
Circle 1122 on Inquiry Card.

OCR Systems, Inc.
ReadRight 2.01, $495
1800 Byberry Rd.,
Suite 1405
Huntingdon Valley, PA 19006
(215) 938-7460
Circle 1123 on Inquiry Card.

Sun Microsystems, Inc.
Sparcstation 2, $14,995 (19-inch monochrome)–$17,995 (16-inch color)
2550 Garcia Ave.
Mountain View, CA 94043
(415) 960-1300
Circle 1124 on Inquiry Card.

Symantec Corp.
Norton Utilities 5.0, $179
10201 Torre Ave.
Cupertino, CA 95014
(408) 253-9600
Circle 1125 on Inquiry Card.

Toshiba America Information Systems, Inc.
T1200XE, $3199 (with 20-MB hard disk drive)
9740 Irvine Blvd.
Irvine, CA 92718
(714) 583-3000
Circle 1126 on Inquiry Card.

Western Digital
Paradise VGA 1024-256, $369
8105 Irvine Center Dr.
Irvine, CA 92718
(714) 932-5000
Circle 1127 on Inquiry Card.

WordPerfect Corp.
WordPerfect 5.1, $495
WordPerfect 2.0 for Macintosh, $495
WordPerfect Office 3.01, $149
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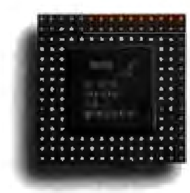
The EPL-7500 handles paper as well as it handles text and graphics. A 250-sheet tray comes standard, a second is optional. Also standard are serial, parallel and AppleTalk® interfaces, allowing the printer to work smoothly in both PC and Macintosh® environments. For even greater versatility, HP® LaserJet® Series II emulation is included.

POSTSCRIPT®



The new Epson EPL-7500 laser delivers brilliant PostScript output at blazing RISC processing speeds. The new EPL-7000 provides serious business performance at a very personal price.

Of course, not everyone needs a PostScript printer. That's why the Epson laser line also includes the new EPL-7000. Like the EPL-7500, it offers brilliant MicroArt Printing, superior paper handling and HP compatibility. Plus a host of other serious business features, all loaded into an extremely affordable package. Moreover, the EPL-7000 even allows upgradability to the EPL-7500's true PostScript and RISC processing.

With the EPL-7500 and EPL-7000, the engineers of Epson have succeeded in raising the standards for laser printing. Without raising the price.

In fact, a demonstration will quickly and clearly show you why these are the most innovative printers in their class. By far.

Engineered For The Way You Work.™

EPSON

NSTL Review Supplement: Advanced Desktop Publishing Programs

Although they are maturing, desktop publishing applications—even those at the high end of the price and performance spectrum—vary widely in the selection of features they provide. Of the six programs discussed here, none comes close to offering a complete set of tools for all publishing and production needs.

Before purchasing, you must consider carefully what capabilities you need in a desktop publisher, because trying to achieve a particular effect without the proper tools can be frustrating at best. You also must decide if you should use the desktop publisher with other programs (in which case compatibility becomes an issue) or if you want a package that can handle everything—from word processing to graphics creation and formatting. Flexibility and print quality remain the most critical considerations in choosing among desktop publishers.

NSTL limited its evaluation to dedicated desktop publishing programs capable of creating document files of at least 99 pages. The list of packages includes Aldus's PageMaker for Windows 4.0, Logitech's Finesse 3.1, Spinnaker Software's PFS: First Publisher 3.0, Timeworks's Publish It 1.21, and Ventura Software's Ventura Publisher DOS/GEM 3.0 and Ventura Publisher for Windows 3.0. Not reviewed are Power Up Software's Express Publisher, which can handle a maximum of 32 pages and therefore could not perform NSTL's long-document tests, and IBM's Interleaf Publisher, which is better suited to workgroup publishing. Quark's QuarkXpress for Windows was not available in time for testing. (For information on these and other suppliers of advanced desktop publishing programs not reviewed here, see the list on page 157.)

About NSTL

National Software Testing Laboratories (NSTL) is an independent organization that tests personal computer and LAN hardware and software. It provides unbiased performance, compatibility, comparison, and usability testing for personal computer users and vendors. Founded in 1983, NSTL pioneered this use of objective, real-world-based, and comparative methodologies to gain its position as the leading independent testing and evaluation facility in the microcomputer industry.

NSTL publishes test results in *Software Digest Ratings Report, Software Digest Macintosh Ratings Report, PC Digest Ratings Report,* and *LAN Reporter Ratings Report.* The publications carry no advertising.

NSTL's Commercial Testing Division offers test services on a confidential, contract basis to vendors.

Additional information on NSTL's Commercial Test Division is available from NSTL, Plymouth Corporate Center, Plymouth Meeting, PA 19462, (215) 941-9600.

Ratings Analysis and Procedures

To rank this group of advanced desktop publishing programs, NSTL evaluated each package in five areas: performance, quality of printed documents, versatility, ease of learning, and ease of use. Ratings focus on a program's overall suitability for creating newsletters with intricate designs and graphic elements (program-generated ones as well as imported ones) and book-length documents that stress readability and cross-referencing over formatting and design. Performance benchmarks measure each package's speed at executing routine publishing operations. Quality tests examine both on-screen representation of documents and print quality. Versatility ratings evaluate the programs in five important categories: the range and effectiveness of options affecting page size, document length, and file size; page layout; text handling; graphics handling; and input/output capabilities. Ease of learning and usability tests assess each program's interface, as well as the completeness of its manual and its usefulness for designing and producing documents.

To ensure consistency when evaluating programs on performance and quality, NSTL conducted these tests on a Compaq Deskpro 386s equipped with 4 megabytes of RAM, a 40-MB hard disk drive, an NEC Multisync 2A color monitor, a Microsoft Mouse, Compaq DOS 3.31G, and—where applicable—Microsoft Windows 3.0 with HIMEM.SYS and SMARTDRV.SYS installed. The system was connected to a Hewlett-Packard LaserJet III with 3 MB of printer memory and an HP PostScript Cartridge.

The test program and its attendant test files were installed in a subdirectory in partition D of the system's hard disk. Program defaults were changed only to enhance performance. The CONFIG.SYS file contains the statements FILES = 25 and BUFFERS = 25, unless a product's manufacturer recommended otherwise. For Windows, the CONFIG.SYS file's settings were FILES = 30 and BUFFERS = 10, as recommended in the Windows manual. Printer setups were configured as specified in the applications' installation instructions and used the PostScript header file resident in the printer. Each program downloaded its header file before testing began.

Performance tests were run from a minimal display. All rules, grids, tools, and other display options were hidden to the greatest extent possible. Graphics were hidden unless the test called for a graphics display. For specific tasks, the programs were tested with the same page area displayed in the same view. Only the files necessary to testing were installed; no clip art or template files were copied during installation.

Advanced Desktop Publishing Programs

Product & Supplier	NSTL Rating	Overall Evaluation	Overall Power	Overall Usability	Performance	Quality	Versatility	Ease of Use	Ease of Learning	Price	Memory Requirement	Hard Disk Space Needed	Operating System
PageMaker for Windows 4.0 Aldus Corp. 411 First Ave. S Seattle, WA 98104 (206) 622-5500	★★★★	8.1	7.6	7.6	red ●	blue ●	blue ●	blue ●	blue ●	$795, with Adobe Type Manager; $636, for License Pak	2 MB; 4 MB recommended	9 MB	DOS 3.x or higher
Ventura Publisher DOS/GEM 3.0 Ventura Software, Inc. 15175 Innovation Dr. San Diego, CA 92128 (619) 673-0172	★★★	7.7	6.9	6.9	red ●	blue ●	red ●	red ●	blue ●	$795, with Bitstream fonts; $395, single-node network version; $995, three-node network pack	640 KB; 4 MB with EMS 4.0 recommended	10 MB	DOS 3.0 or higher
Ventura Publisher for Windows 3.0 Ventura Software, Inc. 15175 Innovation Dr. San Diego, CA 92128 (619) 673-0172	★★★	7.1	6.7	6.7	black ●	blue ●	red ●	red ●	blue ●	$795, with Bitstream fonts; $395, single-node network version; $995, three-node network pack	2 MB; 3 MB recommended	1.5 MB	DOS 3.x or higher
Publish It 1.21 Timeworks, Inc. 444 Lake Cook Rd. Deerfield, IL 60015 (709) 948-9206	★	5.8	5.3	5.3	red ●	red ●	black ●	blue ●	red ●	$249.95	512 KB with CGA; 640 KB recommended	1 MB (hard disk drive not required)	DOS 3.x or higher
Finesse 3.1 Logitech, Inc. 6505 Kaiser Dr. Fremont, CA 94555 (415) 795-8500	★	5.6	4.9	4.9	blue ●	red ●	black ●	blue ●	red ●	$179	640 KB	1.5 MB	DOS 2.x or higher; DOS 3.1 or higher for Bitstream fonts
PFS: First Publisher 3.0 Spinnaker Software Corp. 201 Broadway Cambridge, MA 02139 (617) 494-1200	Less than 5.0	3.2	3.1	3.1	black ●	black ●	black ●	black ●	black ●	$149	512 KB; 640 KB recommended	2.5 MB	DOS 3.x or higher (will not operate under DOS 4.01 shell)

RATINGS KEY (On a scale of 0 to 10)

Overall Evaluation ★★★★★ 9.0 or higher ★★★★ 8.0 – 8.9 ★★★ 7.0 – 7.9 ★★ 6.0 – 6.9 ★ 5.0 – 5.9

All Other Ratings blue ● 7.0 – 10.0 red ● 5.0 – 6.9 black ● Under 5.0

Advanced Desktop Publishing Programs

Computer Systems	Supplier Support	Volume-Purchase Agreements	Site Licenses	Strengths and Limitations
286, 386	90-day telephone support, *Aldus* magazine, forum on CompuServe, Imaging Center Service Bureau program, on-site technical seminars, nationwide training network, discounted or free upgrade program	Yes	Yes	**Strengths:** Quality of printouts; separate integrated word processing environment; ability to search or replace on text formatting attributes; inclusion of spell checker and Adobe Type Manager; tracking and kerning capabilities; image control and color support; file-linking features; ability to import and export a wide range of file type; good network support because files are compatible across operating environments; ability to do background or queued printing; table editor; maximum page size of 11 inches by 17 inches;tiling option that prints oversize documents in sections **Limitations:** Inability to use numeric values to precisely size and place page elements; lack of an automatic file backup feature
8088, 286; 836 rec.	Telephone support; 60-day telephone support for upgrades; 900 telephone line; forum onCompuServe; extended support program for individuals and businesses; discounted upgrade program; *Ventura Professional* magazine	Yes	Yes	**Strengths:** Quality of printouts; ease of use; inclusion of character- and paragraph-level formatting tags; inclusion of Bitstream fonts; ability to use up to six text/graphics frames as repeating elements; ability to edit repeating frames from any page; document and long-document formatting controls; large hyphenation dictionary; ability to handle drop or inset cap; ability to typeset equations; good network support because files are compatible across operating environments; table editor; maximum page size of 27 inches by 27 inches; tiling option that prints oversize documents in sections **Limitations:** Learning difficulty; lack of an undo and a screen-capture feature; inability to globally or conditionally perform search-and-replace procedures
286, 386, or 486	Telephone support; 60-day telephone support for upgrades; 900 telephone line; forum on CompuServe; extended support program for individuals and businesses; discounted upgrade program; *Ventura Professional* magazine	Yes	Yes	**Strengths:** Quality of printouts; ease of use; inclusion of character- and paragraph-level formatting tags; inclusion of Bitstream fonts; ability to use up to six text/graphics frames as repeating elements; ability to edit repeating frames from any page; document and long-document formatting controls; large hyphenation dictionary; ability to handle drop or inset cap; ability to typeset equations; good network support because files are compatible across operating environments; table editor; maximum page size of 27 inches by 27 inches; tiling option that prints oversize documents in sections **Limitations:** Learning difficulty; lack of an undo and a screen-capture feature; inability to globally or conditionally perform search-and-replace procedure
8088	Toll-free telephone support; 24-hour 900 line; mail/fax support; forum on CompuServe; free or discounted upgrade program	Yes	Yes	**Strengths:** Comprehensive collection of predesigned templates; ability to delete master page items page by page; inclusion of polygons and free-form lines in drawing tools **Limitations:** Inability to insert pages to accommodate imported text; need to establish page orientation before you begin building a document; lack of a screen-capture feature; limited features for creating long documents; lack of automatic kerning and file backup; page-size limit of only 8.5 inches by 14 inches
8088, 286	Toll-free telephone support; newsletter; bulletin board; discounted upgrade program	No	No	**Strengths:** Fast performance; ease of learning; optional spell checker; inclusion of Bitstream fonts; ability to accepts direct scanner input; ability to do background and queued printing **Limitations:** Lack of expanded/extended memory support and consequent limitation on document size; lack of named-paragraph styles; lack of separate formatting controls for left and right pages; lack of center-justified tab stops; inability to insert pages to accommodate imported text; inability to import Encapsulated PostScript or gray-scale TIFF files; poor selection of long-document features; lack of automatic kerning; page-size limit of only 8.5 inches by 14 inches
8088, 286	Telephone support; discounted upgrade program	Yes	Yes	**Strengths:** Inclusion of proprietary font-management software; ability to use landscape and portrait orientation in one document; ability to draw free-form lines and rotate and flip graphics **Limitations:** Print quality; inability to accommodate more than one nonsequential text link; lack of support for expanded/extended memory and consequent limitation on document size; lack of named-paragraph styles; lack of separate formatting controls for left and right pages; limited features for creating long documents; lack of tabs, global and conditional search-and replace feature, kerning, repeating headers footers, automatic page numbering, object oriented graphics, automatic hyphenation, automatic file backup; accommodates a page size of only 8.5 inches by 14 inches.

About the NSTL Review Supplements

Each month, BYTE evaluates dozens of products in a broad range of categories. We cover a lot of ground, but we are always trying to do more. To that end, BYTE is proud to bring you the NSTL Review Supplement series. As reports become available, BYTE will present the results of product comparisons from the National Software Testing Laboratories, a division of Datapro Research Group and a BYTE sister company. NSTL is one of the world's premier independent hardware and software testing facilities.

These pages are supplemental; nothing has been cut from the regular issue of BYTE to make room for them. And the BYTE Lab will continue its long-standing tradition of producing comprehensive, hard-hitting product comparisons.

Unlike BYTE, NSTL provides a scoring system based on numerical weightings assigned to key attributes such as performance, ease of use, versatility, and overall quality. While some of these ratings are by nature arbitrary, the criteria within the evaluation are consistent for each package and do provide a legitimate means of comparison. Though we've examined NSTL's methodology and results and found them satisfactory, BYTE has not tried to duplicate NSTL's tests. NSTL retains full ownership of the results published here.

Due to space limitations, we could not publish all the data that NSTL provided in its report. Instead, we boiled down the information to its essential core. The full report is available for sale from NSTL (see the text box "About NSTL").

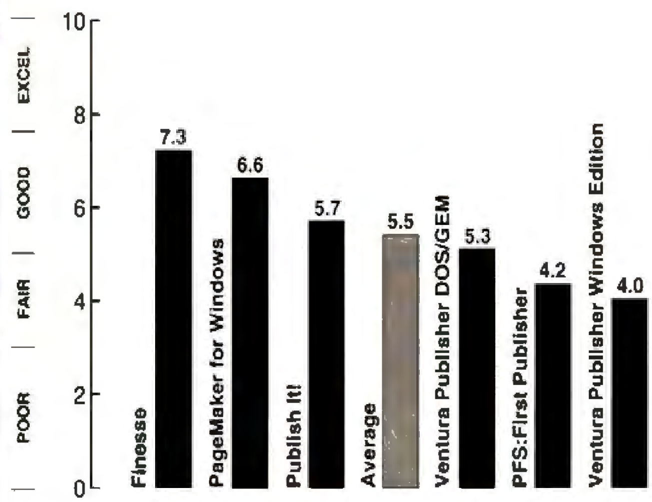
Overall Performance

NSTL's performance benchmarks use short and long documents designed to pinpoint a program's strengths and weaknesses (see the text box "Performance Benchmarks" for test descriptions and performance ratings for each program). The short-document benchmark is a newsletter with three columns of text and graphic elements on every page. In addition to rules and rectangles created within the test program, the file contains two imported Encapsulated PostScript (EPS) graphics, an illustration, and a scanned 256-shade gray-scale image stored as a TIFF file.

The book-length document consists of a title page, table of contents, 11 chapters, and an index. Headers and footers alternate on left- and right-hand pages. There are two variations of the long document. Variation 1 is a single document file; variation 2 consists of a separate document file for each test file. Both variations represent plausible means of creating book-length documents and highlight performance/convenience trade-offs. Large document files generally are more convenient, but they slow down execution time. Separating a document into many small files can be inconvenient—especially in Finesse, PFS: First Publisher, and Publish It, which lack chapter file tracking and continuous page numbering for chapters saved in separate files. When a program could not achieve the desired effect in creating a document, NSTL used the closest substitute.

Although all six programs can produce documents containing as many as 99 pages, creating NSTL's 70-page document in Finesse, PFS: First Publisher, and (to a lesser extent) Publish It can be tricky and tedious. These programs do not support extended or expanded memory, and Finesse and PFS: First Publisher do not use hard disk space as virtual memory, as Publish It does. Only the portion of the DOS-addressable 640-kilobyte area not used by device drivers and memory-resident programs is available for the program, screen fonts, and the document. (To work around this problem, documents were divided into smaller files.) PFS: First Publisher imposes another restriction: a per-page memory limit of 5000 text characters. During testing, NSTL's short newsletter exceeded this limit, and the test could not be completed.

To derive an overall performance rating, NSTL used a weighted average of scores for the rated benchmarks. Individual test scores were based on the following formula: (Program Time - Average Time) / (Average Time - Best Time). All results were then rescaled to fall within a 0-to-10 scale.



Weight	*Criteria*
2	Zoom Out/In—Newsletter
2	Got to Page—Newsletter
2	Save Newsletter to Disk
1	Print Page 1, Return of Control
1	Print Page 1, Page Drop
3	Print Page 2, Return of Control
3	Print Page 2, Page Drop
3	Print Page 3, Return of Control
3	Print Page 3, Page Drop
2	Save Book to Disk
2	Print Chapter (Var. 1), Return of Control
2	Print Chapter (Var. 1), Page Drop
2	Print Chapter (Var. 2), Return of Control
2	Print Chapter (Var. 2), Page Drop

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Now you can get the long document power of Ventura Publisher® at substantial savings. We've lowered the list price of our PC Editions a full $100, from $895 to $795. And for a limited time, we're also giving you a lower price on extra software that will expand your desktop publishing productivity. Buy any Ventura Publisher Edition from your local dealer and use the coupon below to save money on another valuable package.

Ventura Publisher's automated features make short work of long documents. That's why the more you have to do, the more you need Ventura. To do even more—for less—act now to take advantage of this Special Offer.

Buy our Windows 3.0 Edition, save $376 on CorelDRAW! The favorite draw program of PC users. Includes hundreds of typefaces plus clip art. CorelDRAW! retail value: $695. Your price: $319.

Buy our Macintosh 3.0 Edition, save $618 on the new NEC CDR-36 CD Reader and Type Gallery PS. A new world of image and type storage plus new fonts. NEC retail: $1097. Your price: $479.

Buy our DOS/GEM 3.0 Edition, save $179 on VP to the Max and Softkicker. Get spell check, search/replace, thesaurus, and auto-scrolling. VP to the Max/Softkicker retail value: $298. Your price: $119.

Buy our OS/2 3.0 Edition, save $376 on CorelDRAW! The favorite draw program of PC users. Includes hundreds of typefaces plus clip art. CorelDRAW! retail value: $695. Your price: $319.

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State: Zip:

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(   )

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P.O. Box 289016
San Diego, CA 92128-9016
Attn: Special Offer

Indicate form of payment enclosed: ☐ Check payable to Ventura Software; ☐ Purchase order from gov't agency; Credit card – ☐ VISA ☐ MasterCard ☐ American Express

Credit Card #________________ Expires________

Cardholder Name________________

Order Form

(Quantity of Special Offer packages ordered cannot exceed quantity of Ventura units purchased.)

Ventura Publisher Edition Purchased	*Special Offer Package (Sorry, no substitutions)*	*Special Offer Price*	*Qty. Ordered*	*Subtotal (Price x Qty.)*	*Circle Disk Type Required*
VP Windows 3.0	CorelDRAW!	$319	#	$	5 1/4" 3 1/2"
VP Macintosh 3.0	CDR-36/Type Gallery PS	$479	#	$	(3 1/2" only)
VP DOS/GEM 3.0	VP to the Max/Softkicker	$119	#	$	5 1/4" 3 1/2"
VP OS/2 3.0	CorelDRAW!	$319	#	$	5 1/4" 3 1/2"
Total Price All Special Offer Packages Ordered				$	
Add tax* in AZ, CA, CT, DC, FL, GA, IL, MA, MI, MN, MO, NJ, NY, PA, TX, VA, WA, Canada				$	
Shipping/Handling: add $20 per each Special Offer ($25 in Canada)				$	
Please enclose full payment ($ U.S. only). AMOUNT:				$	

Good on products purchased April 15-July 31. Coupons must be postmarked by August 15. Allow 2-4 weeks for delivery. This offer cannot be combined with any other promotion and does not apply to purchases of upgrades or Network Nodes. Good in USA and Canada only.
*Please remit sales tax or there may be a delay in processing your order

BYT91

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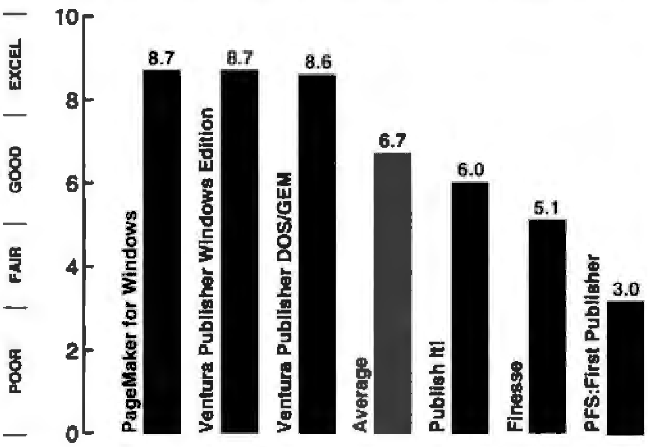
Overall Quality of Display and Printouts

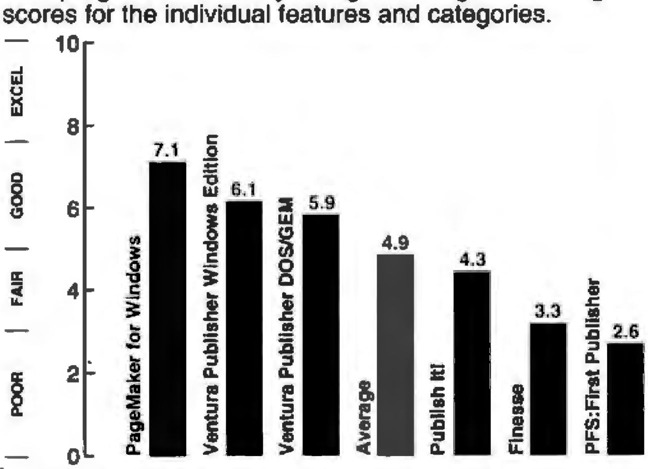
The quality chart summarizes the evaluation of the six products' display quality, document printouts, and document-enhancement capabilities. Display-quality assessments rate a program's ability to display text and graphics on screen. Evaluators judged newsletter printouts for the quality of headline and body text, reproduction of graphics, and tables; book printouts were judged on the quality of text, headers and footers, hyphenation and justification, and creation and maintenance of indexes and tables of contents. (For results from this battery of tests, see the discussion of quality tests and associated graphs included in the "Performance Benchmarks" text box.) The quality rating is a weighted average of scores for individual criteria.



Weight	Criteria
1	Display
2	Newsletter Printout
2	Book Printout
2	Enhancement Capabilities

Overall Versatility

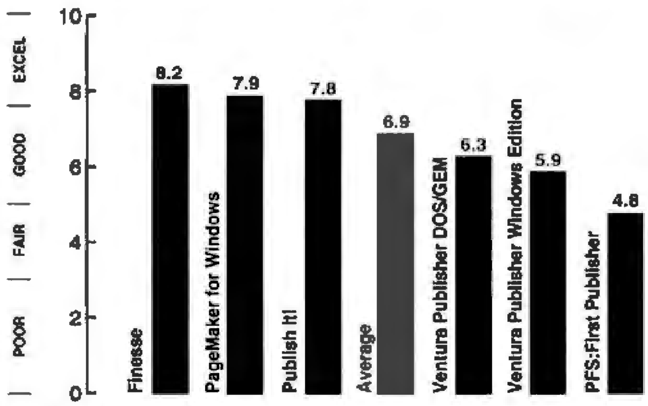
A program's versatility rating is a weighted average of scores for the individual features and categories.



Weight	Criteria
1	Program Parameters
2	Page Layout
2	Text Handling
2	Graphics Handling
2	Input/Output

Overall Ease of Learning

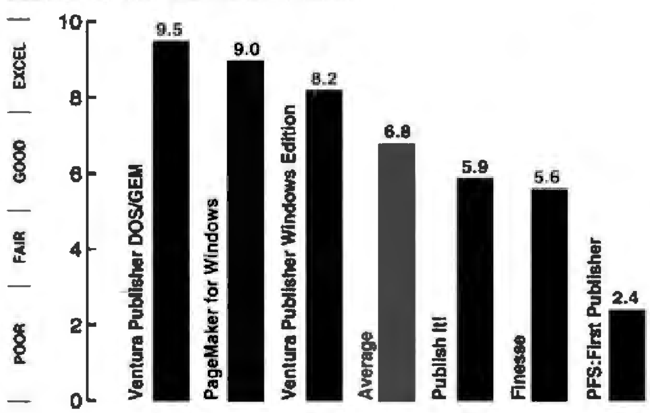
To rate overall ease of learning, testers with varying levels of desktop publishing experience studied the programs' manuals, tutorials, and other learning and reference material and then assessed how easy it was to learn a series of publishing tasks while creating documents. Testers then ranked the programs from best to worst on general ease of learning for all tasks. The ease-of-learning rating is a weighted average of scores for the individual criteria.



Weight	Criteria
2	Manual
2	Program Interface
1	Creation of Newsletter Template
1	Flowing Text and Placing Graphics
2	Paragraph Formatting
1	File Management
4	General Ease of Learning

Overall Ease of Use

After learning the programs, testers evaluated the packages' usability while creating documents. Testers then ranked the programs from best to worst on general ease of use. The ease-of-use rating is a weighted average of scores for the individual criteria.



Weight	Criteria
2	Manual
2	Program Interface
1	Creation of Newsletter Template
1	Flowing Text and Placing Graphics
2	Paragraph Formatting
1	File Management
4	General Ease of Learning

There's more to comparing LaserJet memory boards than just the name.

	Pacific Data Products	Hewlett-Packard
Price	1 MB /$149 2 MB /$219 4 MB /$399	1 MB /$230 2 MB /$390 4 MB /Not Available
Warranty	Lifetime	One Year
Upgradeability	Fully Upgradeable to 4 MB	Not Upgradeable

Don't settle for less just to buy the HP label. Get more for less with Pacific Data Products **Pacific 4 Memory**™ for HP LaserJet IIP, III, IIID, and IIIP printers. With **Pacific 4 Memory** you get 4 MB of memory for not much more than the price of 2 MB from HP. And each board is upgradeable, so you can start with 1 MB of memory then simply install additional memory chips when you need more.

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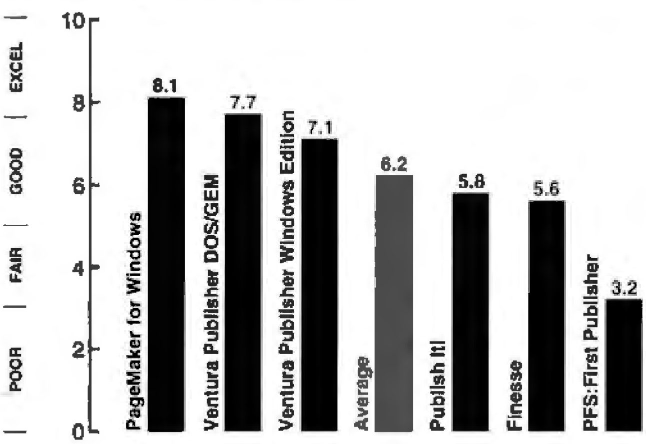
The Final Analyses

After testing each desktop publishing package in the five categories, NSTL computed two overall ratings. The first establishes a power-versus-usability index by weighting the characteristics relating to power (performance, quality of printed documents, and versatility) and those relating to usability (ease of learning and ease of use) and plotting the scores for each program on a grid (see "Power vs. Usability" on page 156). The second overall rating establishes the top desktop publisher among the six advanced programs tested. NSTL recommends as good buys the products designated with a checkmark (✓).

Overall Evaluation

NSTL's overall evaluation is a weighted average of scores in six areas: the five main evaluation categories plus the testers' general evaluation.



Weight	*Criteria*
2	Performance
4	Quality of Printed Documents
4	Versatility
3	Ease of Learning
6	Ease of Use
1	Testers' General Evaluation

PAGEMAKER FOR WINDOWS 4.0 ✓

PageMaker's extensive features, high-quality output, and improved performance make it an excellent desktop publisher for general business documents. In every category, PageMaker's features consistently cover a broad range. The new integrated word processing environment, table editor, table-of-contents generator, indexing capabilities, and file linking with link management extend the depth of a very intuitive product backed by excellent documentation.

The program produces tremendously appealing output relatively quickly and with comparative ease. Now that PageMaker offers Macintosh and DOS versions with file compatibility, businesses running both operating systems can transfer files between environments for editing and printing.

VENTURA PUBLISHER DOS/GEM 3.0 ✓

Ventura Publisher's forte is the high degree of control it provides over formatting and the maintenance tasks associated with routine production of long documents. For technical manuals and other long documents that require automatic numbering of chapters, sections, tables, and figures, Ventura is a better choice than PageMaker.

The DOS/GEM edition produces high-quality output equal to PageMaker's, but the program lacks PageMaker's extensive word processing features and file import/export support. Like PageMaker, Ventura Publisher DOS/GEM (as well as the Windows version) is available in both the Macintosh and DOS formats.

VENTURA PUBLISHER FOR WINDOWS 3.0 ✓

Unless your computing environment demands compatibility with Windows, NSTL recommends the DOS/GEM version of the package over the Windows version. The former's wide array of formatting controls for short and long documents increases learning difficulty, but the flexibility of these controls makes the program easier to use once you learn your way around.

Ventura Publisher DOS/GEM and Ventura Publisher for Windows exhibit more pronounced differences in usability and performance than in features. Specifically, the DOS/GEM version loads its hyphenation dictionary into expanded memory when the program is started; for certain operations, this affords Ventura Publisher DOS/GEM a substantial performance advantage over Ventura Publisher for Windows, which does not employ this technique.

PUBLISH IT 1.21

A reduced feature set and a very simple interface make Publish It comparatively easy to learn, but the program's usability is adversely affected by its lack of key features. One of Publish It's greatest strengths is its collection of predesigned templates; one of its greatest weaknesses is that it doesn't permit changes to a document's basic page-layout characteristics once they are set.

FINESSE 3.1

Like Publish It, Finesse's limited feature set makes the program easy to learn but reduces its versatility, as well as the quality of its on-screen display and its printouts. The program does excel in the performance area, however, quickly saving and printing files that have object graphics or that contain images scanned directly into the program.

PFS: FIRST PUBLISHER

PFS: First Publisher has little to recommend it for dedicated business publishing; users will get comparatively poor output quality and performance, very limited features, and the frustration of trying to implement them. PFS: First Publisher also shares with Finesse a lack of support for expanded and extended memory, which means that the size of a document is limited to the amount of available system memory.

Performance Benchmarks

NSTL used the following short-document benchmarks to establish a performance rating for each of the six desktop publishers.

If You Have Windows 3.0... You Should Have CorelDRAW!

CorelDRAW 2.0. It's the award winning PC graphics package that's easy to learn and use. If you're artistic, you can create your own graphics from scratch with CorelDRAW's powerful drawing tools. In a hurry? Choose from CorelDRAW's collection of over 4000 clipart images and symbols, or use CorelTRACE to automatically trace scanned images and bitmaps. You can even import graphics from other packages and jazz them up in CorelDRAW.

And the CD-ROM version of CorelDRAW comes with over 3500 extra clipart images from ArtRight — a $2000 value.

Thanks to the large storage capacity of the CD-ROM, we are able to offer top quality images and symbols in uncompressed format, for easy and instant access.

If you don't already have a CD-ROM drive, Corel offers a package that includes CorelDRAW, a high-performance CD-ROM drive and an easy to use CorelDRIVER SCSI interface kit. Corel offers you powerful plug and play solutions for all your CD-ROM needs, as well as access to the hundreds of exciting CDs available.

Ride the CD-ROM and multimedia wave today!

COREL
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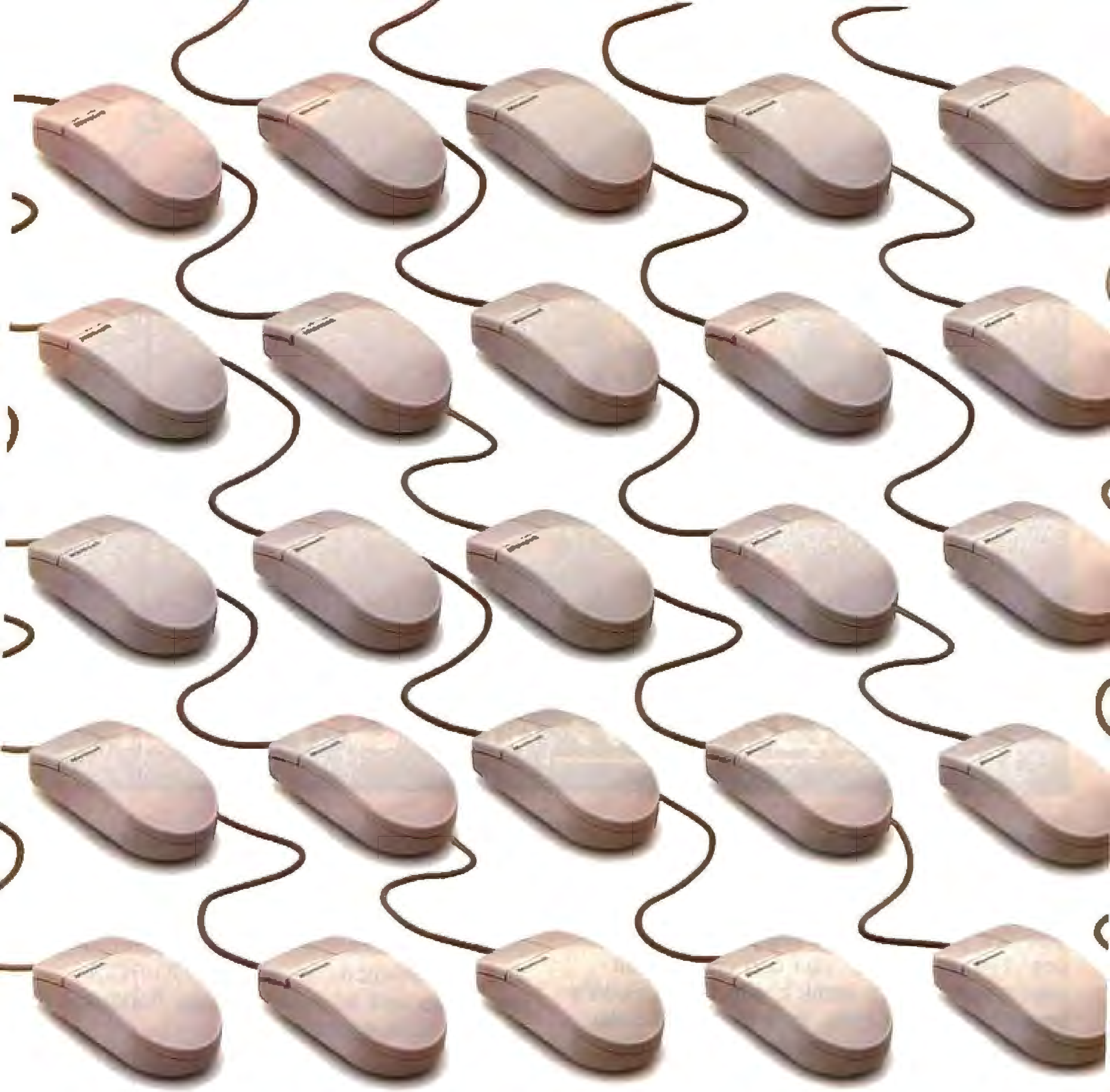
Circle 74 on Inquiry Card (RESELLERS: 75).



When you build a better mous

Microsoft® Mouse devotees number over 6 million, and counting.

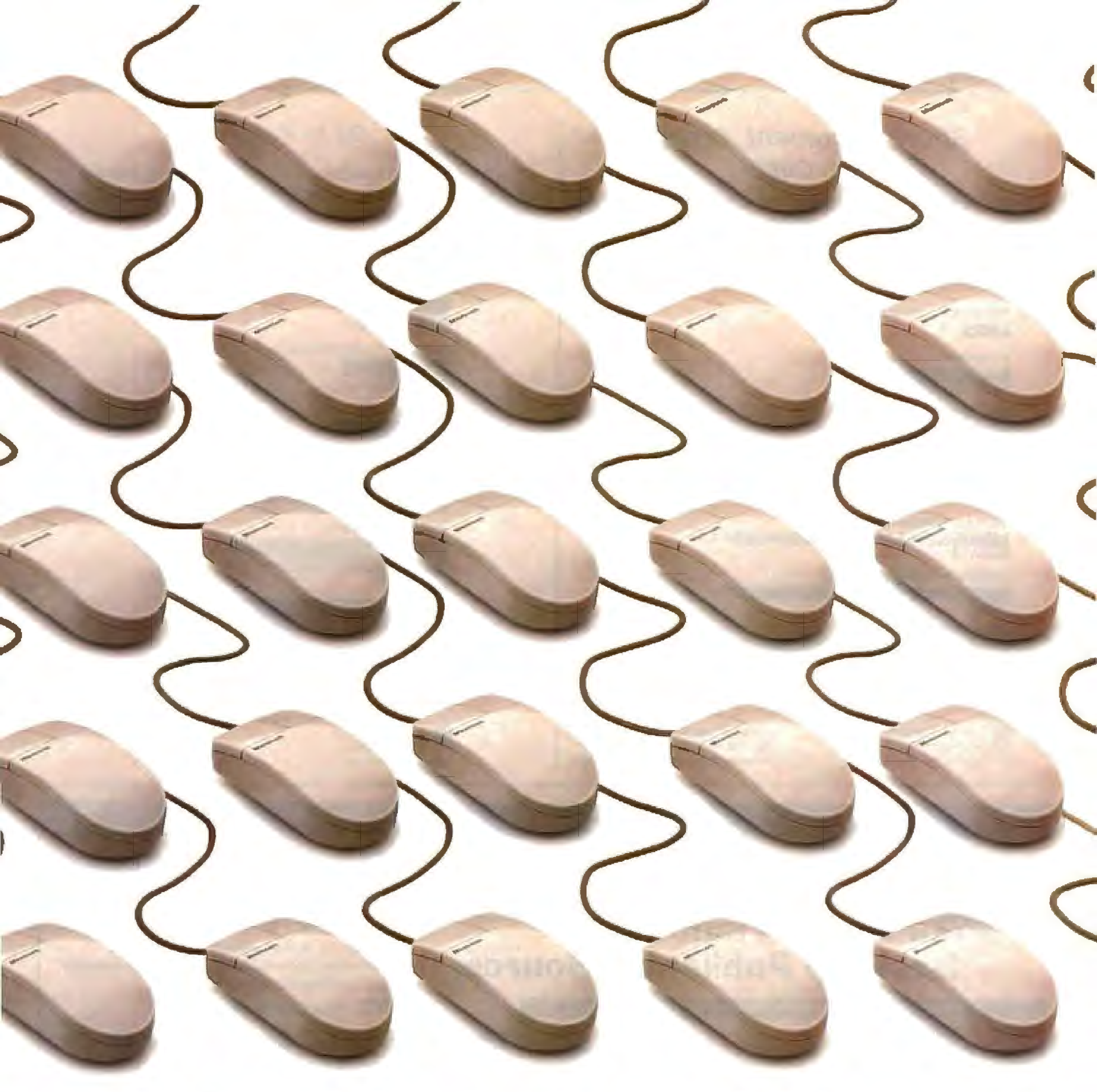
Just what kind of mouse inspires people this way?

Well, the kind with a patented ergonomic design and high resolution, 400-points-per-inch tracking.

The kind of mouse that wins the *PC Magazine* Editors' Choice Award *and* Technical Excellence Award.

Not to mention the Innovation in America Design Award from *Business Week*, the Industrial

PC MAGAZINE EDITORS' CHOICE



e, you build a bigger following.

Design Award from *Industrie Forum* and others.

And incidentally, no mouse works better with another innovation of ours, Microsoft Windows™ graphical environment version 3.0.

To track down America's number one mouse, call (800) 541-1261, Department P98.

We'll be happy to point you in the right direction.

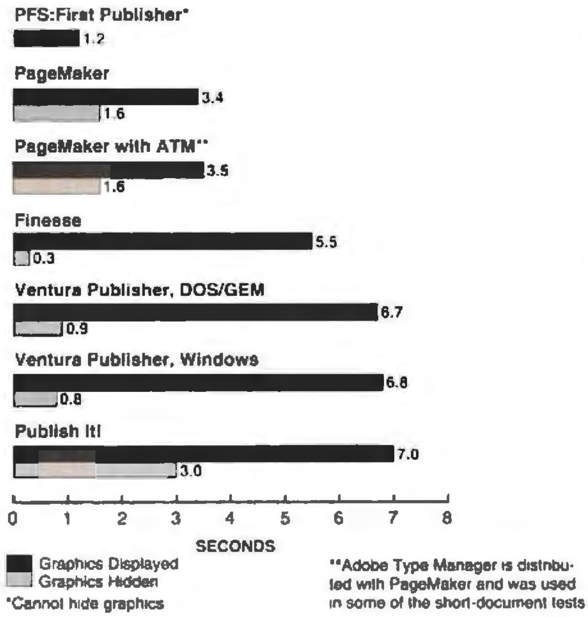
Microsoft

Making it all make sense™

Short-Document Tests

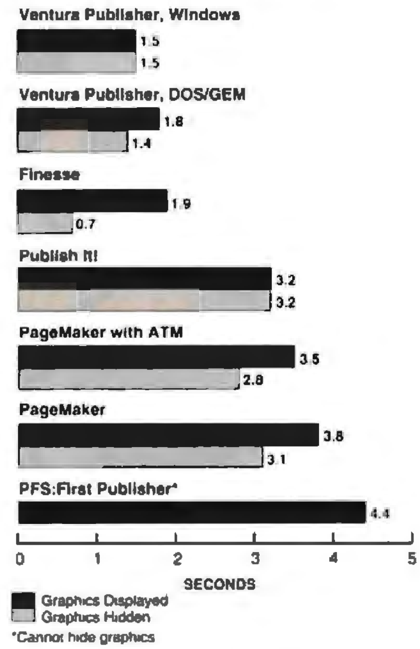
Zoom Out/In

Each program changed from an actual-size view of a page containing a scanned gray-scale image to a full-page view and vice versa; times were averaged. The test was timed until return of program control and was repeated with the graphics hidden.



Go to Page

Each program moved to another page using the Go to Page function; the operation was timed until program control was restored. The page contained line art attached to an EPS file and tracked and kerned text. The test was repeated with the graphics hidden.



If you need more megabytes than your hard disk can swallow, don't buy a new drive. Stretch it with Stacker.

Stacker is the fastest, most economical way to safely double your hard disk capacity. Without sacrificing DOS compatibility. It's the new standard in real-time data compression.

- Increase storage 100%
- Compatible with DOS 3.x, 4.x
- Industry's fastest real-time data compression
- Includes disk caching
- Fastest, easiest installation
- Toll-free technical support
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And it's the only product of its kind available in both software and coprocessor versions.

Stacker is fully compatible with Windows 3.0 and all your favorite disk utilities, too. Plus, Stacker includes a powerful disk caching program for added performance.

And when you add the Stacker coprocessor card you also get the fastest data compression in the business.

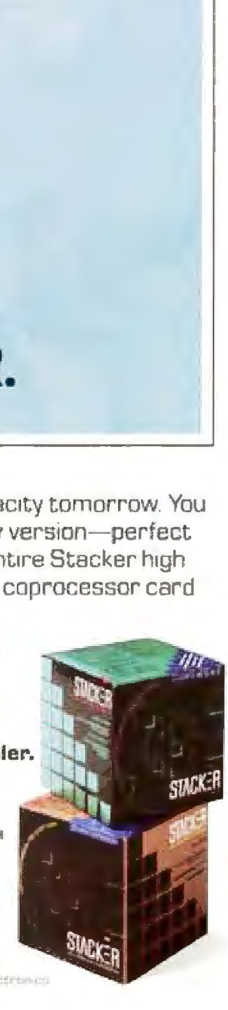
No wonder there are already over a million satisfied users of Stac's compression technology.

So call today and double your disk capacity tomorrow. You can purchase the Stacker software-only version—perfect for laptops—for only $149. Or get the entire Stacker high performance system with software and coprocessor card for just $229.

Order today. Visa, MasterCard, American Express cards accepted.

1-800-522-7822

Or see your local computer/software dealer.

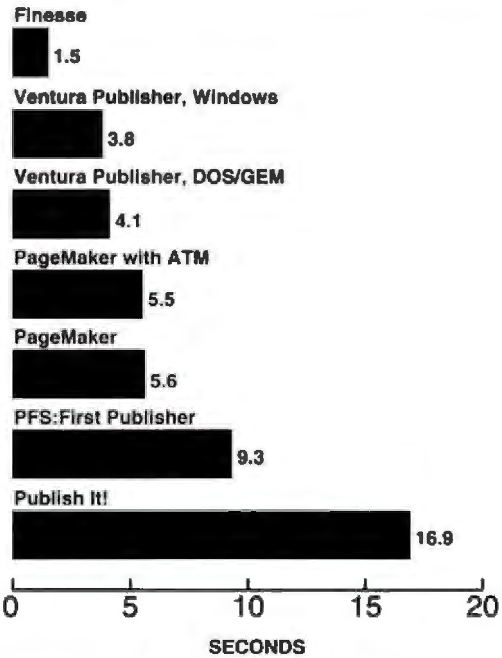


STACKER™

Circle 265 on Inquiry Card (RESELLERS: 266).

Save to Disk

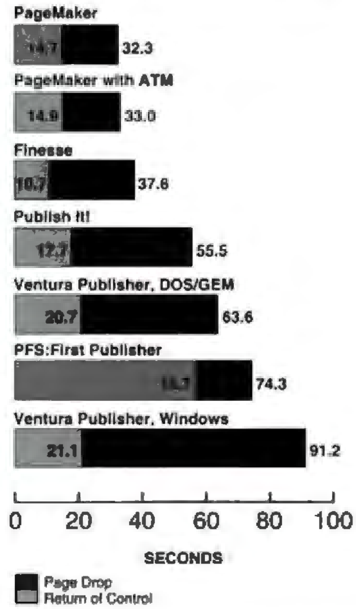
Each program saved the short document under a new name; the operation was timed until program control was restored. Saving the file under a new name ensured that the program saved the entire file, rather than merely updating it.



Print Speed

Each program printed individual newsletter pages; the operation was timed until the return of program control and each page was printed (page drop). The printer was turned on and a trial print was executed to download the PostScript header file prior to benchmark timing. Test results showed the difference between printing in proof mode and quality mode, and differences caused by page content (gray-scale graphics on page 3 and EPS object graphics on page 2). The EPS graphics on page 2 monopolized printer time, and the gray-scale graphics on page 3 monopolized computer time. Page 1, the control page, contained text and graphics (rules and boxes) created within the program.

Spooler programs reduced return-of-control times, sometimes at the expense of longer page-drop times. Programs that included spoolers were tested with and without spooling.



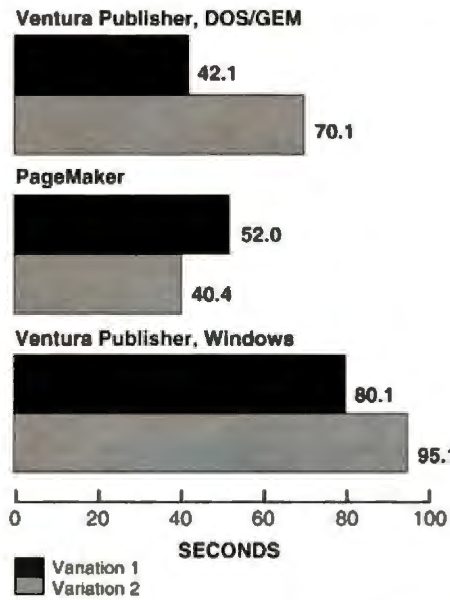
Long-Document Tests

Reformat Document

Each program globally changed the document's body text from 12-point Times Roman with two points of spacing (leading) to 11-point Times Roman with one point of leading, and vice versa; the two times were averaged. The programs were tested with variation 1 and the first chapter of variation 2.

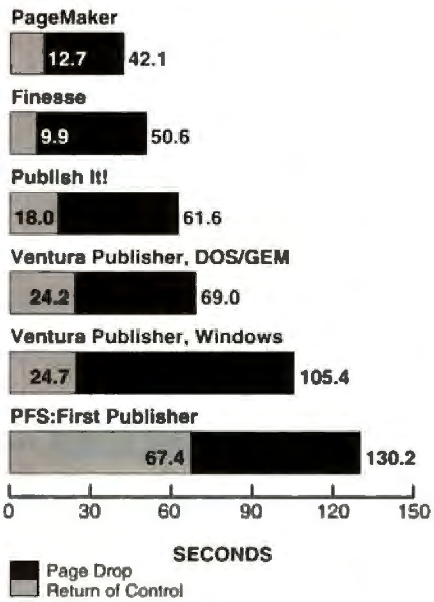
Create Table of Contents

Each program automatically created a table of contents with accurate page references using 11 tagged chapter titles; the operation was timed until the return of program control. The programs were tested with variation 1 and variation 2. Finesse, PFS: First Publisher, and Publish It do not offer automatic table of contents generation.



Print Chapter 6

Each program printed a three-page chapter located near the middle of the long document; the operation was timed until the return of program control. The programs were tested with variation 1 and variation 2, with and without spooling. The printer was turned on and a trial page was printed to download the PostScript header file before benchmark timing began.



Quality Tests

Display Quality

NSTL evaluated each program's ability to represent final printed output on screen; of particular importance were the display quality of headline text, body text, and imported graphics.

	Finesse	PageMaker Windows	PFS: First Publisher	Publish It	Ventura DOS/GEM	Ventura Windows
Display Quality	7.0	9.5	3.5	5.5	9.3	9.3
Headline Text	3.0	5.0	3.0	3.0	5.0	5.0
Body Text	4.0	5.0	1.0	4.0	5.0	5.0
Page 3 Graphic	2.0	4.0	1.0	3.0	3.5	3.5
Page 2 Graphic	5.0	5.0	2.0	1.0	5.0	5.0

1=Poor 2=Below Average 3=Average
4=Above Average 5=Excellent

Print Quality of the Short Document

NSTL evaluated each program's short-document printout for the quality of its headline and body text, table formatting, and rendering of imported graphics files.

	Finesse	PageMaker Windows	PFS: First Publisher	Publish It	Ventura DOS/GEM	Ventura Windows
Short Document	6.4	10.0	3.2	8.4	10.0	10.0
Headline Text	3.0	5.0	2.0	4.0	5.0	5.0
Body Text	4.0	5.0	3.0	4.0	5.0	5.0
Page 3 Graphic	2.0	5.0	1.0	3.0	5.0	5.0
Page 2 Graphic	3.0	5.0	1.0	5.0	5.0	5.0
Product List Table	4.0	5.0	1.0	5.0	5.0	5.0

1=Poor 2=Below Average 3=Average
4=Above Average 5=Excellent

Print Quality of the Long Document

NSTL evaluated each program's long-document printout for the quality of its headline and body text, hyphenation and justification, and headers and footers. NSTL also considered the program's ability to enhance the publishing process with index and table-of-contents generation and by establishing and maintaining cross-references.

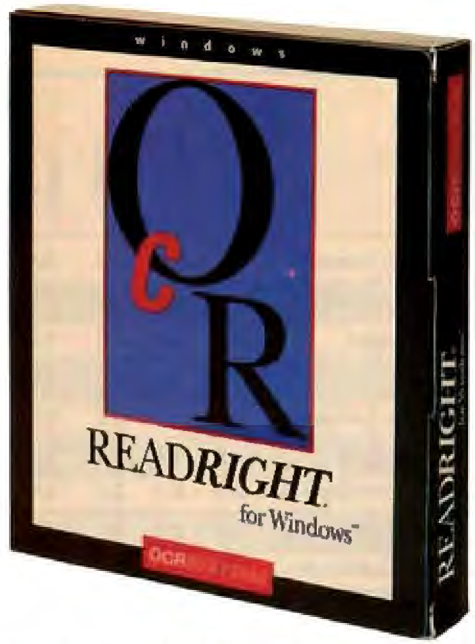
	Finesse	PageMaker Windows	PFS: First Publisher	Publish It	Ventura DOS/GEM	Ventura Windows
Long Document	5.2	8.6	3.2	6.2	9.4	9.4
Headline Text	4.0	5.0	3.0	4.0	5.0	5.0
Body Text	3.0	4.5	2.0	4.5	4.5	4.5
Headers & Footers	3.0	4.0	1.0	3.0	5.0	5.0
Hyphenation & Justification	2.0	4.0	1.0	3.0	5.0	5.0
Index Creation & Maintenance	1.0	4.0	1.0	1.0	4.0	4.0

1=Poor 2=Below Average 3=Average
4=Above Average 5=Excellent

Document Enhancements

NSTL evaluated each program's features for enhancing the quality of printed output, including the number of predesigned templates, typeface and page-description language support, kerning and tracking, named-style formatting, hyphenation and justification, numbering and referencing, table formatting, drawing, graphics manipulation, image control, and color support.

Table on following page ➡



Sometimes the best way to solve a problem is to put two heads together. That's why OCR Systems, Inc. and ZyLAB Corporation—developers of the leading OCR and text search/retrieval products—have teamed up to offer you a special software bundle of their new Windows 3.0 products. ReadRight for Windows and ZyINDEX for Windows will make document management *easy* for you. Not to mention affordable.

Document Management for Windows.

First, Text Recognition . . .

Even the power of Windows 3.0 won't help you to manage your documents while they're still on your desk. But with ReadRight for Windows and your full-page scanner, you can convert your paper documents to text files that you can use in your favorite software applications. ReadRight for Windows is an omnifont OCR product that offers you the highest level of accuracy (99.9%) at an affordable price. And with plenty of features to help you tackle your paper documents.

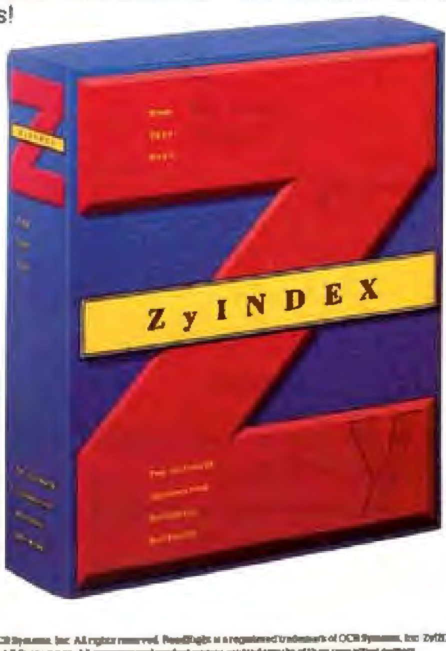
Like a built-in dictionary that enhances ReadRight's already impressive accuracy. You can even add your own words to a user dictionary. And with the pop-up error checker, you can proof the recognized text against the scanned image without ever looking back at the original document.

ReadRight automatically separates text from graphics, even on pages with complex formats, for faster text recognition. Or if you don't want to put the whole page online, you can clip the paragraphs that you want ReadRight to recognize. You can design templates to quickly process pages with similar layouts. And ReadRight handles stacks of pages, single- or double-sided. You can even defer processing so your computer isn't tied up when you need it.

ReadRight reads practically any page—typewritten, typeset, laser-printed, NLQ dot matrix, and fax images. Even text that's bold, underlined, or italics, from 6 to 72 points. And ReadRight outputs the text directly into the formats of your other software applications.

. . . And Then Text Retrieval . . .

Once you've recognized your documents with ReadRight, ZyINDEX for Windows can help you to find those documents when you need them. With ZyINDEX, you can simultaneously search through all of your online documents—200,000 pages or more, even entire networks—with results in less than 3 seconds!



Prepare your entire drive for searching with just one keystroke. So if you work on a network or with frequently updated text, you don't have to go through long procedures to find new information.

And searching is easy. To find a word, just enter it. All instructions are in plain English on the screen when you need them.

ZyINDEX provides a full set of search techniques. Like Boolean logic (AND, OR, NOT) searches. And wildcards so you can find forms of words—such as "combine," "combination," and "uncombined"—in the same search. You can even do proximity searches to find documents that contain words which you know will appear near each other. Or search by phrases, so if you're looking for "New Jersey," you don't also find "New York" and "New Mexico."

ZyINDEX simultaneously searches text located across multiple subdirectories and drives, regardless of the document format.

Select any document for viewing. Browse or jump from document to document or "hit" to "hit." Scroll through entire documents at will.

ZyINDEX displays every occurrence of your search request and highlights the word, phrase, or date you're looking for. Once found, you can copy and paste, print, and/or report.

. . . For An Unbeatable Combination!

And an unbeatable price. Sold separately, these two products total $895. But through September 1, you can buy ReadRight for Windows and ZyINDEX for Windows together at a special price of $595. That's a $300 savings.

To take advantage of this limited time offer or for further information, call **(800) 233-4627.**

Free working demonstration disks are available.

Circle 309 on Inquiry Card (RESELLERS: 310).

ReadRight™ for Windows™
The #1 OCR Software

OCR Systems, Inc.
1800 Byberry Road, Suite 1405
Huntingdon Valley, PA 19006
(215) 938-7460 Fax (215) 938-7465

ZyINDEX™ for Windows™
The #1 Search/Retrieval Software

ZyLAB Corporation
100 Lexington Drive
Buffalo Grove, IL 60090
(708) 459-8000 Fax (708) 459-8054

	Finesse	PageMaker Windows	PFS: First Publisher	Publish It	Ventura DOS/GEM	Ventura Windows
Document Enhancements	2.9	7.0	2.2	3.8	6.0	6.3
Templates & Stylesheets	2.5	7.2	3.7	8.7	5.7	5.7
Screen Environment	5.3	7.4	4.2	7.2	7.0	7.4
Spell Checker	3.1	7.5	0.0	0.0	0.0	0.0
Fonts/Page Des. Language	2.0	6.0	3.2	3.7	4.5	6.5
Character Formatting	3.7	9.2	4.7	3.7	7.1	7.1
Paragraph/Column/Document	2.8	6.7	2.2	2.5	8.3	8.3
Long Document Formatting	1.2	5.9	0.7	1.0	8.6	8.6
Hyphenation & Justification	4.5	9.1	2.4	6.8	9.0	8.1
Special Formatting	0.8	3.5	2.7	0.2	4.7	4.7
Graphic Handling	2.0	5.6	2.0	3.3	4.1	4.1
Graphic File Formats	1.8	6.6	2.1	4.3	5.8	5.6
Printing	4.6	9.8	1.2	4.2	7.3	9.4

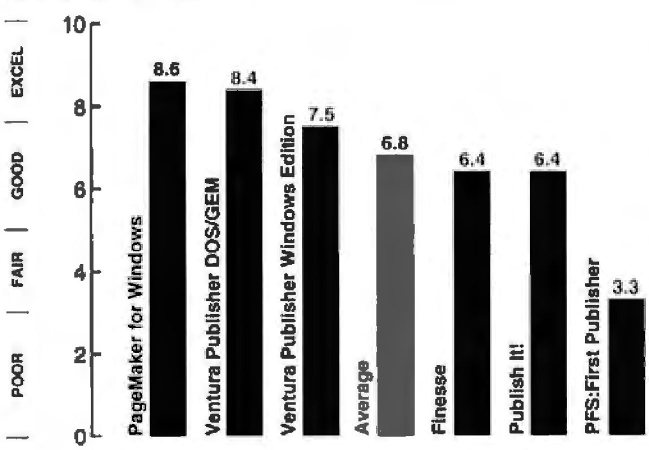
1=Poor 2=Below Average 3=Average
4=Above Average 5=Excellent

Power vs. Usability

One way to judge the effectiveness of advanced desktop publishing programs is to analyze how well they balance power and usability. NSTL first rated the programs in each category and then plotted the programs' scores to produce an index of power versus usability.

Overall Power

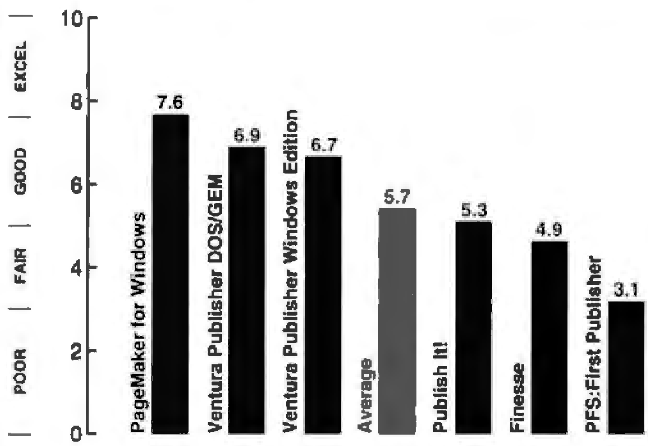
Overall power is a weighted average of scores for the individual criteria.



Weight	*Criteria*
2	Performance
4	Quality of Display and Printouts
4	Versatility

Overall Usability

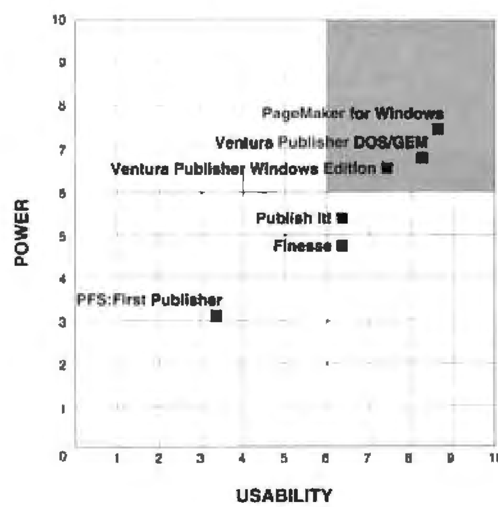
Overall usability is a weighted average of scores for the individual criteria.



Weight	*Criteria*
3	Ease of Learning
6	Ease of Use
1	Testers' General Evaluation

Index of Power vs. Usability

Programs plotted in or near the shaded portion of the chart come closest to having the ideal combination of power and usability. Programs plotted in the center of the chart are equally powerful and useful. Those that fall near the diagonal in the upper-right corner exhibit a balance of power and usability that becomes less acceptable toward the lower-left corner. Difficult, yet powerful, programs gravitate to the upper left, and very accessible programs with little power gravitate to the lower right.



To compute the coordinates for each program, NSTL used the following weighted formulas:

Overall Power = ((2 x Performance Score) + (4 x Quality Score) + (4 x Versatility Score)) / 10

Overall Usability = ((3 x Ease of Learning Score) + (6 x Ease of Use Score) + Testers' General Evaluation) / 10

PageMaker and Ventura Publisher: Composition Techniques

One of PageMaker's greatest compositional strengths is an electronic pasteboard that provides users with quick access to text elements and easy on-screen manipulation of graphics and text. The pasteboard approach lends itself well to the assembly of short documents with varying page specifications—newsletters, brochures, and the like. It gives users a rough idea of how documents will look when printed, and they can then tinker with the placement or formatting of blocks of text and graphics.

Ventura Publisher, on the other hand, offers a style-sheet file that contains page, paragraph, and character information, as well as information about simple graphic elements, such as rules and boxes. The process of breaking out and defining individual elements of a document requires some planning and initial concentration that can be postponed using PageMaker's pasteboard method—hence PageMaker's higher ease-of-learning scores. The payoffs for time spent in planning and document setup in Ventura Publisher are the ease, precision, and flexibility with which you can globally manipulate text and graphics. Ventura Publisher is best for document layouts that vary little from page to page and from production deadline to production deadline. Since the page formatting of book-length documents tends to be simple and requires more powerful global formatting controls, Ventura is at its best when used to produce long documents.

Something Borrowed...

Aldus and Ventura have added elements to make their programs more useful in the other's area of strength, but overall the programs' respective areas of expertise remain largely unchallenged.

Aldus has gradually introduced paragraph-level style sheets in PageMaker, adding a good deal of global formatting control, but this control is less precise than it is in Ventura. Ventura Publisher users can apply formatting hierarchically at document, page, text-block (frame), and character level. More recently, Aldus expanded PageMaker's capabilities to include indexing and creation of tables of contents, but PageMaker's long-document capability still lacks the key elements that distinguish Ventura Publisher.

Ventura has changed its product's preview of facing pages so that it now permits text formatting and editing. Users still cannot move blocks of text or graphics between the facing pages as they can in PageMaker, however.

Vendors of PC-Based Desktop Publishing Software Not Reviewed

Frame Technology Corp.
1010 Rincon Circle
San Jose, CA 95131
(408) 433-3311

Interleaf, Inc.
10 Canal Park
Cambridge, MA 02141
(617) 577-9800

Personal Tex, Inc.
12 Madrona Ave.
Mill Valley, CA 94941
(415) 388-8853

Power Up Software Corp.
2929 Campus Dr.
San Mateo, CA 94403
(415) 345-5900

Quark, Inc.
300 South Jackson St.
Ste. 100
Denver, CO 80209
(303) 934-2211

Unison World
1321 Harbor Bay Pkwy.
Alameda, CA 94501
(415) 748-6670

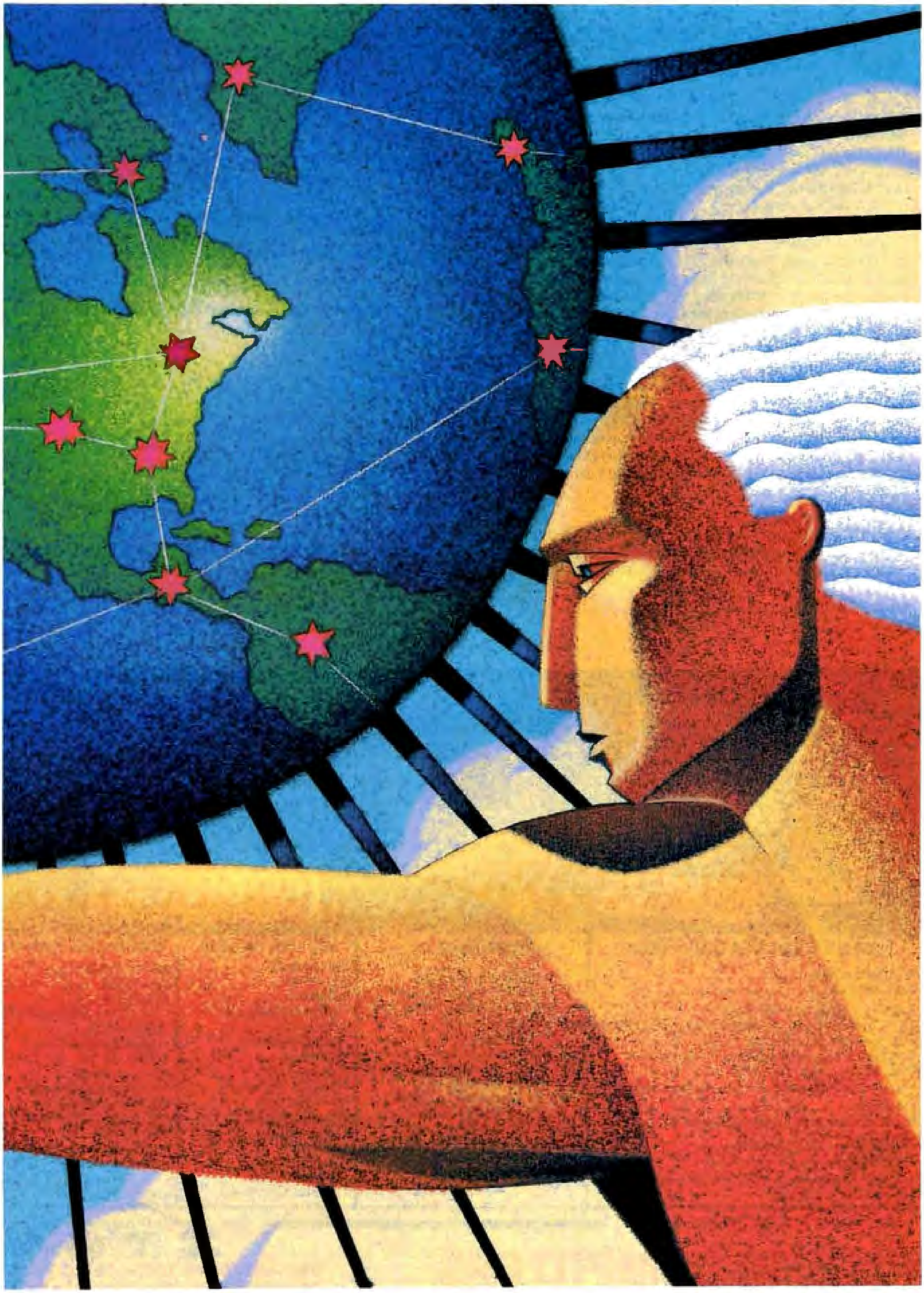


ILLUSTRATION: DAVID TILLINGHAST © 1991

WIDE-AREA NETWORKING

Circling the world in 80 days was once considered quite a feat. Today, however, if it takes 80 seconds to move data that far, we lose patience. We have become accustomed to the nearly instantaneous accessibility of information. We have come to expect the miraculous.

As in the movie *Around the World in 80 Days*, where Phineas T. Fogg combined a variety of modes of transportation to accomplish his goal, today's trip around the world, across the country, or throughout your enterprise may involve combining a variety of networks in a variety of ways into a wide-area network (WAN). Some sections of the trip may be through private or proprietary networks, while others take their turn on public data highways.

Wide-area networking includes many different types and levels of connections and provides the means for connecting remote sites—and/or LANs—into a single system across one or more networks. In "Remote Connections," Roedy Green looks at various ways of connecting remote systems—similar or dissimilar, networked or not—into a single network, as well as the pitfalls you can run into when you ignore the fact that they're still physically separate systems. In the text box "You've Been Framed," Bob Ryan describes frame relay, a new technology that significantly improves the throughput speed of X.25 connections.

ISDN is another way to connect remote systems. I know, I know—"ISDN is old hat," and it seems to have atrophied and died on its painfully slow road to market. But take note: There may be life in the old girl yet. A number of major ISDN companies and organizations have at long last signed an implementation agreement. In the text box "ISDN: Is It or Isn't It?" Janet J. Barron examines National ISDN 1.

Actually implementing a WAN within the confines of a multilocation—or even multinational—corporation involves a great deal more than just finding out what connections you can make, however. You need specifics. You need to consider a myriad of details and choices to create the appropriate configuration for your business. In "Create a WAN," Peter Stephenson discusses the five main steps necessary to implement a corporate WAN. In the accompanying piece, "Selecting a PDN," he describes some of the public data network offerings available.

One data network not yet available is the National Research and Education Network. While there is broad-based agreement on the need for such a service, the subject of who should fund and sponsor it causes significant disagreement. In "Whither NREN?" Sharon Fisher looks at this network—its potential advantages and liabilities and opinions for and against it. In the text box "Feeding the Internet," she describes the Internet, a network also devoted to research and education, and NREN's forerunner.

BYTE is also pleased to present the case for NREN as made by its main congressional proponent. In the text box "A National Vision," U.S. Senator Al Gore eloquently explains why the U.S. needs NREN to compete in a global marketplace.

At today's pace of life, 80 days seems too long to wait for anything. Certainly, in a global marketplace, we need the best and fastest communications possible to remain competitively in sync with Germany, Japan, Taiwan, and other nations. Even the values of our respective currencies change constantly.

Wide-area networking can forge the connections to keep us constantly in touch around the world. Then we can reserve *Around the World in 80 Days* for the pure enjoyment of leisurely travel—or for a spot in our video libraries.

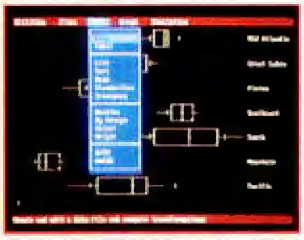
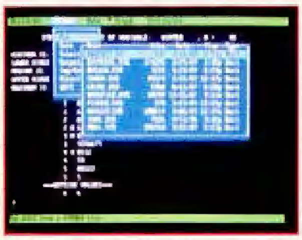
—Jane Morrill Tazelaar
Senior Editor,
State of the Art

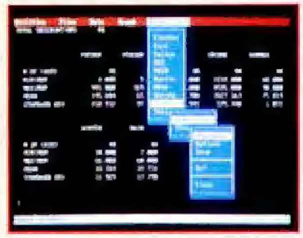
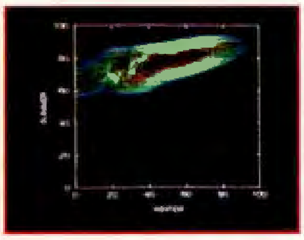
The best got better.

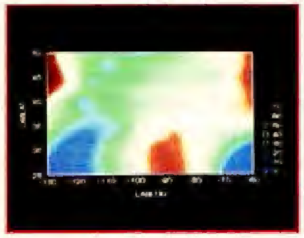
SYSTAT 5.0's new menus make the top-rated statistical program even easier to use.

V 4.1

SYSTAT is the *only* package to receive these three awards.




New Features Menus or commands – your choice ▪ Rewritten documentation includes statistics tutorials ▪ Fast, built-in drivers for SYGRAPH ▪ Global mapping and many new plots ▪ Multi way repeated measures ▪ Means model for missing cells designs ▪ Post-hoc tests ▪ Interactive stepwise regression.

Statistics Basic statistics, frequencies, *t*-tests, post-hoc tests ▪ Multi way crosstabs with log-linear modeling, association coefficients, PRE statistics, Mantel-Haenszel, asymptotic standard errors ▪ Nonparametric statistics (sign, runs, Wilcoxon, Kruskal-Wallis, Friedman two-way ANOVA, Mann-Whitney U, Kolmogorov-Smirnov, Lilliefors, Kendall coefficient of concordance) ▪ Pairwise/listwise deletion of missing values, Pearson correlation, SSCP, covariance, Spearman, Gamma, Kendall Tau, Euclidean distances, binary similarities ▪ Linear, polynomial, multiple, stepwise, weighted regression with extended diagnostics ▪ Multivariate general linear model includes multi way ANOVA, ANCOVA, MANOVA, repeated measures, canonical correlation ▪ Principal components, factor analysis, rotations, components scores ▪ Multidimensional scaling ▪ Multiple and canonical discriminant analysis, Bayesian classification ▪ Cluster analysis (hierarchical, single, average, complete, median, centroid linkage, k-means, cases, variables) ▪ Time series (smoothers, exponential smoothing, seasonal and nonseasonal ARIMA, ACF, PACF, CCF, transformations, Fourier analysis) ▪ Nonlinear estimation (nonlinear regression, maximum likelihood estimation, and more).

Graphics Overlay plots ▪ Drivers for most graphics devices ▪ *Two-dimensional:* Error bars ▪ Scatterplots ▪ Line and vector graphs ▪ Vector, dot, bubble and quantile plots ▪ Bar graphs (single, multiple, stacked, range) ▪ Box plots (single and grouped) ▪ Stem-and-leaf diagrams ▪ Linear, quadratic, step, spline, polynomial, LOWESS, exponential smoothing ▪ Confidence intervals and ellipses (any alpha value) ▪ Smooth mathematical functions ▪ Rectangular or polar coordinates ▪ Log and power scales ▪ ANOVA interaction plots ▪ Histograms (regular, cumulative, fuzzy) ▪ Stripe and jitter plots ▪ Gaussian histogram smoothing ▪ Scatterplot matrices ▪ Voronoi tesselations ▪ Minimum spanning tree ▪ Maps with geographic projections (U.S. state boundary file included, county and world boundary files available) ▪ Chernoff faces ▪ Star plots ▪ Fourier plots ▪ Pie charts ▪ Contour plots on regularly and irregularly spaced points ▪ Control charts and limits ▪ *Three-dimensional:* Data plots ▪ Smooth function plots ▪ Vector plots ▪ Linear, quadratic, spline, least squares surface smoothing ▪ Typefaces that print in perspective.

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REMOTE CONNECTIONS

A WAN can turn all your sites into one seamless whole? Don't you believe it.

ROEDY GREEN

In the broadest sense, a wide-area network (WAN) is a group of computers that are both physically separated by long distances and logically tied together. In the narrowest sense, it is a bridge that connects remote LANs so they look like one big LAN.

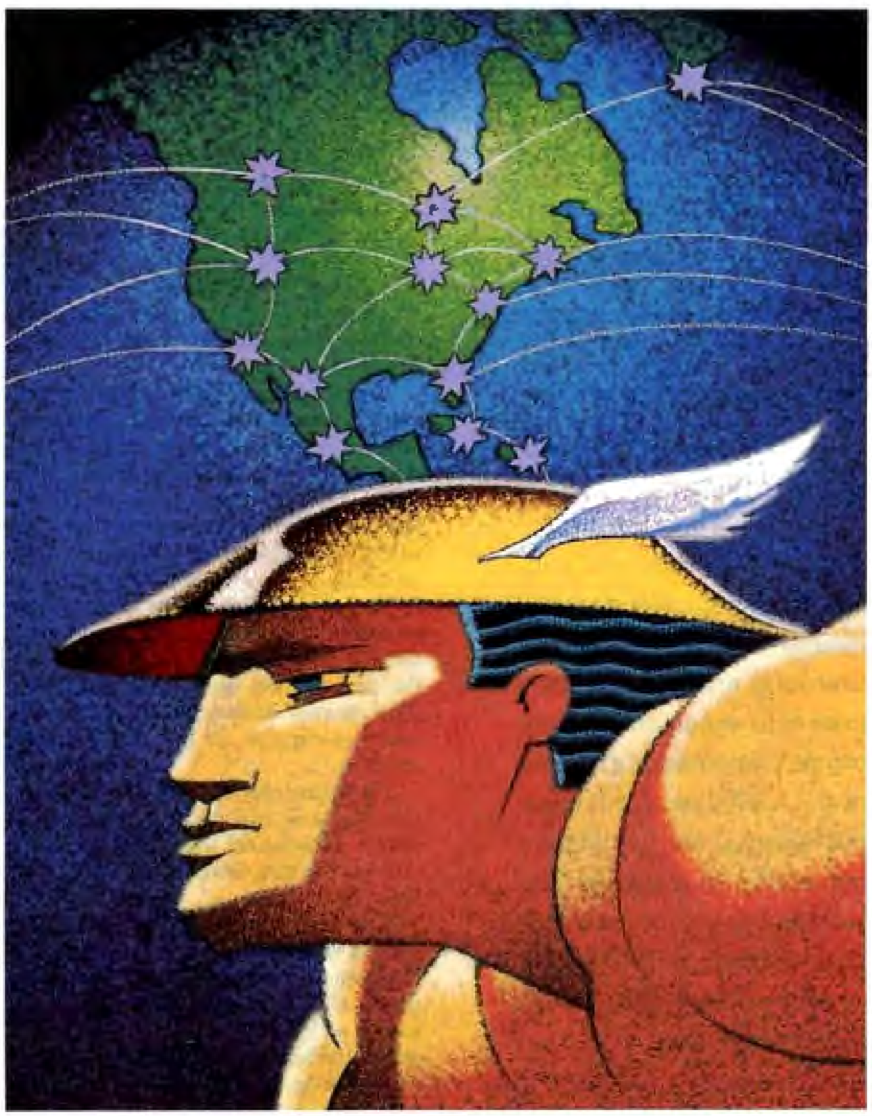
In WANs, the three most important factors are speed, speed, and speed. When I was working in a lab doing solar-energy research, we needed to send data to a mainframe computer 30 miles away. My boss wanted to use a modem to send the data by phone line. I argued that this method would be too slow and suggested sending magnetic tapes via the company mail system. But since he was the boss, I did as he asked.

When the programming was complete, I pulled a John Henry: I started up the file transfer by modem, and then I walked out to my bicycle with a tape under my arm and rode the 30 hilly miles to the mainframe. I arrived long before the modem file transfer was completed.

People often think that you only have to connect the two computers to solve such a problem; they fail to realize just how slow modems really are. Figure 1 gives you an idea of the magnitude of the problem.

A WAN has two primary functions: to allow people who are geographically separate to share common information and to let them send messages to each other. To accomplish either of these functions, the appropriate LANs (and their respective computers) must be connected.

There are six main ways to establish these physical connections: dial-up telephone lines, dedicated analog leased



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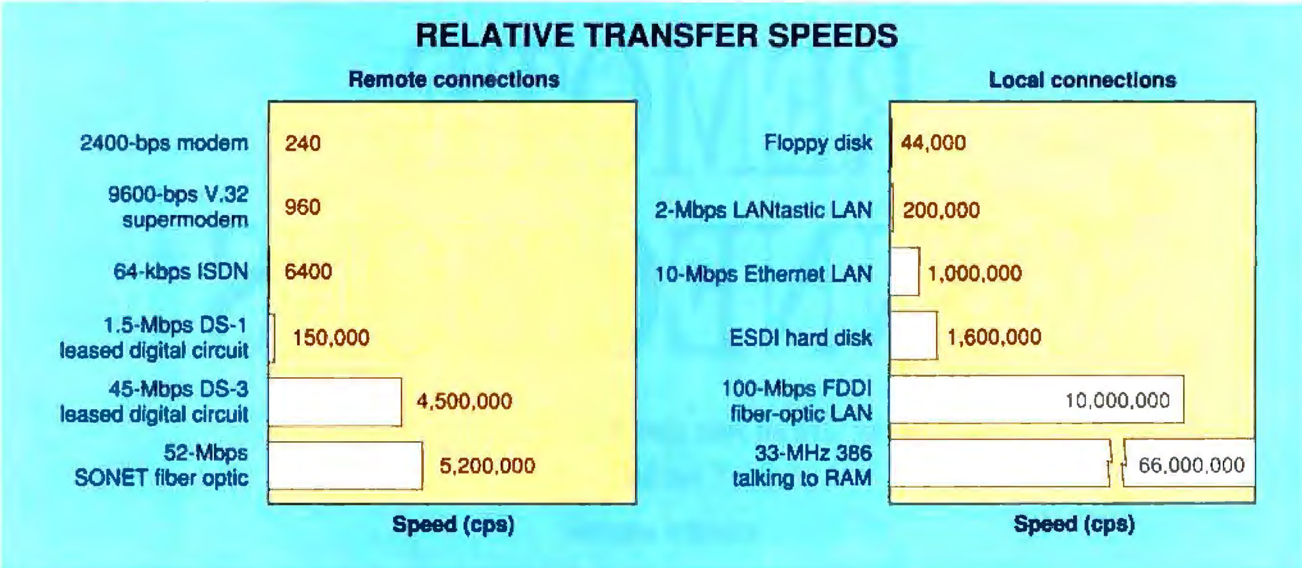


Figure 1: *When you compare the transfer rates of modems, disk drives, and even high-speed fiber-optic lines with the internal speed of a 33-MHz 386, you can see how far telecommunications still has to go to clear the bandwidth bottleneck: If the 33-MHz bar were drawn without a break, it would be about 10 inches long. (The numbers shown are approximate theoretical raw speeds in characters per second. The scale shown is roughly 1 inch = 6,600,000 cps.)*

lines, dedicated Dataphone Digital Service (DDS) leased lines, packet-switched networks, ISDN, and fiber optics. (X.25 packet-switching is being challenged by frame relay. For more information, see the text box "You've Been Framed" at right. Changes are in the wind for ISDN, too. For more information, see the text box "ISDN: Is It or Isn't It?" on page 166.) In addition, you need a lot of software.

BYTE ACTION SUMMARY

A wide-area network connects remote LANs and ties remote computers together over long distances. Its purpose is to enable the sharing of information among remote users. A WAN can accomplish this whether the computers are similar or dissimilar and whether the protocols are compatible or not. Complexity may be more difficult, but it's not impossible.

The OSI Layer Cake

The Open Systems Interconnection (OSI) Reference model breaks the software puzzle down into seven independent pieces, or layers (see figure 2). This kind of layering is analogous to structured modular programming: It creates a relatively bug-free, easy-to-modify, easy-to-maintain system.

The application layer is the highest level. It interfaces with users, fetches information from databases, and transfers whole files. It is the raison d'être of the whole process. The application layer is not in the least concerned with *how* any of this work gets done. It delegates those problems to the next level down, known as the presentation layer. As a capable administrator, the application layer never directly meddles with any layers below the presentation layer. The application layer always accomplishes its ends by making requests of presentation-layer services.

The presentation layer compresses transmissions and encrypts them for security. It foists off the transmission details on the next-lower level, the session layer.

The session layer makes the initial contact with other computers and sets up the lines of communications. It uniquely names all the different players that want to talk with each other. The session layer passes the buck to check for messages received to the next lower level, the transport layer.

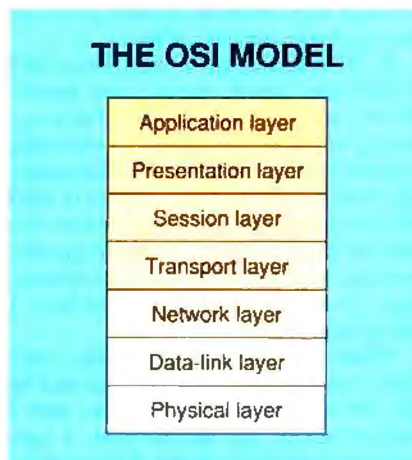


Figure 2: *The Open Systems Interconnection Reference model breaks software into seven independent pieces to simplify programming, modification, and maintenance. It separates the pieces by functionality.*

The transport layer is the auditor in charge of checking that all data is received correctly, end to end, even if it had to be relayed via several intermediate computers. The transport layer may also break long messages into convenient-size packets. It delegates the work of sending the packets to the next lower level, the network layer.

The network layer plans the routing of the packets; they may need to travel over

You've Been Framed

Bob Ryan

In the future, the most important function of a wide-area network (WAN) will be to connect LANs. Presently, you can characterize most wide-area LAN-to-LAN connections in one of two ways: expensive or slow. Frame-relay technology promises a middle path.

Companies with a lot of cash and very few networks to connect can always establish dedicated T1 point-to-point links between all the LANs on the network. Such a circuit-switched network provides high-speed interconnections, but the price is high, not only in terms of cost, but in efficiency and flexibility. For example, adding another network to a six-network mesh would mean establishing six additional T1 connections.

The X.25 Route

Most companies with multiple LANs to connect opt for either public or private X.25 packet-switching networks. X.25 is an international standard for encapsulating data with the routing information necessary to transmit it over a network of X.25-compliant switches. X.25 is characterized by robust error checking that virtually ensures error-free transmission.

The reason for X.25's robustness in error handling can be found in its roots in the 1970s, when the telecommunications infrastructure was primarily analog. Digital switches and fiber-optic channels that provide digital end-to-end connectivity were still in the future, as were vastly improved analog transmission technologies. Robust error handling was a must.

The drawback to this robustness is throughput. Assembling an X.25 packet at the LAN-to-WAN interconnection is a time-consuming process, so much so that the fastest LAN links to an X.25 network are normally 56,000 bps. That, in addition to the fact that X.25 packets are checked for errors at every switch along their route, means that X.25 networks simply don't have the bandwidth to seamlessly interconnect multiple LANs.

Frame-Relay Packets

Frame-relay technology is a recent development in packet switching that recognizes the advances made in the past 20 years in both the communications infrastructure and the processing power that can be brought to bear in network interconnection devices. Sometimes described as a subset of X.25, frame relay actually has its roots in efforts to give ISDN a packet-switching capability. The most exciting benefit of frame-relay networks is that they are expected to provide up to 10 times the throughput of X.25 networks.

In contrast to X.25, which resides in both the network and data-link layers of the Open Systems Interconnection model, frame relay resides within the data-link layer only, thus eliminating much of the X.25 overhead. In fact, the 48 bits used to encapsulate a frame-relay packet is only 20 percent to 25 percent of the overhead of a typical X.25 packet.

As a data-link protocol, frame relay deals with how packets are assembled and routed over a network. Frame relay also deals with multiplexing different data streams. Unlike X.25, which multiplexes individual data streams in the network layer, frame relay uses the link-access protocol of the ISDN D-channel, which performs multiplexing in the data-link layer. By avoiding services handled by the processing-intensive network layer, frame relay speeds up throughput dramatically.

One of the biggest differences between X.25 and frame relay is in error correction. A frame-relay packet is checked for errors only when it is sent to or received from the network. Thus, error checking is relegated to the periphery of the network, which is then free to concentrate on routing packets. Frame relay recognizes the ability of modern interconnection devices to handle error detection and correction (and other functions), freeing the network to move packets more expeditiously.

With frame relay's low overhead requirements, companies can offer T1 interconnections to the network backbone. Instead of offering a bandwidth limited by a 56,000-bps interconnection, frame relay offers LAN-to-LAN connections that are 10 percent or more of local LAN speed. The effect is a logical network comprising all the LANs attached to the frame-relay backbone.

Frame Relay Goes Public

Although the frame-relay standard has yet to be finalized, vendors are rushing frame-relay services and products to market based on specifications that have been published by CCITT and ANSI. Any changes required down the road to comply with the final standard will be dealt with through software upgrades.

Many vendors, including AT&T, StrataCom, and Northern Telecom, are currently shipping frame-relay equipment, and many more plan to ship this year. In the services area, WilTel became the first long-haul carrier to make a public frame-relay service available when it began its service in March. CompuServe, GTE/Sprint, and BT Tymnet have announced that they will have public frame-relay services in place by the end of the year.

Even the Bellcore companies, which have invested heavily in switched-multi-megabit data services (SMDS), are taking another look at frame-relay technology, with NYNEX and Pacific Bell committed to testing. Network managers' desire to link their far-flung LANs as soon as possible may adversely affect the acceptance of SMDS, which will lag behind frame relay in the marketplace.

Frame relay will usher in a new era in LAN-to-LAN wide-area connectivity. It will let companies link their disparate LANs into a logical whole while maintaining a level of throughput unattainable with X.25. As LANs become standard in businesses both large and small, frame relay will ensure that geographically separated LANs act together as an integrated whole.

Bob Ryan is a technical editor for BYTE's State of the Art section. You can contact him on BIX as "b.ryan."

Let Me Count the Ways

You don't necessarily have to have a LAN tying two remote computers together to exchange data. There are other methods. Here are some approaches to consider, starting with the simplest.

• *Direct modem-to-modem file transfer:* In the simplest method, you fit each computer with a modem and some general-purpose communications software, such as Procomm. Then you play telephone tag until the two computers connect and you can transfer the file.

You can use a protocol that automatically corrects errors and lets you pick up where you left off if the connection breaks partway through. However, such a protocol isn't intelligent enough to redial on its own if the line is busy.

• *Single-user BBS*: One end of the connection runs unattended with some special software, such as TBBS (eSoft, Aurora, CO) or Wildcat (Mustang Software, Bakersfield, CA). You call into the BBS to either upload or download files, and you communicate with other users by leaving messages or files for them.

The BBS requires less labor than the modem method, since one end runs unattended; if you use scripts, both ends can run unattended. However, you may get a busy signal when you call.

• *E-mail service*: This type of connection acts much like a BBS: You drop off E-mail at an electronic post office, and other users pick it up later. Mail consists of messages and files. However, there are several differences.

An E-mail user interface tends to be simpler than a general-purpose modem utility. Some E-mail services handle mail in the background so you can continue using your computer for other tasks. E-mail is designed to handle more callers than a BBS, so you rarely get a busy signal. And if you do, most E-mail software automatically reschedules the call for a few minutes later.

However, the biggest difference between a BBS and E-mail is in scope. BBSes are designed for use primarily within a single city. You must call long-distance to use a remote BBS. To use a remote E-mail system, you make a local call to the packet network (e.g., Tymnet in the U.S., Datapac in Canada, Telepak in Sweden, or Telepac in Singapore). The packet network then relays your mail, halfway around the globe if necessary, to the central-post-office computer. Because the packet network is all digital and the E-mail software automatically corrects errors, including disconnects, mail almost always arrives error-free without manual intervention.

However, you cannot hold a real-time conversation with someone on E-mail; you have to exchange mail messages. Also, you must send mail to a particular person or group of people; you can't just post messages for any interested party to read, the way you can with a BBS or conferencing system like BIX. And you can't share a common database.

• *Terminal emulation*: The first CRT capable of sharing a telecommunications line with other terminals, the IBM 3270, was a smashing success; thousands are still in use in many of America's largest corporations.

You often find perfectly capable personal computers pretending to be one of these old 3270 terminals. They carefully emulate all its eccentricities and mask their own native intelligence. It is as if two capable ambassadors from the U.S. and the U.S.S.R. decided to conduct their discourses in baby talk.

The 3270 interface is stable and well understood, however, and you can easily tie into existing mainframe programs designed to work with 3270s. In addition, the terminal itself has evolved over the years so the modern SDLC emulations are more efficient than the old BSC ones.

• *Remote-control software*: With remote-control software, such as PCAnywhere (DMA, Huntington, NY), Close-Up (Norton-Lambert, Santa Barbara, CA), and Carbon Copy Plus (Microcom, Norwood, MA), you can work on problems on a computer anywhere you are without having to go to its particular location.

For example, you can phone a computer, remotely control its keyboard, and see what's on its screen. You can run programs on it—the programs run at full speed—and even reboot it.

Behind the scenes, the software notes changes to the remote screen and sends them to your computer. When you press a key, the software in your computer informs the corresponding software in the remote machine, which in turn fools that computer into thinking that the key was pressed locally.

Suppose you have a LAN with four workstations, and you add one more that sits unattended and is equipped with a modem. In the field, the salespeople have laptops and remote-control software. When they want to use the system, they dial into the dedicated station. They can then use the LAN exactly

several segments to get to their final destinations. It looks for alternative uncongested routes and acts much like an air-traffic controller. However, the network layer just plans the routes; it doesn't actually send any data. That's the job of the next level, the data-link layer.

The data-link layer is also an auditor, in charge of ensuring that each packet travels safely through its route. However, the data-link layer's concerns are local—one segment of the journey. If a packet arrives garbled, the data-link layer arranges to have it re-sent. In contrast, the transport layer ensures end-to-end delivery.

Finally, the physical layer is at the very bottom of the stack. It mindlessly sends a string of bits from one computer to another. Whether or not the data arrives garbled is not the physical layer's problem. The supervisory work of all the higher levels simplifies the physical layer's job to just shoveling bits.

Some of the different ways you can transfer information between remote computers fit the OSI model, but most do not. The text box "Let Me Count the Ways" above discusses various transfer options.

as if they were sitting at that workstation. The LAN is unaware that the workstation is remotely controlled and treats it like any other attended workstation.

The big advantage of this method is there is no special programming. You just take a normal LAN or stand-alone application and add remote-control software, and, instantly, you can run the application remotely. The disadvantages are that you tie up a computer full-time, doing nothing but answering the phone. Busy signals can slow you down, and you need a direct long-distance connection. But the method works well if you make complex queries.

• *File-server model*: When most people think of a wide-area network, they think of software that links them with a file server on a remote LAN. The software makes the remote file server appear to be local. Unfortunately, this is just about the least efficient way to use your telecommunications resources.

A file server is a brain-dead slave with limited capabilities. It can either fetch some bytes off the disk or store them there. The file server isn't bright enough to do any filtering for you. Consider what would happen if you ran a program to sequentially sift through 10,000 database records, summarizing a select few into a one-page report: The file server would transmit every single record in the database to you over the phone line, insisting that you select the small subset of interest yourself. The file-server approach is appropriate only if you are careful never to request large amounts of disk I/O inadvertently.

• *The time-sharing model*: Time-sharing makes exactly the opposite assumption. It presumes that the central database server is large, powerful, and intelligent. This view usually errs a little too far in the other direction.

You run a large program remotely on the central computer. This program has only one purpose: to serve one remote user. It is oblivious to all the other users and does no work for them; it sits and waits patiently for you to enter more information. It remembers what you keyed in previously and adjusts itself based on that history.

There are four major drawbacks to this approach. First, the main computer has to run a different program for each remote user, and it must run these programs simultaneously. This requires quite a bit of RAM. There are two primary ways to lower overhead: swap to disk and keep only one copy of a program in RAM while making it look like there are two independent copies. Time-sharing systems tend to bog down with the overhead.

Second, these remote-control programs are largely unaware of what other slave programs are doing. None has a bird's-eye view of the whole. The programs tend to stumble about in the dark tripping over each other, using primitive record-locking mechanisms for coordination.

Third, traditionally, time-sharing paradigms presume you are sitting at a teletypewriter. Thus, they rarely exploit any remote intelligence. And fourth, if the system crashes, it is hard to reconstruct a time-sharing system the way it was just before the crash.

Time-sharing works best for statistical inquiry rather than specific record inquiries or updates. It is not well suited to updating shared databases, but it is the only way to go for ad hoc data analysis. The main advantage of time-sharing is that only the distilled essence of the data needs to be transmitted, since the central computer can read thousands of records and summarize them in a few bytes.

• *Transaction processing*: The airline industry and banks think in terms of transaction processing (TP). Remote stations create a concise request packet describing a discrete unit of work to be done, such as "make a reservation," "deposit $100," or "ask how many seats are available on the Los Angeles–to–New York flight next Christmas Eve."

The remote station carefully hones the packet down to the bare bones and sends it off. At the central site, packets arrive from a variety of locations. They are routed to the program that specializes in handling their specific transaction type. A specialist program can maintain an overview of what is happening companywide. For example, the program that handles bank deposits can maintain RAM-based running balances for each teller and for the bank as a whole. The central computer then sends back a result packet that is compressed as tightly as possible. The remote station decompresses the information and displays it.

Coordination can be very simple in a TP system. Since only one routine handles all the deposits, it doesn't need to coordinate its efforts with hundreds of other interfering processes. It only needs to coordinate with a single withdrawal-handling routine. As in time-sharing, the TP routines may call on database engines such as Structured Query Language to perform complex inquiries.

TP is an efficient electronic assembly line. It is the method of choice when you have high volumes of repetitive work. It makes optimal use of both the central computer's resources and the transmission lines. Banks love TP because if the system crashes, they can replay a log of the neatly unitized transactions and accurately reconstruct the database the way it was just before the crash.

Proper Protocol

A protocol could be considered a system of etiquette; it is a rigidly formal, very terse language of numeric codes computers use to control the flow of messages between them. There are many different protocols. There are separate ones for each layer in the OSI hierarchy and hundreds of possible variations in them across the different levels. Since OSI's ascendancy is recent, all the older protocols and many of the newer ones violate its guidelines.

In order for two computers to communicate successfully, they both have to agree on a common set of protocols. If the two computers cannot find a protocol that they both speak, you need a translating device to create a bridge between them.

The protocol match between computers has to be absolutely perfect; if people worked the way computers do, you would need to hire a translator anytime someone in Texas phoned someone in London, just because they have a few small differences in the way they use the English language. I cannot stress the importance of rigidly standard, common protocols enough.

continued

ISDN: Is It or Isn't It?

Janet J. Barron

Because of a number of inherent problems, the coming of ISDN has become an industry joke. During its lengthy evolution, computer users had just about given up hope of its ever becoming a reality. Many have dubbed ISDN the ultimate "virtual technology."

But on February 26, Mike Walter, vice president of sales and marketing for the Corporation of Open Systems (COS), announced a development that may put the "oomph" back into the push to deploy ISDN. The announcement disclosed the commitment of a variety of major ISDN companies and organizations to an implementation agreement called National ISDN 1.

The agreement aims to standardize some of the interfaces, protocols, hardware, and software whose compatibility is essential to making the use of ISDN ubiquitous and transparent (see "The Ultimate Link?" in the July 1988 BYTE). It's called "National" ISDN 1 because certain facets of U.S. and international ISDN environments are not totally compatible. The National ISDN 1 agreement proposes to standardize the ISDN technology across the board in the U.S., but it will not yet address the issue of global compatibility.

Walter states that, with the new agreement, ISDN services "will be widely available by late 1992. Through the implementation of standards, ISDN capabilities, such as the interconnection of personal computers or video transmission, will become as widespread and as easy as placing a voice call is today." The upshot of this agreement is that the technology could finally move forward at a rapid pace. You may at last find yourself able to send and receive voice and data—and even video in a basic form—end-to-end over the telephone that already sits on your desk.

"For the first time, an industrywide consensus has been reached to develop and deliver, by late 1992, ISDN services in the public telephone network based on a standard set of technical specifications and implementation agreements," stated Walter.

Promises, Promises...

Analysts predict that by the end of this year, approximately 192,000 ISDN lines will be installed and operating domestically. Unfortunately, many of the users of these lines will not be able to communicate with other ISDN users because of the present incompatibility of equipment among different vendors' switches. This phenomenon is known as *island ISDN*.

The Regional Bell Operating Companies (RBOCs), switch and Customer Premises Equipment (CPE) vendors, standards organizations, and users all have high hopes for the potential that ubiquitous ISDN 1 offers. But is it simply another case of too little, too late? Many believe that ISDN is a technology that should have been put in place at the beginning of the microcomputer age and that, at this stage of the game, it will receive its "15 minutes of fame" only as a speedy alternative to the modem.

Others say, "not so." ISDN standard technology has already been implemented for digital network-access lines and central-office, switch-to-switch interoperability (ANSI 2B1Q transmission standard and Bellcore Technical References 444 and 448). The goal of National ISDN 1 is to speed up the deployment of ISDN technology across the board.

John Seaholtz, vice president of technology and information services for Bell Atlantic, says, "The word *National* is very important. It reflects the scope of the ISDN deployment. It is nationwide. The number 1 indicates that this is the first foundation set of capabilities and that more will follow." Seaholtz adds, "We support deployment of a common ISDN platform that includes an agreed-upon list of testing tools and procedures—and a timetable for ISDN conformance tests—that reflect the needs contained in the consolidated view."

Necessity, the Mother of ISDN 1

The ISDN 1 agreement proposes to standardize the signaling protocols and messages used between users' equipment and the network and invoke uniform services, such as data connections and call forwarding. In essence, say representatives of COS, a standard ISDN platform will meld the currently fragmented ISDN market to provide the

Apples and Apricots

If you have two LANs that speak the same physical-layer protocol (e.g., Ethernet), you can connect them with a simple low-cost *repeater*. If the two LANs speak the same data-link layer protocol (e.g., IEEE 802.3), then you can connect them with a *bridge*—even if they differ at the physical layer. If the two LANs have a common network-layer protocol (e.g., Novell IPX), you can connect them with a *router*. If two LANs have nothing in common, you must resort to connecting them at the highest (application) level with a *gateway*. Finally, a *brouter* is a chameleon device that can act as either a bridge or a router.

A bridge is more expensive than a repeater, because it handles data-link functions and potentially two kinds of physical attachments. A router, in turn, is more expensive than a bridge, because it adds the complexity of the network-layer functions. A gateway is the most complex of all.

The cardinal rule is that the more similar two computers or LANs are, the more efficient, simple, inexpensive, and generally satisfactory the connection will be. Unfortunately, most of the time you have no choice; the computers that are to be connected are already in place, as stubbornly different as Apples and Apricots.

Efficiency First

Today's linking software can be seductive, creating the illusion that two sites are one—as well-linked as though they were in the same room. However, it *is* only an illusion. If you take the convenience too seriously, you can find your-economy of scale necessary to produce affordable, profitable products.

Steve Jones, director of switched services, product management, for Northern Telecom, states, "Currently, ISDN is a proprietary capability—different switches offer different services. What this implementation agreement provides is the potential to buy ISDN right off the shelf. It will take a while for users to be able to buy ISDN devices at Radio Shack, go home, and have the service all ready. But that is the aim of National ISDN 1."

The structure of National ISDN 1 was created by Bellcore, the North American ISDN Users (NIU) Forum, and several key telecommunications firms. Its technical innards are composed of the NIU Forum Implementer's Agreements (IAs) and a number of Bellcore Technical References, or TRs. (For the five most important Bellcore Technical References for ISDN, see the table.)

The IAs generated by the NIU Forum provide for the use of ANSI standard specifications for an ISDN. The IAs were developed and approved by industry and user representatives participating in the individual expert working groups. The IAs exist to expedite the development of ISDN capabilities; to promote interoperability of ISDN communications equipment; and to provide a universal, multivendor implementation. TRs are documents that dictate how a service or a device must be designed for it to work on Bell company networks.

Until the technology specified in these IAs is put into place, companies that offer ISDN products can only provide vendor-specific versions of it, which may or may not be compatible with products from other companies. The goal of National ISDN 1 is to achieve uniformity of network interfaces and service offerings.

But at the moment, National ISDN 1 is only a concept. There is much to be done before the agreement becomes a reality.

Among the issues to be resolved is concern about ISDN's speed limitations. High-quality video and interactive communication of high-resolution images (digitized video) requires data transfer rates of 50 to 100 kilobits per second. Another issue yet to be addressed is the standardization of ISDN's more sophisticated features. In addition, older equipment that conforms to proprietary applications and standards may not be reconfigurable.

National ISDN 1 industry players have their work cut out for them. They must implement a standard interface between terminal equipment and the public network and speed up the universal deployment of Signaling System 7. SS7 is a common-channel signaling system that allows telephone calls to be set up by packetized signaling in a separate channel outside the voice band.

And then there is the difference between talking a good game and making it all really happen. Susan Schuman, ISDN product manager for Apple, one firm marketing an ISDN software developer's toolkit, says, "A lot of CPE vendors are taking the step, as are some of the RBOCs, but the infrastructure has to be put in place. We *all* have to stand up, make a commitment, and say, 'we're going to do it.' Aggressive implementation plans need to appear, and there must be a public decision that we are moving in this direction. The phone companies have to do more than pay lip service to ISDN—they are very lethargic. I want to be able to call up an RBOC and say, 'I want ISDN.' "

Janet J. Barron is a BYTE technical editor. You can contact her on BIX as "neural."

ISDN DOCUMENTATION

Here are the five most important Bellcore Technical References that the National ISDN 1 agreement is based on.

TR268 provides standard signaling between the individual and the public network. This is the foundation for terminal portability.

TR444 and **TR448** define the standard protocols that allow ISDN services to ride on the Signaling System 7 (SS7) network.

TR317 defines the protocols for standard SS7 networking between the Local Exchange Carriers' (LEC's) Local Access Transport Area (intraLATA) switches that, when combined with TR444 and TR448, can deliver ISDN services.

TR394 defines the protocols for standard SS7 networking of interLATA switches that, when combined with TR444 and TR448, provide the interface for ISDN services and the interexchange network.

self in serious trouble.

By way of analogy, a wallet full of credit cards creates the illusion that you have tens of thousands of dollars in cash to spend. This may be convenient, but it is also an illusion—at least in my case. If you took this "virtual money" too seriously and spent it as freely as if it were real money, you'd soon end up in bankruptcy court.

In reality, two sites are linked only by the thinnest of pipes, and you must do your best to avoid clogging them with traffic.

Traffic Control

The primary technique used to cut down the traffic on a line is to place some intelligence at each end. The smarter the two boxes are, the more terse their communications can be.

For example, if you need to transmit a list of dates, you might send each date as a 10-byte string: 12/31/1991. However, if you have some local intelligence, it can convert this date to unsigned binary days since January 1, 1860, for example; such a date would take only 2 bytes to send. The receiver can easily reconvert the dates and put the slashes back in if they are needed.

You can use local intelligence and a data-entry language to paint screen displays, generate error messages, and expand numeric codes to meaningful descriptions. You don't need to send all that extra data over the communications lines. By validating keyed data locally, you can further cut down the traffic. Data compression can reduce it even more (see "Lossless Data Compression," March BYTE).

The most effective way to avoid traffic

is to store the data nearest to the people who will be using it most. They can then access the data directly, without using the communications lines at all. All too often, managers insist on putting all the data in one place and all the people in another.

But what if two large, geographically separated groups of people both need high-volume access to the same data? One method is to make duplicate copies, one stored locally for each group. But then how do you keep the two copies synchronized?

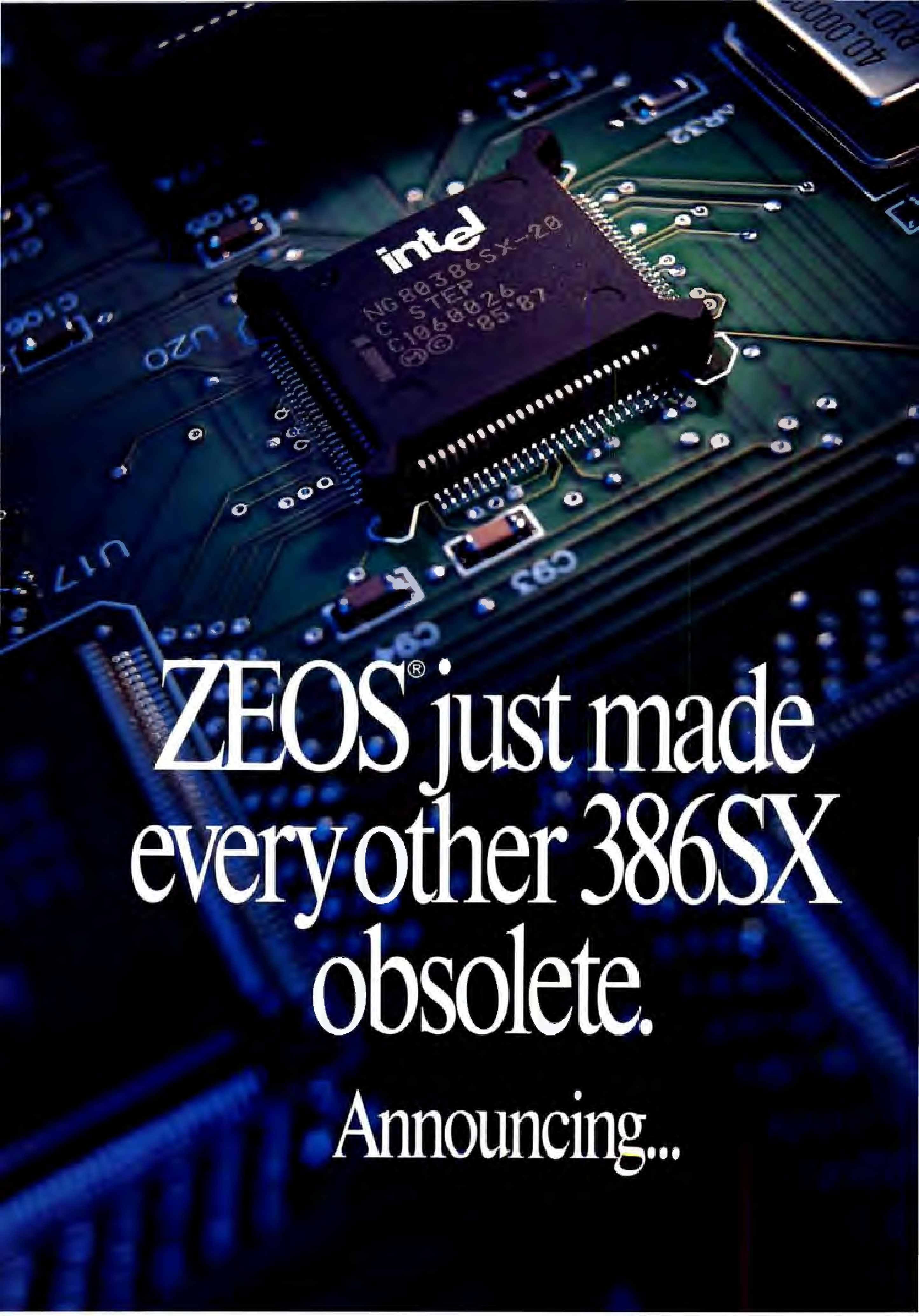
- You can send changes to both copies. Then you can examine the up-to-date local copy as much as you want without using the link.
- You can make one copy read-only. Then one group can look but not touch. Each night, the read-only copy receives an update of the changes that were made to the other copy. During the day, the read-only group makes do with a slightly stale copy (which can also act as a hot backup if the master copy fails).
- You can allow both groups to update their local copies. However, the first group doesn't see the changes that the second group makes, and vice versa. At night, both groups send their aggregate daily changes to a central site where a batch program merges them. Then the merged changes go back to the groups so that the next day they start out in sync again.

Keep Your Eyes Open

When you start to set up a WAN, it's important to remember that similar computers or LANs are easier and less expensive to connect satisfactorily. You should also bear in mind that common protocols simplify the connection process.

But managing network traffic is the major challenge. You have to find ways of avoiding clogged network arteries. "Rush-hour" conditions will leave everyone steaming and screaming with frustration. Never allow the WAN to seduce you into believing the illusion that all the sites are tied into one seamless whole. Keep one eye on the traffic at all times. ■

Roedy Green, president of Canadian Mind Products in Vancouver, B.C., Canada, builds custom computers and writes custom software for charities. He is the author of the public domain Abundance database and data-entry language (see "Abundance," October 1986 BYTE). You can reach him on BIX as "roedy."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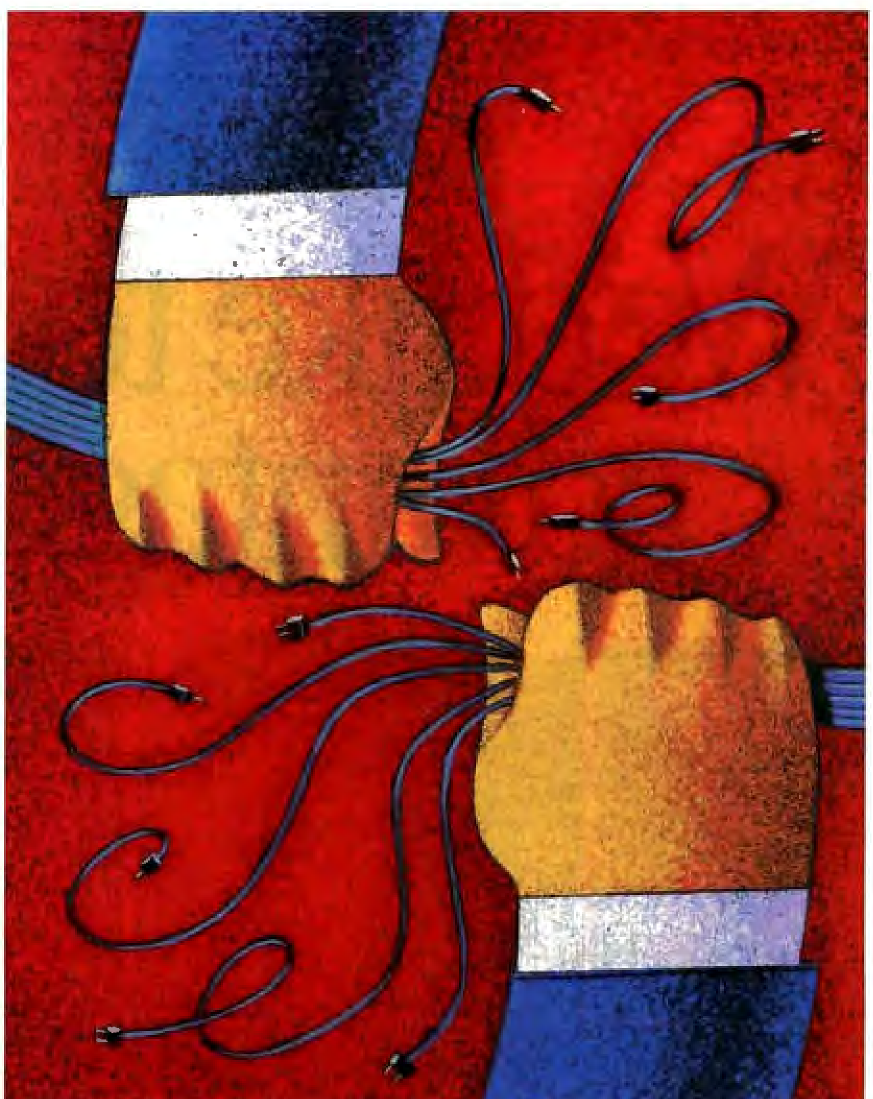
CREATE A WAN

Implementing a corporate WAN is a bit like trying to nail jelly to a wall—it's pretty slippery, and the end result can be unsatisfactory

PETER STEPHENSON



Now that LANs are commonplace in most medium and large companies, wide-area networks have become the next communications frontier. However, the implementation of a WAN often founders due to a lack of definition and limited product support.

While the issues of interconnecting LANs within an enterprise pose some interesting questions—and occasionally some difficult choices—implementing a corporate WAN is a bit like trying to nail jelly to a wall. It's pretty slippery, you get your hands dirty, and the end result can be unsatisfactory.

To help pin the subject down, I'll begin with a few definitions. When I speak of a *node*, I am referring to a single point of entry for data on a WAN. That could be a LAN, a mainframe, a personal computer, or a terminal. A *site* means a collection of nodes, usually in the same building. And a *campus* is a collection of sites in a compact area, such as a college campus, an office complex, or a military base. Campuses characteristically have one telephone private-branch-exchange system. Sites not having a common PBX, even though they may be physically close to each other (e.g., across the street), are considered separately, because access to their internal phone systems differs.

In the Beginning

LANs constitute a fairly well-defined architecture, complete with specific, generally used protocols, but WANs are far more fuzzy. Basically, a WAN is little more than a group of campuses interconnected over a wide area so that they can move and share information. If you think

ILLUSTRATION: DAVID TILLINGHAST © 1991

that sounds somewhat vague, you're correct. Unlike LANs, with WANs, form follows function.

For example, if I want to transfer a file from my headquarters in New York to a sales office in Des Moines, Iowa, I will use a primitive WAN. All the file transfers might be accomplished with a simple asynchronous modem connection. The only real difference between that and a network of offices, factories, and field personnel is the size and complexity of the WAN.

BYTE ACTION SUMMARY

Wide-area networks can connect the various sites of your far-flung enterprise, but the process of implementing a WAN is very confusing. It isn't nearly as well-defined as putting in a LAN. However, there are steps you can take and questions you can answer that will help limit the confusion.

WANs are designed and configured to meet particular requirements. To a certain extent, LANs are, too, but your choices are more limited and well-defined with LANs. You can pick Ethernet, Token Ring, or another common protocol. You then define by default the range of media available. Finally, you come down to a set of fairly straightforward hardware decisions. Add a bridge, a router, and a brouter or two, and you're finished. This is oversimplified, but it's accurate for purposes of illustration.

WANs are not nearly as well defined or well structured. Their products seem to be aimed at solving isolated pieces of the WAN puzzle. You are left to assemble it yourself. There's an old adage that says, "In a divorce, the only winners are the lawyers." In a WAN, often the only winners are the integrators who are called in to make everything work. However, you can take a few steps to limit the confusion.

Step 1: Define the Requirements

This step is not significantly different from planning a LAN in concept, but in scope, it's orders of magnitude greater. First, you must define the sites to be interconnected and the connections between them. At this point, you're not concerned with the nature of these connections, just with the paths themselves. Defining the paths will help you determine the optimum carrier or mix of carriers for your WAN. You can't make a choice until you know the nature of the connections, but you can at least begin to see the options.

Usually, the options for interconnecting a WAN are limited to private or public networks. If the connections are limited, fairly generic, and not constant, a public data network, or value-added network, may be the best bet (see the text box "Selecting a PDN" on page 176). If you have many connections and lots of 24-hour on-line connections, a private network may make more sense. Either way, you will be using the facilities of a

PDN. Sometimes, you can justify a true private network, which uses dedicated, company-owned transmission equipment, but those times are rare.

For smaller networks, an alternative to PDNs or company-owned systems would be one of the broadband offerings, such as T1. T1 is a circuit-switched system (PDNs are packet-switched) available through most long-distance telephone carriers. Accessing these systems requires far more equipment on your part than accessing a PDN does. All the phone company offers is the transmission facility. Selecting protocols, routing, and access to the network is up to you.

For simple point-to-point WANs with few nodes, T1 or some of the faster media can make a lot of sense. As the WAN becomes more complex, however, you'll benefit by letting a PDN take over the long-distance headaches. T1 circuits are generally dedicated point-to-point connections, terminating at various premises. Also, the price you pay for most T1 lines is based on distance. What you pay for the use of packet networks is based on packet usage. A packet, as PDNs define and charge for them, is nothing more than a single protocol (e.g., X.25) data frame.

Next, you need to determine the nature of the data that you will be moving over the WAN. Are you going to simply transfer files? Do you have on-line connections (e.g., LAN bridges, terminals on a mainframe, or LAN-to-mainframe connections)? How many of the paths must be on-line simultaneously? How about voice and video? Will you be required to transmit them as well? Do your network paths cross international boundaries? Does the data move in spurts, or is it constantly moving?

What is the nature of the connections between sites? Are the links personal computer–to–personal computer, personal computer–to–LAN, LAN-to-LAN, personal computer– or terminal-to-mainframe, LAN-to-mainframe, or mainframe-to-mainframe? Do you have distributed databases? How about laptop users who need to dial into the system remotely? What platforms that must interconnect are located at each site? What protocols are they using? What operating systems? When are asynchronous connections appropriate, and when must point-to-point synchronous circuits be established?

Security is also a serious issue. Although you'll need to add security to the WAN to protect data during transmission and ensure that the ports at each node on the WAN have acceptable access control, existing security requirements at a node can materially affect the nature of its connection to the WAN.

Finally, what are the natures of the various campuses that must interconnect? Should you interconnect the sites on the campus or let the WAN provide the interconnections? How much interaction occurs on the campus as compared to long-distance interaction? Depending on its size and nature, you may want to save the cost of networking the campus and let everyone communicate via the WAN.

Step 2: Explore the Options

You need to determine how you would solve specific problems as if each one were the only thing you had to concern yourself with. You don't need to make any choices yet, but you do need to know what the options are and what their costs might be. Here are some generic options for several typical requirements.

File transfer. You can transfer files in various ways (see the text box "Let Me Count the Ways" on page 164). E-mail is potentially the cleanest and most elegant option. However, this approach assumes the existence of a companywide E-mail system that supports file attachments over all the platforms it connects to. When a company uses—as most do—several E-mail systems over a variety of platforms, such file transfers can become very difficult.

LAN-to-LAN connections. These are most often accomplished by the use of bridges, routers, or brouters. Bridges are usually used in multiprotocol environments. Routers are often the best choice for long-distance connections.

When you use routers for the long haul and bridges for the local sites, the physical networks connected by bridges are seen as individual logical networks. For example, if you bridge four physical networks in a building, the people who use those networks will see a single logical LAN. So, if you want individual physical networks on a WAN to appear as a single logical network, you should use bridges.

The main difference between bridges and routers is that bridges pass data on the basis of the data's ultimate destination. They are intelligent, and they can learn the addressing schemes of the networks to which they are attached.

Routers, on the other hand, only know the addresses of the preceding and subsequent routers or sources—where the data came from and where it will go. Because routers don't have to evaluate each packet for its final destination, they often perform better on a busy long-distance WAN than bridges do.

Brouters are a cross between bridges and routers. They are far more complex than either of the others.

A well-thought-out WAN will use a combination of bridges, routers, and brouters. To determine which internetworking device is most appropriate for a particular location, you need to consider the traffic on each path.

Load sharing. This is an option on the more congested network paths. It simply means that the network looks at the traffic on alternative paths and selects the least congested. The data may have to travel over a longer distance, but if the selected path is significantly less congested, the network response will be better. If you select a PDN as your carrier, load sharing is less important, because PDNs already implement it.

Asynchronous dial-in. This is most often an issue when individuals in the field must access the network over phone lines. The subject also becomes relevant when the network is used primarily for file transfer.

Keep in mind the impact of long-distance telephone charges, especially from hotels, where long-distance rates are exceptionally high. If you have a large number of field personnel who must dial in, it may make sense to use a PDN to get to a central modem pool (a collection of modems on a communications server that are accessible to other users on the network).

Most large PDNs have asynchronous dial-in capability from nearly all major cities. Access to the PDNs is a local call. The cost trade-off is between a long-distance charge and the packet rate. PDN charges are based on the number of packets and distance instead of being based on distance and time, as regular telephone

company charges are.

If you choose asynchronous dial-in over a PDN, decide where the dial-in will terminate. You'll probably want a modem pool and a communications server on the network to handle such incoming calls. Then you will want the communications server to have access to other nodes at other sites on the WAN for file transfers and E-mail. That type of system implies a centralized WAN that connects to branches like the spokes of a wheel, with the headquarters at the center.

This configuration is usually best because it makes adding new sites easy. It does not, however, provide alternative paths. If you are developing a truly private WAN (one that doesn't use PDNs for any long-distance connections), you'll want to provide additional transmission paths for network load sharing.

Heterogeneous connections. In this case, I'm talking about LAN-to-mainframe connections or connections between personal computer LANs and clusters of Unix workstations. The rules for interconnecting these different platforms, operating systems, and protocols on a LAN are not much different from those for doing the same thing over a WAN. The key is to provide whatever level of protocol translation is necessary to allow the various systems to communicate.

With a WAN, the connection options severely limit the link's responsiveness. The speed of a direct connection is much greater than a long-distance carrier's. That limitation can dictate how you use the link. Interestingly, the rules that have always applied to the connection of a terminal to a mainframe over a dedicated communications circuit still apply in a WAN. The difference is that you need to take more devices into account.

In most cases, you will use either a bridge, a protocol converter, or a terminal emulator to make a heterogeneous connection. If it sounds like you need a LAN just to make the outside connections, that can be a good approach for the hub of corporate communications activity. A single LAN containing asynchronous communications servers with modem pools, bridges to other networks, terminal emulators for direct mainframe connections, and connections to mainframe communications processors can be quite useful.

For example, if you are connecting to an IBM mainframe, you may want to bridge other LANs into a Token Ring that connects directly to a Systems Network Architecture (SNA) front-end processor. If you are connecting to a DEC VAX, you may want to use Ethernet and either DECnet or direct connections. The key is to provide as few layers of communications translation as possible. You should let similar systems talk to each other and try to get them talking to dissimilar systems over a single link.

E-mail. This is perhaps the toughest requirement of all, because most WANs are by default heterogeneous networks, composed of a variety of platforms, operating systems, topologies, and protocols. It's almost impossible to find an E-mail package that will work equally well on all the links.

Well before anyone in the organization considers a WAN, what usually happens is that the mainframe users establish an E-mail network. The Unix users also find a package that suits their needs. Then the LAN users set up their E-mail

system—or systems, because it's normal for a large company to have many LANs, all planned by different groups. Because departmental LANs seem to just spring up, the probability of their using the same E-mail package is minimal.

Then all these people will want connections to outside systems, such as MCI Mail or the Internet. Those connections imply an asynchronous dial-up system. The key is to find a shell that can access a variety of E-mail systems and present the results uniformly. The options are limited or, depending on existing configurations, may be nonexistent. You may be faced with multiple accesses to multiple E-mail systems.

There is no right or wrong way to build a WAN. But because the state of the art in communications is constantly changing, it's important to design the WAN to be able to take advantage of new technology. You should be able to make changes and additions to the WAN without wiping it out and having to start over.

Step 3: Plan the Links

The heart of WAN planning is in communications link design. How will the sites on the WAN communicate? If you require asynchronous dial-in, will you use regular phone lines or access a PDN? You should lay out the dial-in links first. Designing communications links is an iterative process. You start with what appears to work on a path-by-path basis and then refine your choices as you discover conflicts.

Suppose you decide to use a PDN for the asynchronous dial-in, and eventually you realize that it would make more sense to build your own system and own the communications hardware (assuming that everything is in a compact area and you already own microwave or satellite facilities). In this case, you probably want to rethink the decision to use a PDN for dial-in.

Once you have the asynchronous paths worked out and have decided how to execute them, move on to LAN-to-LAN connections. These are the most complex, because they use internetworking devices. Do you need dedicated channels (each transmission channel is leased by a single user for his or her own exclusive use), or can you get by with shared channels (transmission channels shared by more than one user, such as nondedicated dial-in ports)?

For most internetworking, the best bet is usually dedicated full-time channels over a PDN, such as BT Tymnet. These are communications links that are the exclusive property of the user, 24 hours a day, seven days a week. It is possible on some carriers to have part-time dedicated channels (e.g., a channel available during business hours five days a week), but there is usually no justification for such an arrangement.

Finally, you need to add the large platform connections (assuming you have several campuses or sites to connect). Ordinarily, there will be a central communications point within a site that everyone at the site can access. In many instances, the large platform computers reside at remote locations, not at headquarters. A dedicated computing center is likely to be located at its own remote site.

Step 4: Select the Vendors

Now you're ready to get down to specifics. You may want to enlist some help at this point, if only from the different equipment vendors. The most serious issue to be confronted is how to address the various nodes on different platforms at multiple sites. How you approach that issue has a lot to do with how different vendors will implement available protocols. You need to select protocols across the platforms that are as compatible as possible with each other.

For example, if you are using IBM mainframes, you will find it easiest to stay with SNA-compliant systems. These systems have well-established products for interconnecting to LANs (in this case, Token Ring). The issues of addressing are complex and vary significantly from vendor to vendor.

The choice of vendors depends heavily on the complexity of the installation and the breadth of the protocols and addressing schemes to be supported. The best approach is to start with your primary communications vendor to determine what long-distance protocols the WAN will be using and how it will connect to the PDN.

In most cases, the long-distance protocol will be X.25, and the WAN will connect via a packet assembly/disassembly at a network gateway. If so, that will simplify a lot of the addressing and bridging requirements. You can simply take each site to its gateway, using a communications concentrator, and focus the bridging and routing at the site level. In other words, you can determine how the various sites interconnect from the individual's point of view instead of looking at the subject globally. The PDN will handle issues like load sharing, long-distance routing, and other wide-area concerns.

Assuming that each site or campus is properly internetworked, you now must ensure that you can make the individual connections to the PDN. That includes having your equipment in place and the correct connections back into the campus network. You must also be sure that you have chosen the proper long-distance medium (shared or dedicated channels) to suit your needs.

This last step is actually a check on many of the previous selections. It is easy to lose track of the big picture when you are choosing several long-haul connections. You want to make sure that all the links (including any combinations of carriers) will work together.

How do you select vendors for the communications equipment and software you'll need? The short answer is that you must ensure that each internetwork device can communicate with the other devices on the WAN that it must connect to. The details of this task, however, are fuzzy.

If you have designed the WAN as a group of point-to-point connections, using the facilities of a PDN, the job will be easier. No single connection has to be all things to all nodes. In fact, you can send data to the PDN and let the distant end interpret what comes out of the spigot. All you need is a unique addressing scheme that takes into account enough users to cover all the WAN's nodes. This is not usually a serious problem. You just select vendors that provide that addressing flexibility along with the requisite PDN connections, and you've met most of the challenges.

Step 5: Managing the Network

This can be a serious problem, because most of the networks that make up a WAN are not directly compatible. No

Selecting a PDN

The best way to view a PDN, or value-added network (VAN), is as a data-communications version of the phone company. Instead of carrying voice, PDNs carry data. Like telephone companies, they have different capabilities and cover different geographical areas, and the differences between them are often not really significant.

Selecting a PDN requires a serious look at the available offerings as they relate to your prerequisites. The selection may come down to three criteria: Does the PDN offer the gateway connection you need? Does it cover the geography you need now as well as what you may need in the future? Is the price right?

In addition, some PDNs offer a choice of access protocols, although most use CCITT X.25 as the communications protocol over the network. PDNs are packet-switched networks, as opposed to circuit-switched networks, using transmission facilities like T1.

A *packet-switched* network routes individual data packets in the most efficient way. As circuit loads change during a transmission, the network reroutes packets to maintain load balance and maximize transmission speed.

A *circuit-switched* network switches entire circuits and cannot change during a communications session. If a circuit path becomes overloaded, system response deteriorates. Also, you must use some routing method to provide load sharing. The phone company doesn't do that for you.

Often, some confusion exists about what constitutes a PDN. While the telephone company provides only the transmission facility, a PDN provides a variety of services. That does not include such additional capabilities as E-mail, BBSes, or conferencing. Systems such as CompuServe (excluding CompuServe Network Services), GEnie, BIX, the Internet, and MCI Mail are not PDNs. They are different services entirely.

A PDN provides the road and a traffic cop. You must put the vehicles on it. However, many PDNs add services beyond those that relate specifically to protocols and other data-handling features. PDNs may include E-mail or access to on-line databases through gateways to providers of other services. These services, however, are not inherent in defining a carrier as a PDN.

In the report "An Overview of Value-Added Networks (VANs)" (Datapro Research, McGraw-Hill, 1990), 82 percent of the 1989 VAN market is attributed to just two providers: US Sprint and BT Tymnet. The rest of the market is divided, relatively equally, among 11 other networks (see the table).

PUBLIC DATA NETWORKS

Different PDNs have different capabilities and serve different geographical areas, but their differences are often insignificant. This table shows which protocols these services support and the number of locations they serve. The PDNs listed here are all dedicated, dial-up networks, unless otherwise noted. Contact information for these services is contained in the Resource Guide on page 190. (●=yes; ○=no; N/A=not applicable.)

Service	X.25	Async	X.75	SNA/SDLC	3270	2780/3780	BSC	X.400	MNP	Locations	Other protocols
ADP Autonet	●	●	○	○	○	○	○	○	○	320 U.S.	N/A
AT&T Accunet	●	●	●	●	●	●	●	○	○	350 U.S.	N/A
BT Tymnet	●	●	○	●	●	○	●	○	○	850+	RJE/HASP, 2946, VIP7700, Polled Async, X.PC
CompuServe Network Services	●	●	○	●	●	○	●	○	●	350 U.S.	5250
Cylix Communications	●	○	○	●	●	○	●	○	○	Dedicated only	Burroughs Sync, Poll Select
GE Information Services	●	●	○	●	●	●	●	○	●	750	SNI, LU 6.2/APPC, XMODEM, X.PC
Graphnet Freedom Network II	●	●	●	●	●	●	●	●	●	1000	ASCII, X.32, Baudot, QLLC
IBM Information Network	○	●	○	●	○	●	●	○	●	276 U.S.	RJE, LU 6.2
Infonet	●	●	○	●	●	●	●	○	○	1200 U.S.	N/A
Infoswitch	●	●	○	●	○	○	●	○	○	88 Canada	X.21, X.26, HDLC
Telecom Canada Datapac	●	●	○	●	○	●	●	○	○	200+ Canada	ISO poll/select
US Sprint Sprintnet	●	●	●	●	●	●	●	●	●	1000+	X.32, 5250, QLLC2, protocol-sensitive channels
WangPac	●	●	●	●	○	○	●	●	●	650 U.S., 4 Canada	X12, XMODEM

The information in this table is courtesy of Datapro Research, Datapro Management of Data Communications (Delran, NJ). For more information, call (800) 328-2776.

one size fits all for managing WAN components. If you have the luxury of designing the WAN from the ground up, you can settle on a network management protocol, such as a simple network management protocol (SNMP). Then you can install centralized network management.

If you don't have that luxury (and you probably won't), you have two choices. First, you can install as many individual network management systems as you need to cover all the bases. For example, you might use Novell's LANtern system or one of the other SNMP systems for LAN segments, an SNA system for the IBM mainframes, and DECmcc for the VAX segments. The other option is a universal management system, such as Cabletron's Spectrum (East Rochester, NH). Spectrum is so programmable that it can manage virtually all of a WAN and the sites and nodes on it from a central point.

Regardless of which approach you take, you should use a hierarchical management system. That means that the managers of the various levels of the network (e.g., sites, campuses, regions, and the central location) are responsible for their own areas. Many of today's WANs are simply too large and complex for a central site to manage alone.

Final Decisions

It's time to implement the grand plan. How do you approach it? The easy answer is usually to configure the central location first. To do that, you'll need to ensure that all the sites and nodes within that group are internetworked and ready to roll. Then establish a central communications control center (if you haven't already).

If you are using a hierarchical system, where the central office communicates with regional nodes that in turn communicate with their branches, turn on the nearest region. Establish the link between the regional communications control center and the central control center. The regional center should implement the same turn-on procedures as the central site, in terms of the nodes and sites connected to it locally.

At this point, a single spoke of the WAN is up and running. Add the branch offices to the region. During this process, identify any problems that arise as you turn on other regions. Don't forget that you need to continue to operate whatever old system you were running parallel to the WAN until you are satisfied that the WAN is running reliably.

Unless you anticipate significant delays in turning on subsequent sites or regions, don't put one path into production until you can turn them all on. The impact on the staff of the unconnected sites as well as personnel who must process information arriving in a disconnected variety of ways can make day-to-day operations difficult at best.

Planning and implementing a WAN is far from simple. A great many issues—many seemingly contradictory—work together to complicate matters. But if you assess your requirements, analyze your alternatives, plan carefully, and implement methodically, you can interconnect your organization across the city or around the world. ■

Peter Stephenson is a writer, consultant, and lecturer specializing in enterprise networking and information security in Rochester Hills, Michigan. You can reach him on BIX as "pstephenson."

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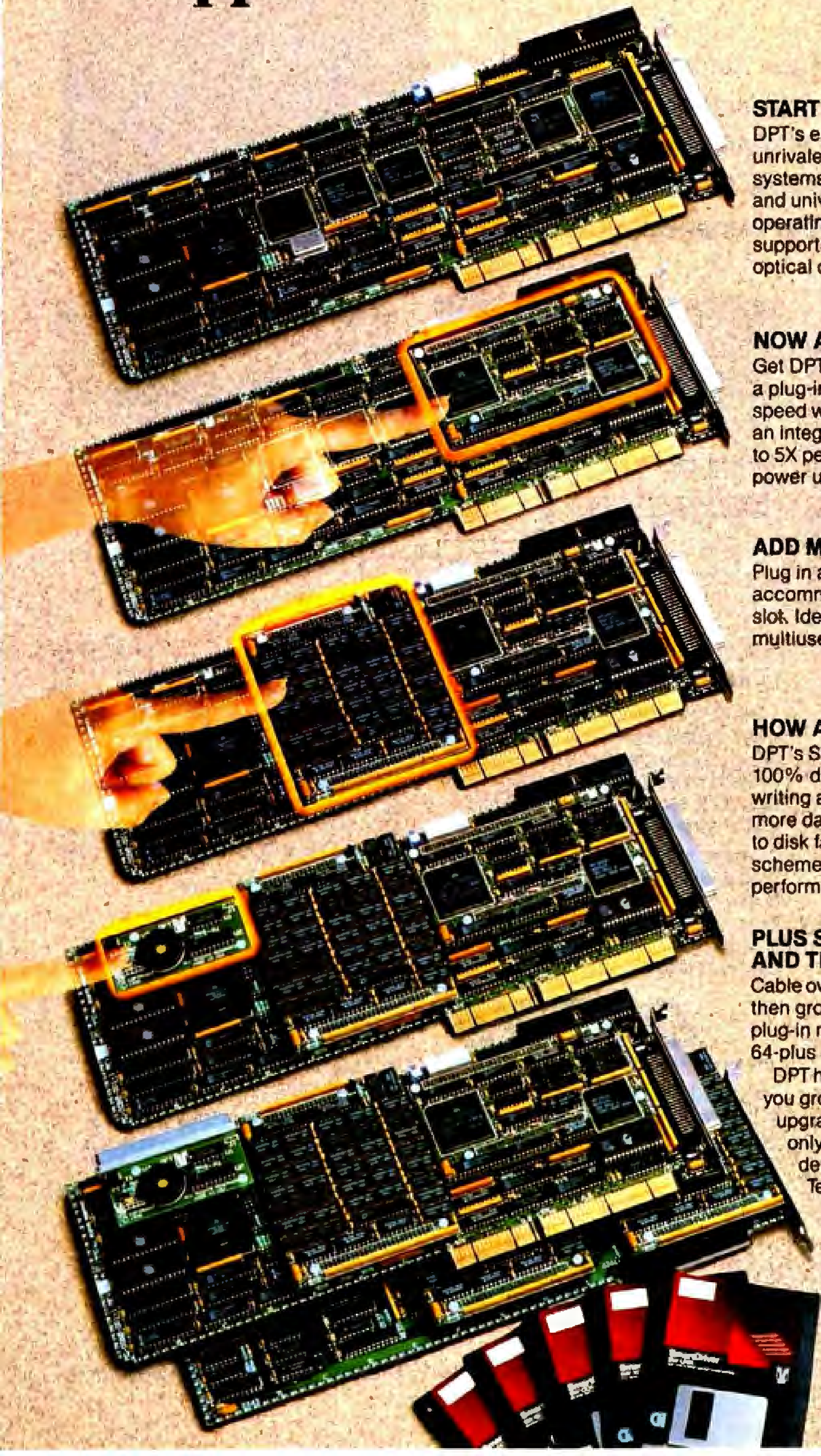

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DPT

WHITHER NREN?

Everyone agrees that a high-performance network for research and education is vital if the U.S. is to remain competitive in the world economy. The question is, who should provide the network?

SHARON FISHER

To those who prefer to limit the amount of government in their lives, one of the three great lies is "I'm from the government, and I'm here to help." But others believe that for certain large tasks, only an entity with the scope of the federal government can get things done.

These two philosophies are currently in conflict over the U.S.'s future networking needs, or, more precisely, how such needs should be satisfied. One camp proposes a federally funded National Research and Education Network (NREN), comparing it to the interstate highway system, while the other believes that sufficient commercial services already exist to provide such a network.

Ironically, both groups agree that this type of network should end up being provided commercially. The question, then, is whether such a network needs a federally sponsored jump start.

History Behind NREN

The forerunner of NREN is the Internet, a network devoted to research and educational use, the development of which was originally funded by the Advanced Research Projects Agency of the Department of Defense (see the text box "Feeding the Internet" on page 184).

The first step toward a more sophisticated national network was in the late 1980s, when the National Science Foundation funded a high-speed network backbone, NSFnet, linking first 12 and now 16 supercomputer centers around the U.S. (see figure 1). As a result, links between these centers were upgraded to T1 speeds (1.5 megabits per second), and a central-management network-operations center was established by the Merit organization in Ann Arbor, Michigan. Merit, with IBM and MCI, won a five-year contract in 1987 to manage the network and oversee upgrades.

The value of such a network is apparent in its staggering growth (see figure 2). For the past three years, the amount of network traffic has grown at an annualized rate of 20 percent per *month*, according to Joel Maloff, former vice president of client services for Advanced Network and Services (ANS), which manages the network along with Merit. In March alone, the network transmitted over 7 billion packets of information.

At the same time, members of government and industry were becoming concerned over what they perceive to be a high-technology lag in the U.S., compared to other countries. In response, in 1989 the President's Office of Science and Technology Policy issued its Federal High-Performance Computing Program report. This report proposed four areas for R&D in technology that could bring the U.S. back to the forefront: high-performance computing systems, advanced software technology and algorithms, basic research and human resources, and a national research and education network.

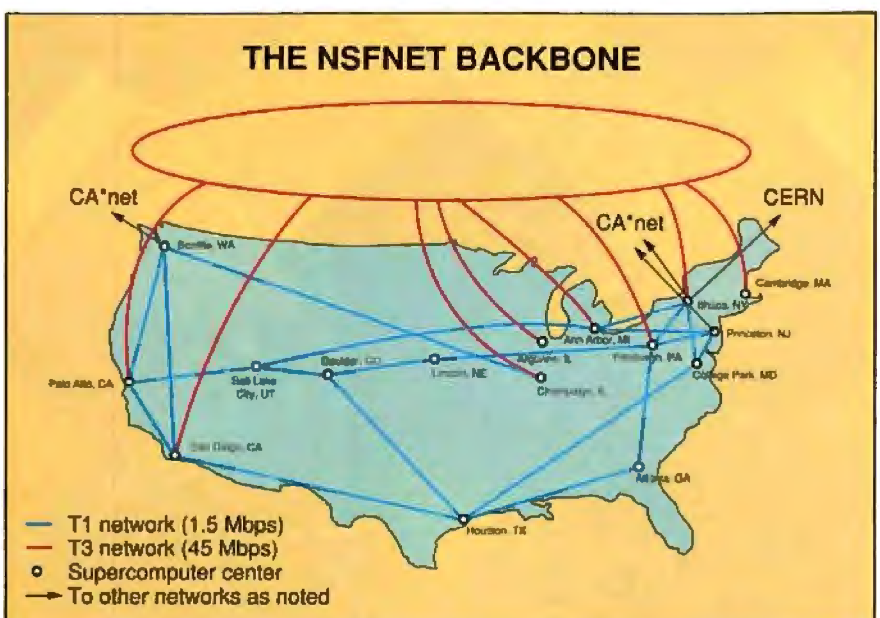

Figure 1: *With T1 links between 16 supercomputing centers and a T3 cloud in place, the NSFnet backbone and the associated Internet serve most research and educational institutions in the U.S. (Courtesy of Merit Network, Inc.)*

NREN and Congress

It's this last area, NREN, that has attracted most of the attention. The report proposed a three-step process whereby the federal government would fund a network, based on the Internet and NSFnet, that could eventually transmit data in the gigabit range (more than 1 billion bps), and that would extend not only into the traditional research, university, and government arenas, but even into selected elementary and secondary schools. Once the network was built, it would gradually be commercialized, or run by commercial organizations rather than the government.

Proponents note that the entire program is projected to cost $988 million in the first year, and a total of about $2 billion over a five-year period. In comparison, the total funding for science each year is some $70 billion. Or to put it in more readily understandable terms, the whole project would cost about the same as one B-2 bomber, according to a congressional source.

In response, bills funding the proposed project have been brought to the Senate Committee on Commerce, Science, and Transportation, spearheaded by U.S. Senator Al Gore of Tennessee. In 1990, such a bill unanimously passed the Senate Commerce Committee and the full Senate, but it died in committee in the House of Representatives, mainly due to the lack of a strong champion. Gore resubmitted the bill, now known as S. 272, the High-Performance Computing Act of 1991, to the subcommittee on March 5, and it is slowly working its way through the process (see the text box "A National Vision" on page 188).

The Question of Control

But while there's little disagreement that such a network would be useful, there's some argument over whether the federal government should be paying for—and controlling—it. While the national data superhighway comparison is often made, the analogy breaks down when you consider that the infrastructure for such networks already exists in the facilities of organizations like AT&T, US Sprint, and MCI.

"It depends on your view of NREN," says Martin Schoffstall, vice president and chief technical officer for Performance Systems International (PSI), which provides a commercial network service and a portion of the existing NSFnet backbone. "If it's a funding device for the grade schools or the high schools or the local libraries or the community colleges to participate in the Internet, then it is needed. If it means building a big network, owned and controlled by the government or by some contractor, then it probably is not [needed]."

Many believe that the best way for the government to develop a network is to support existing services rather than to build another network. "The Internet, up to now, has been this wonderful social-welfare state," says Geoff Goodfellow, president of Anterior Technology, in Menlo Park, California, which provides E-mail and news feeds. "Not to say that the Internet hasn't been a good thing," Goodfellow adds, "but we're now at that turning point when those commercial carriers can provide the same level of service that the government backbone can. Then it's time for the government, rather than funding the backbone, to put the money in the hands of the subscribers of the network and let them pick the network service provider they wish to go with, along the same lines that they would pick a long-distance carrier."

Commercialization of the Internet

A couple of years ago, the question of commercial use of the Internet would have seemed heretical. Traditionally, its use and access have been free. But as organizations have grown to depend on it more and more, they have not wanted to rely on its somewhat free-form management.

Consequently, a number of organizations are already in the business of providing access to the Internet—and even providing their own networks. Many of the supporters of these organizations believe that the best way to produce an efficient, high-performance network is through the time-honored American method of competition rather than the time-honored American method of federal subsidies.

The commercial companies providing Internet access include General Atomics, of San Diego, through its CERFnet; PSI of Reston, Virginia; and UUNET Technologies of Falls Church, Virginia. It's worth noting that both CERFnet and PSInet were originally NSFnet regional networks, with CERFnet covering parts of southern California and with PSI starting out as NYSERnet, the middle Atlantic regional network. UUNET, for its part, has long been in the business of providing commercial access to the Internet.

These groups compete with ANS, which is headquartered in Elmsford, New York, and has offices in Ann Arbor, Michigan. ANS is a nonprofit corporation, funded originally by IBM and MCI, with the mission of supporting research and education networking in the U.S., says Maloff.

"Where ANS fits in is that, several years ago, the NSF ran a solicitation for the management of the NSFnet backbone to upgrade to T1," says Maloff. This contract was won by a consortium of MCI, IBM, and Merit, the University of Michigan-based organization that also runs Michigan's statewide network.

But it was later determined that this type of relationship would not effectively bring the network into the 1990s, Maloff relates, so a new organization was required. "The first concern of industry was that if IBM had the ability to control and dominate it, that was not a good thing. That ruled out a straight partnership or stock corporation."

The result is the current not-for-profit corporation, funded by $5 million each from MCI and IBM. Both companies

BYTE ACTION SUMMARY

The future of high-performance networking for research and education will soon be decided. Proponents of a federally sponsored network liken it to the interstate highway system. Others claim that commercial services are the best way to implement such a network.

Feeding the Internet

The Internet has a reputation akin to that of a black hole—many people know it exists, but they've never seen it. Over time, however, access to the Internet—and understanding of it—is increasing. Commercial organizations are learning what educational and research institutions have known for years: The Internet is an invaluable information tool.

Technically, the Internet refers only to a particular group of machines with particular capabilities, not to the more numerous group of smaller machines that communicate with it. Some people make a distinction between the terms *Internet* and *internet*, with the latter including all the smaller machines—a difficult distinction to make in speech. In practice, users generally refer to the entire conglomeration as *the net*, as I will here.

Net Assets

People who have access to the net use it for various things, but it all boils down to exchanging information. Generally, net usage falls into four areas: E-mail, news, remote log-ins, and anonymous file transfer protocol (FTP).

Like other E-Mail services, E-mail on the net lets you exchange messages with other people. The difference is the net's scope: Millions of people all over the world are accessible through the net; all you need to know is the address of the recipient. In addition to private messages, the net also supports dozens of mailing lists on various topics, as well as social lists not tied to a particular topic.

News, also known as Usenet or netnews, consists of public messages that are differentiated into various newsgroups. News is similar to the sort of public exchange you can find on a BBS. Again, the difference is in the scope and breadth of participation. There are hundreds of newsgroups, ranging from technical topics on nearly every facet of computer science (the comp. groups) to various social and recreational subjects (soc. and rec.) to conferences of regional interest (e.g., ba. for the San Francisco Bay Area).

E-mail and news are available throughout the net. Remote log-in and anonymous FTP, however, are available only on systems directly connected to the Internet proper. Remote log-in, as the name implies, lets you log in to one Internet system from another remote Internet system (remote log-in is also known as *telnet*, after the name of the command that provides this function).

Anonymous FTP is similar to remote log-in. It lets an organization set up an anonymous guest account and place in it files and archival information that the organization is willing to disseminate freely. For example, many text files about the Internet and software that lets you connect to it from non-Unix systems are available through anonymous FTP. Another popular service is directories listing the sorts of services that are available through anonymous FTP itself; often the only way to get such information is through word-of-mouth—or "word-of-computer"—by way of news and E-mail.

A more recent innovation is Internet Relay Chat, which allows two people on the Internet to communicate in real time. While this eliminates the drag resulting from exchanging mail messages, it is still limited by the typing speed of the participants.

Managing the Net

The net has been called the world's largest anarchy. While the Internet is managed by a two-tier system of national and regional organizations, links to the net are far less closely monitored. New systems are supposed to register their names with regional mapping coordinators, but the lists are individually maintained, and new information sometimes takes a while to disseminate.

The backbone of the network is the National Science Foundation network (NSFnet). The next tier consists of regional, or midlevel, networks. As the name implies, the regional networks were originally defined to cover a specific geographic area, but over time, these networks have grown and may overlap in some places. Connections to a regional network can be over links ranging from 2400 bps to 1.5 megabits per second. These networks are run by a variety of organizations, ranging from commercial vendors to state-chartered groups.

Informal relationships take over below the regional networks; any machine on the net has the capability of providing feeds to any number of other machines, assuming it has the storage and transmission capacity to do so. Although there are costs—generally telephone charges—associated with providing feeds, organizations usually consider them to be part of normal network overhead. Because the point of the net is to provide for the exchange of information to as many sites as possible, being a good net citizen means being willing to provide feeds for others. Additional feeds also improve network reliability by providing multiple communications paths.

Ties That Bind

The net consists of computers of many different architectures, using many different communications links to exchange information. That it works is a testament to the ability of TCP/IP to link heterogeneous computers and to the people who volunteer their time and effort. The overwhelming majority of machines on the net run this ancient, creaking—but functional and widely supported—communications protocol.

Generally, systems call each other up

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have a seat on the eight-person board of directors, although neither can ever have more than one. In addition, the original agreement between Merit and NSF for management of the existing NSFnet has been assigned to ANS as well (with the engineering portion then subcontracted back to Merit).

The result, too, is that portions of the NSFnet backbone have already been upgraded to 45-Mbps T3 speeds, Maloff says. The T3 infrastructure (now referred to as a *cloud* rather than a backbone, to indicate its redundant, nonlinear nature) is managed by ANS.

ANS, at this point, consists of the NSFnet backbone and its own commercial service.

At present, organizations that use the NSFnet backbone—which includes ANS—are not supposed to use the network for commercial traffic, only for traffic in support of research and education.

In other words, although commercial organizations like Sun Microsystems or Apple Computer can be on the network,

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at administrator-defined intervals to exchange information. Some of the information that system A gives to system B may be for system B; some may be for system C, which communicates with system B; some may be for system D, which communicates with system B through system C.

Until a few years ago, you had to be much more knowledgeable about the paths between sites than you do now and often had to specify the route by which a message would travel, using almost legendary trivia for the most efficient path.

These days, due to the innovation of domain addressing, you can generally use the address format `userid@organization name`. The organization name may be of several forms. For example, a name with the suffix .com is a commercial company (e.g., Sun or Apple). The suffix .edu signifies an educational institution. And .gov means a governmental group. In other cases, especially in the lower hierarchies, the organization name may show a further regional breakdown.

Issues of Content

Because at least some of the Internet is funded directly or indirectly by various government agencies, people (including, but not limited to, congressional representatives) sometimes take exception to the types of information transmitted over the network. Technically, all messages transmitted over the Internet should be related to research and education. In practice, sometimes the only relationship the information has to these areas is that someone working at an educational or research site is sending or receiving it. To some people, that's justification enough; others disagree. Generally, the one hard-and-fast rule is that commercial messages are not allowed, but even *commercial* is ill-defined. Unless complaints are filed, the net usually keeps chugging along.

The problem arises when people take exception to some of the things transmitted over the network. Such complaints are usually lodged against social news or files available through anonymous FTP. However, longtime net users point out that newsgroups for social topics were originally set up to help focus the discussion in the technical newsgroups: The social topics keep tangential material out of the technical discussions.

The net has so many layers of redundancy that it's nearly impossible to shut down some forms of traffic. While it's unfortunate when a major site ceases transmission of some newsgroups, the newsgroups continue to be available from many other sites, some of which are unlikely to ever be controlled by people who feel the need to halt such messages.

Gaining Access

You can access the net in many different ways. If you're employed by a company that has any sort of government, research, or education ties, you may find that you're on the net already or that access to it can be made readily available to you. Such organizations are also the most likely to have bona fide Internet access. The person to ask about this is the network or system administrator.

If an organization doesn't have any sort of net access and you can't convince your managers how useful it would be, you can consider becoming a net node yourself. To do this, you need two major components (besides a computer): software and a *feed*. The feed is your link to the net.

Software is available in many forms for many systems, including PCs, Macintoshes, and Unix systems, often in various sorts of freely available programs. Yet setting up and maintaining a node is complicated and can require all sorts of ancillary equipment (e.g., large hard disks and high-speed modems).

Once you have the software, you still need someone to talk to. This someone is your feed. Generally, it's preferable to find a feed within your local calling area to save on phone bills. In some areas, such as Boston or San Francisco, finding a feed may not be difficult; in more remote areas, it may be harder. It's a good idea to have more than one feed, in case one of the systems feeding yours goes down.

Each region usually has a coordinator, who keeps track of existing systems and the systems they're connected to. Once you obtain your feed, you will need to register your system with the coordinator to ensure that other systems on the net know about you.

Once you're established on the network through the benevolence of the person or organization supplying your feed, you are honor-bound to consider similar requests made to you in the future. The Golden Rule is highly regarded in the net community.

If you don't have the equipment or the inclination to become a network node, you can use one of the increasing number of public-access Unix systems to acquire an Internet E-mail address and some sort of news feed. If all you need is an occasional E-mail exchange with somebody on the net, you may not have to look further than your current online information system. Nearly every commercial on-line system, including CompuServe, MCI Mail, and AppleLink, offers E-mail exchange with the net. All you need to know is the right way to address the message.

Aside from system manuals and postings made to the news.announce newsgroups, the best source of information on using the net and setting up your own node is *Unix Communications* by The Waite Group (Howard W. Sams & Co., 1987). For a more theoretical discussion of the net, see *The Matrix: Computer Networks & Conferencing Systems Worldwide* by John Quarterman (Digital Press, 1989.)

Beyond the Internet

The Internet is an institution in transition. It is moving away from its traditional form, which was geared toward research institutions, to a greatly expanded shape in the future.

Tomorrow's Internet will reach into the commercial sector and into educational institutions on a broader basis. It may even enter the realm of elementary and high schools.

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they are not allowed to use the network for commercial services. For example, a number of PC vendors use services such as BIX to provide technical support to their customers; on the NSFnet, this is not allowed.

These particular restrictions are in place because of commercial information and networking vendors' concern that a federally subsidized network could compete with them unfairly. "The concern with commercial use over the NSFnet is that commercial organizations will be using the facilities that are subsidized by the federal government," Maloff explains.

Maloff indicates that work is under way to loosen these restrictions, but that the final determination rests with NSF. "If, in fact, there are ways to be able to fairly cost and allocate costs back to the appropriate place, there is less of a concern [about competition and commercial use]," he says. "We want to eliminate, if possible, the chilling effect that some of these policies have. Folks are worried about whether they are in

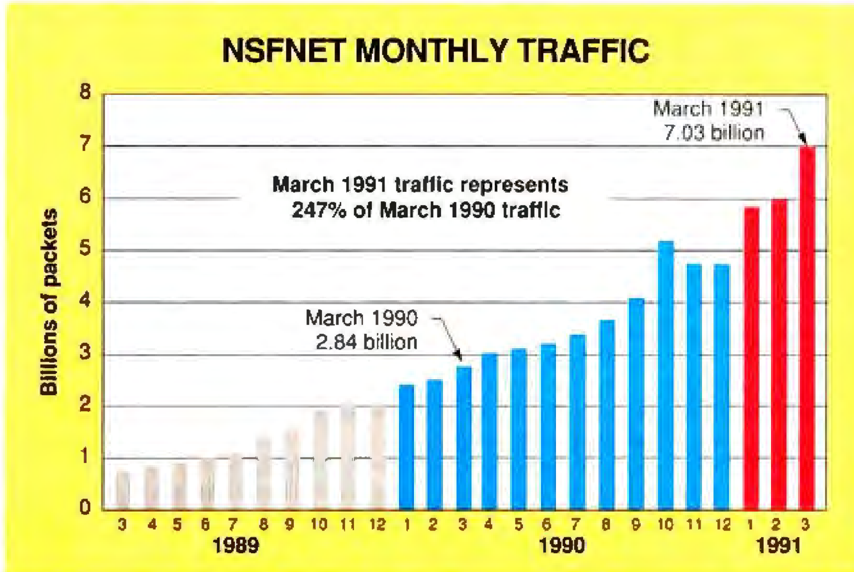

Figure 2: *The success of the NSFnet backbone is borne out by the phenomenal growth in traffic the network has experienced in the past two years. (Courtesy of Merit Network, Inc.)*

compliance with the acceptable-use policies."

Policing the Internet

In practice, making acceptable-use determinations is very difficult to do when up to 45 Mbps can be transmitted, each routed a different way depending on destination and network traffic, and when neither service organizations nor users are interested in having the service organization check every data packet and determine whether it's acceptable traffic.

Consequently, there's a question even now about just how much of a restriction there really is on commercial use of the NSFnet backbone. "The use rules, for the most part, are illusory," says Goodfellow. "Enforcement is really a problem unless you look inside the information itself, and no one's willing to do that." Maloff concurs, noting that ANS has not, to date, taken any action regarding any breaches of the acceptable-use policy.

In an attempt to eliminate the problem, several commercial services banded together this spring to set up an alternative backbone that would not use NSFnet links and consequently would not have to follow acceptable-use policies.

The Commercial Internet Exchange allows all users of AlterNet (UUNET's service), CERFnet, and PSInet to exchange Internet traffic directly at no additional cost. This would mean that CERFnet users could communicate with AlterNet or PSInet users without having to traverse the NSFnet backbone at all.

Moreover, the organizations said, the agreement means that they can continue to provide service even if the NSFnet backbone were to fail completely—a point of vulnerability, after the 1988 Internet Worm incident, of which many users are aware. The three commercial services claim they provide nearly 100 percent of the commercial TCP/IP- and Open Systems Interconnection-based internetworking services in the U.S.

Another possibility is that NSFnet's purpose may be redefined, says Douglas Van Houweling, vice provost for information technology at the University of Michigan and chairman of the board of ANS. "It's entirely possible to imagine the net being targeted to serving the research and education community, including the library community, but not restricted in terms of the type of traffic it can carry in service to that community." In other words, the network would be able to support commercial services like Dialog as long as the customers were in the research and education community.

Content is a subset of the issue of who should control the network, says Van Houweling. "The current environment is one that works because of the cooperation among a very large group of organizations all over the world," he says. "We need to continue that highly decentralized, cooperative model of organization delivering the network."

"Quite a few people have suggested that we need some agency or organization that is 'in charge,' " Van Houweling

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A National Vision

U.S. Senator Al Gore

Of the many things that distinguish human beings from other living creatures, one of the most important distinctions is our ability to deal with symbols in the world around us, to share them with each other, to manipulate them, and, in the process, to gain understanding about how to transform the real world. Human beings communicate with symbols. Yet the way we exchange pieces of information changed dramatically with the scientific and technological revolution and with the computer, the steam engine of this revolution.

Because of computer technology and related developments, the global civilization prematurely heralded many times in this century is now a palpable reality. And this global civilization provides the framework within which every problem, every challenge, and every opportunity must be defined.

Business executives must consider the global marketplace. Scientists must think about their global scientific discipline. In 1991, no one operates in a vacuum. This developing global civilization is based on shared knowledge in the digital form. Digitized information is now the lingua franca of the entire world. Those companies, those universities, and those nations best able to deal with information in that form turn out to be most successful.

It used to be that how well one nation competed with another depended on the transportation infrastructure. Nations with deep water ports that could house large steamships prospered more than nations unable to exploit the technology of ocean transportation. Experience taught that canals, railroads, and highways have a tremendous impact on a nation's ability to succeed in commerce.

Today, there is a new infrastructure challenge. We have a lot more information than we can use or move. The problem is not all that new; the nineteenth-century philosopher John Stuart Mill was said to be the last man who knew everything. Since then, no matter if it's law, business, science, or government, people in every field must resign themselves to the fact that a great deal will take place completely outside their awareness. They must develop strategies to become, at the very least, familiar with a summary of what is happening.

The process that began early in the scientific revolution has become a major problem. Fields of specialization are becoming narrower and narrower as the amount of information continues to metastasize and double every several months.

I coined the word *exformation* to describe all the information that exists outside our awareness. For example, the Landsat satellite is capable of taking a complete photograph of the entire Earth's surface every two weeks. The information contained in the photographs taken over the last 18 years is invaluable to farmers, environmental scientists, geologists, educators, city planners, and businesses. Yet more than 95 percent of those images have never been seen by human eyes. They are left to decay in their digital silos. While our nation craves knowledge and new information, vast silos of data are going unused.

Part of the problem is how information is presented. An analysis of the human brain, in computer terms, shows we have a low bit rate, but very high resolution. The telephone company decided several years ago that seven numbers were the most people could remember, and then added the three-digit area code. Yet absorbing information bit by bit by bit is difficult. Human beings cannot do it very well. On the other hand, billions of bits of information can be absorbed instantly if they are arrayed in a meaningful pattern, where each bit relates to every other bit. A mosaic such as this can be absorbed quickly, because human beings have very high resolution: a great ability to understand pictures or graphs.

Luckily, just as this fantastic problem of exformation, or silos of data, presented itself, a wonderful new tool, the computer, appeared. Long touted for organizing data into a form that makes it possible for us to absorb its meaning, the computer also permits us to search through vast fields of data to find those bits that have special relevance.

There is one big obstacle, however: We do not have the national infrastruc-

continues. "I believe that we do need an organization that draws together the involved service providers with the diverse user community to set overall objectives for the NREN. But that is very different than saying that group should be in charge."

Creating the Future

At this point, there are two major actions that will help to determine the future and form of NREN. The first is the success or failure of the NREN funding bills that are currently before the Congress. It's always difficult to predict when such actions might hit the floor. It is possible that this decision will have already been made by the time this article appears in print.

The second is a little further in the future. Merit's contract with the NSF for running the NSFnet backbone expires in October 1992. "What will happen after that will be determined in part by what the NSF concludes is the follow-on activity to the current cooperative agreement," says Eric Aupperle, president of Merit Network, in Ann Arbor, Michigan.

To provide for an orderly transition, a preliminary decision may be made as early as the end of this year, Aupperle says. Such a decision might be a continuture needed to provide the processing capacity to deal with these vast amounts of data. Pictures, especially moving pictures and graphics, require such densely packed information bits that to transmit them requires connecting lines with a very large and high-speed capacity.

The demand for these new transmission networks—the high-capacity connection lines, fiber-optic cables with special switches, software, and algorithms that make it possible to transmit these densely packed data sets, pictures, and moving graphics—is not readily apparent because the sophisticated, new communications services and products are not yet widely offered beyond a few specialized groups. And why? Because the network is not there—a classic chicken-and-egg problem. If the infrastructure existed, it would be in great demand. But because it doesn't exist, that demand is not apparent.

Just as the interstate highway system made sense for a postwar America with lots of new automobiles clogging crooked two-lane roads, a nationwide network of information superhighways—high-speed, fiber-optic networks—now is needed to move the vast quantities of data that are creating this information gridlock.

Once the network is in place, the nation will make fantastic use of it. A school child, instead of coming home to Nintendo, could plug into the Library of Congress every afternoon and explore a universe of knowledge, jumping from one subject to another, according to the curiosity of the moment. A doctor in Carthage, Tennessee, could consult with experts at the Mayo Clinic in Minnesota on a patient's CAT scan to avert an emergency. Teams of scientists and engineers working on the same problem in different locations could work together in a co-laboratory if their supercomputers were linked.

Today, a climate modeling team wishing to share the results of work in progress has to download the work onto a magnetic storage medium, take it with them on an airplane and travel to whatever location the other team is working in, and then upload their model and the work in progress so that they can talk about it and share the work. Researchers should not have to do that. Yet because they do, work is not shared.

We are missing out on work in progress, this ability to search through data, configure it into a meaningful form, and communicate the result. Work in progress is now so important it has emerged as a third basic form of knowledge creation: inductive reasoning, deductive reasoning, and computational science. If there are only two ways to create knowledge and you discover a third, that's important. We excel at inductive and deductive reasoning, but the third, which is going to revolutionize the entire world, we're not yet using effectively. We need to start.

Yogi Berra once said, "What we have here is an insurmountable opportunity." Supercomputers that today sell for $20 million will, within four to five years, cost only a few thousand dollars. Almost every medium-size business in America will want one.

One of the real secrets to productivity is figuring out new ways to distribute information-processing capacity and to coordinate the results of the distributive work. New business management techniques, theory Z, and quality-control circles are just corporations discovering that their most valuable asset is the unused brain power on the assembly line.

Consider "America's Funniest Home Videos," one of the top-rated TV shows in America. Tapping into the unchanneled creativity of people with home-video cameras all over the U.S., the show receives 20,000 tapes a week and searches through each one, looking for the one that contains a diamond. It was the number-one show in America last year. This was not possible until the technology of home-video cameras was sufficiently ubiquitous to enable enough people to participate.

Just as democracy was impossible until the printing press empowered enough people with civic knowledge to participate in the process, computers now provide people all over the U.S. with a brand-new ability to use their creativity to change the world around them, in ways they never before envisioned.

Eleven years ago, I first proposed a nationwide network of fiber-optic data highways to link supercomputers and digital libraries throughout our nation. This legislation, the High-Performance Computing Act, now pending before Congress, would not only create the network needed, it would also create digital libraries, stimulate the development of more powerful supercomputers, and increase the number of trained scientists and engineers capable of helping us to make the best use of supercomputers. Whereas current information lines transmit 56,000 bits of information per second, this network will accommodate several billion bits per second—an entire *Encyclopaedia Britannica* every second.

One thing is certain: The information revolution is changing our lives, and we need to prepare ourselves to cope with its promise and potential. Our challenge is to process data into information, refine information into knowledge, extract from knowledge understanding, and then let understanding ferment into wisdom.

Steam locomotives weren't much use until railroad tracks were stretched across our land, and that didn't happen until the federal government made it possible. Supercomputers are the locomotives of the information age, but we haven't laid down the tracks. It's time to drive the digital golden spike.

Al Gore is a U.S. senator from Tennessee. You can contact him at the Senate offices in Washington, D.C. In addition, BYTE welcomes your comments on this text box. You can reach us on BIX c/o "editors."

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ation of the current scheme, passing control to ANS, setting up a competitive bid between ANS and whatever other commercial organizations might feel qualified, or something else. "Among the possibilities are, rather than funding an organization like Merit, using NSF dollars that would be available to provide funding to the regionals to acquire backbone services from whomever," he explains.

Once all the issues have been settled, then the NREN—in whatever form it eventually takes—will indeed be able to become the broad-based network that it was originally intended to be. "We haven't really yet become a market-driven community," says Maloff. "We have been technology-driven. At the point where we become more concerned with the secondary-school teacher in the middle of North Dakota or the astronomer who no longer has to once a month fly into a city to pick up a set of tapes, then we'll be a real community with real needs. Until then, we are an esoteric kaffeeklatsch." ■

Sharon Fisher is a San Francisco–based freelance writer specializing in data communications. She can be reached on the Internet as slf@well.sf.ca.us, and on BIX as "sharonfisher."

Public Data Networks

Like public telephone systems, public data networks mix communications from many customers over the same network. The difference is that PDNs route packets of data instead of voice communications. The companies below provide data-communications services to large and small businesses.

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fax: (313) 995-6458
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Basking Ridge, NJ 07920
(201) 221-2000
fax: (201) 221-7304
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BT North America, Inc.
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San Jose, CA 95131
(408) 922-0250
fax: (408) 922-7030
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CompuServe
Network Services Division
5000 Arlington Centre Blvd.
Columbus, OH 43220
(614) 457-8600
fax: (614) 457-0348
Circle 984 on Inquiry Card.

Cylix Communications
800 Ridge Lake Blvd.
Memphis, TN 38120
(901) 761-1177
fax: (901) 766-0229
Circle 985 on Inquiry Card.

GE Information Services
401 North Washington St.
Rockville, MD 20850
(301) 340-4000
fax: (301) 340-5390
Circle 986 on Inquiry Card.

Graphnet
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Teaneck, NJ 07666
(201) 837-5100
fax: (201) 833-3888
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3405 West Dr. Martin Luther King Jr. Blvd.
Tampa, FL 33607
(813) 878-3000
Circle 988 on Inquiry Card.

Infonet
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El Segundo, CA 90245
(213) 335-2600
fax: (213) 335-2699
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Reston, VA 22096
(703) 689-6000
fax: (703) 689-5176
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Ottawa, Ontario,
Canada K1P 6H5
(613) 560-3010
fax: (613) 563-9540
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Unitel Communications, Inc.
(Infoswitch)
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M8X 2W9
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Inclusion in the resource guide should not be taken as a BYTE endorsement or recommendation. Likewise, omission from the guide should not be taken negatively. The information here was believed to be accurate at the time of writing, but BYTE cannot be responsible for omissions, errors, or changes that occur after compilation.

First off, let's get one thing straight. We totally agree with Apple.* A truly powerful computer is measured in how often it's used.

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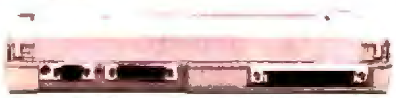
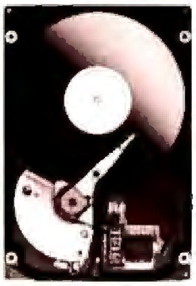


Our technologically superior battery can be fully recharged in a mere ninety minutes.

find on the T2000SX: An 80386™SX processor with a math coprocessor socket, VGA compatible display, 1 MB (expandable to 9MB) of 80 nsec RAM, a 60 MB hard disk with 19 msec access time and 1.5 MB/sec data transfer rate.



The T2000SX has a 60MB hard disk with 19 msec access time.

But more important than the specs themselves, is the way the T2000SX lets you use them. Which is more often.

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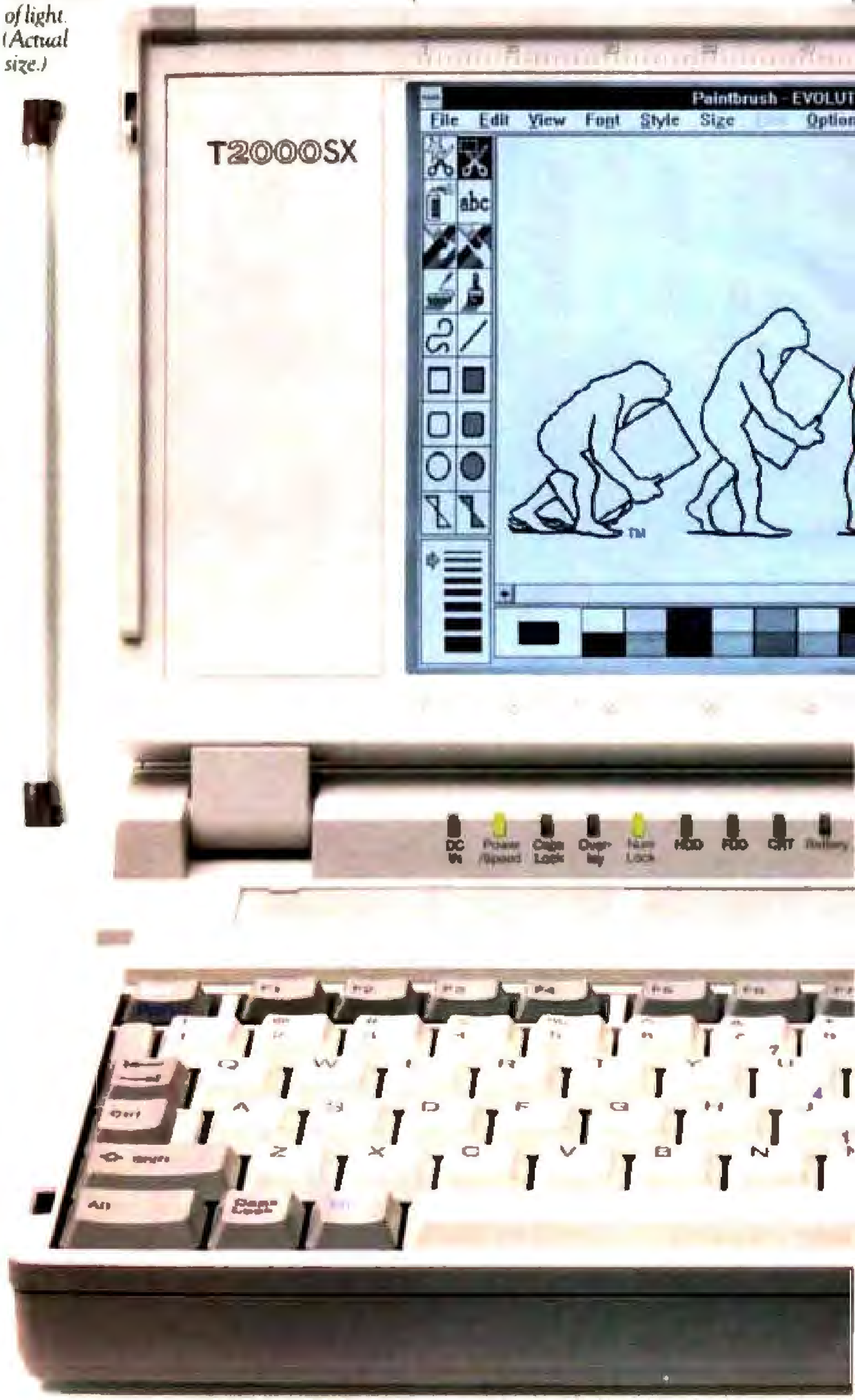


Welcome to the next generation in personal computing.

Because the T2000SX can fit easily into a briefcase (it weighs a scant 6.9 pounds), you can take it anywhere you go and use it in more ways than you can imagine.

Need to make revisions to a

Our internal AutoResume back up battery automatically saves your work if your main battery runs out.

business proposal? The T2000SX gives you the freedom to do it from a train. The client wants an estimate on costs? You can give it to him right then and there – wherever there is.

No more wasting time running back to the office. Because the office is always with you.

But just in case there's something

Our user-installed memory card allows you to add up to 8 MB of memory yourself.

back at the office you still need, you can get back to it with our optional built-in modem. Which supports industry standard error corrections and data compression (CCITT V.42, V.42bis, MNP® 5). It even supports cellular data communications via our optional smart cable adapter.

The T2000SX also has a unique feature you won't find on any other computer in the world. It is called AutoResume.

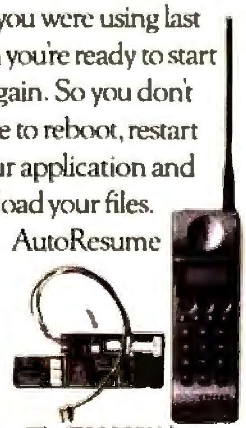
AutoResume: Think of it as a bookmark for your computer.

AutoResume automatically saves whatever you're working on whenever you turn the computer off. And it lets you go directly to the program you were using last when you're ready to start up again. So you don't have to reboot, restart your application and reload your files.

AutoResume also helps save on battery life and it allows you to change batteries without losing an ounce of information.

The T2000SX comes complete with Hypertext on-line documentation.

As for batteries, the T2000SX touts the latest in battery technology – Nickel Hydride. Nickel Hydride delivers 22% more watt-hours per pound than NiCad and it doesn't suffer from memory effect.



The T2000SX has an optional modem that allows data communications via a cellular phone.

In keeping with the Toshiba tradition, the T2000SX also offers superior ergonomics. Like full-size, standard-spaced keys on a keyboard which has a full set of 12 dedicated function and 8 cursor control keys. And a VGA compatible, reversible black on white or white on black high resolution display.

Okay, let's wrap this thing up.

These are just a few of the reasons why we believe the T2000SX is the most useful, and therefore, most powerful computer in the world. And why P.C. Week® Labs said, "*the T2000SX offers performance comparable to the LTE 386s/20, plus many of the design features that have made Toshiba a market leader in portable PCs.*"

PC WEEK

We invite you to learn more about the T2000SX and Toshiba's best-selling line of portable computers by calling us at **1-800-457-7777** for a complete information kit.

In closing, we'd like to thank you for reading our ad.

We'd also like to thank our friends at Apple for giving us such a wonderful endorsement.

In Touch with Tomorrow

TOSHIBA

JOURNEY TO FARAWAY LANS

Here are nine ways to connect remote sites to your local network

STEVE APIKI

Networks are an invaluable tool for compiling and sharing information. Unfortunately, access to central databases extends only as far as your physical network. For employees in satellite offices or in the field, much of the benefit of shared network information is lost unless they're able to connect to the central LAN.

You have two options for providing remote access to your network. You can expand the network to include the remote sites by using remote bridges, or you can give remote users their own processors on the network and turn their PCs into remote terminals. Remote bridges extend your network by running network traffic out to remote sites. But remote bridges must communicate over slow leased-line or dial-up connections, where throughput is measured in kilobits, rather than megabits, per second. For most applications, you'll get better performance if you run software on a local processor under remote control. The remote PC becomes a terminal to the local processor, swapping only screen and keyboard data over the asynchronous connection.

This month, BYTE examines nine products that accommodate multiple inbound sessions on your LAN. Four are hardware-based solutions that offer each remote user a processor on the LAN: Alloy's PC-Slave/286, Cubix's QL 3001, Evergreen's FlexComServer 100, and J&L's Chatterbox 6000. Novell's NetWare Access Server and LANmaster's IncomServ give remote users virtual 8086 sessions on a 386-based host. Two packages—The Software Link's PC-MOS 4.1 and Alloy's 386/MultiWare 2.03—offer the same capability as an adjunct to their multiuser DOS capability. (IGC was updating this capability for VM/386 at press time.) Finally, the Telebit ACS 2.20 redirects incoming sessions to available workstations on the LAN.

Each of these products represents the fastest, most powerful configuration the vendor provides; Cubix and J&L are the only vendors currently selling 386SX hardware. See table 1 for a summary of all these products. To find out how these products are faring in the real world, see the text box "Reports from the Front" on page 204.

BYTE ACTION SUMMARY

■ **WHAT REMOTE-ACCESS SERVERS DO**
These products let many remote users dial into a single communications server and control network sessions running on a locally connected host processor or virtual machine.

■ **LIKES**
Remote users gain access to local databases and other shared information on the LAN. Centralized access makes the network administrator's job easier.

■ **DISLIKES**
Software-based products break down if you run the wrong applications, and performance slows quickly as you add users. Hardware products are more stable but more expensive.

■ **RECOMMENDATIONS**
Novell's NetWare Access Server software is economical and reliable for running typical business applications. Where speed is the first criterion, J&L's Chatterbox 6000 comes out on top.

Common Ground

You could offer computing sessions to remote users simply by installing several PCs on your network, attaching modems to them, and designating them as available for remote access. Remote users would call in and take over the entire machine, using remote-control software, such as Carbon Copy or Co/Session. But dedicating big, boxy PCs becomes unwieldy if you need to put more than one or two in an office or computer lab, and having unattended PCs in distributed locations on your network can create security and maintenance problems.

The products reviewed here let you centralize dial-in access to your LAN while avoiding many of the space and maintenance problems associated with using multiple PCs. All provide at least some management and security features for administering remote computing sessions.

With so many different designs that claim to accomplish the same task, it's hard to come up with common ground on which to compare them. But regardless of the specific needs of your application, you'll want reliable operation, low total-system cost, and high performance. You

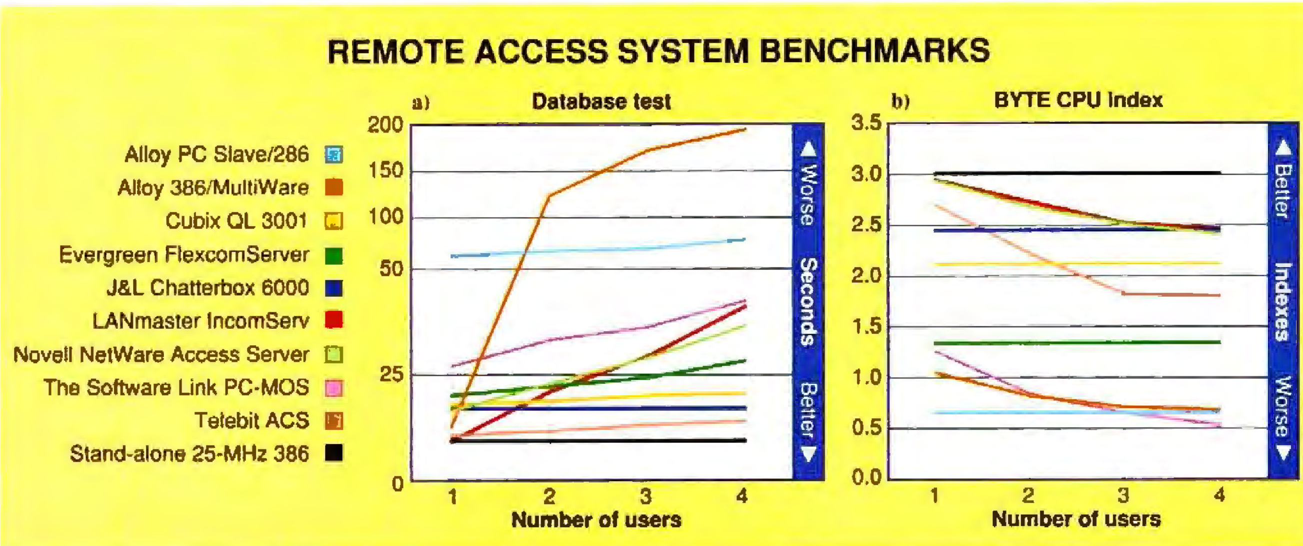


Figure 1: **(a)** *This test runs a database script to measure each product's end-to-end performance. 386/MultiWare's speed looks worse on this test than it actually is because of uneven allocation of processor time (see the text for details).*
(b) *Raw CPU performance for the local processor or virtual machine running each remote session. Hardware products hold steady as you add users, while multitasking software shows a discernible drop.*

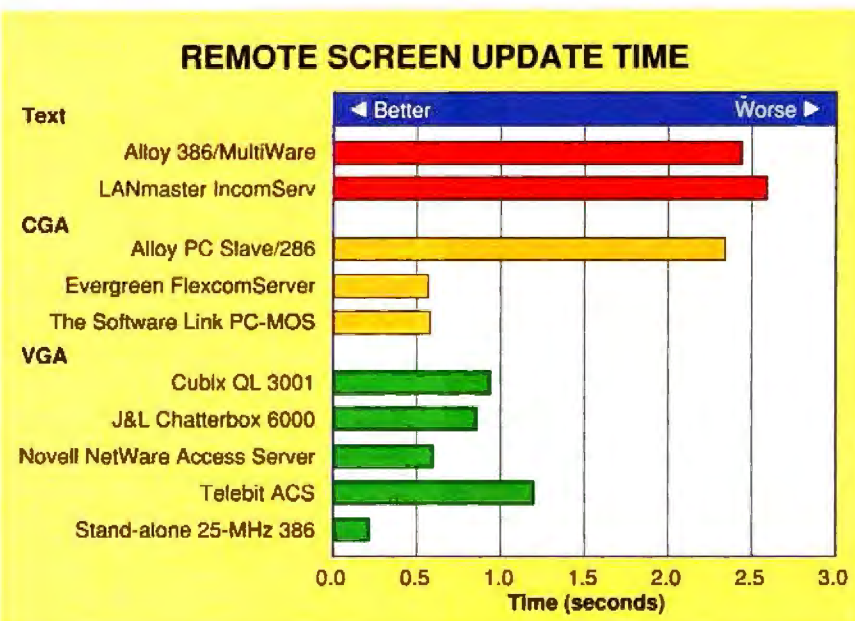


Figure 2: *This test measures the remote-control or terminal software's ability to quickly update text-mode screens on the remote system. Cubix didn't include remote-control software with the QL 3001, so we tested it with Co/Session; other packages may provide the Cubix boards with better performance.*

will also want to look for good management and security functions and ease of use for both the end user and the network administrator.

Performance Measures

Two factors determine remote-access performance: the speed of the remote processor and the speed of the remote-control software. Funneling keyboard and screen information through a 9600-bps connection creates a considerable bottleneck. Therefore, no matter what the processor, almost all the software you run from a remote site will respond more slowly than it does locally.

To test performance, I set up a thin-wire Ethernet LAN and attached a Compaq Deskpro 486/33L file server running NetWare 3.10 and four Gateway 2000 386SX workstations. The network interface cards I used included Eagle Technolgy's NE2000 (formerly sold by Novell) and Western Digital's EtherCard Plus.

I installed each package that required a host PC on a 25-MHz Gateway 386 with 4 megabytes of memory. The Telebit ACS was the exception. It required a PC with exactly 512 kilobytes of memory; the only system I had that fit the bill was an 8-MHz AT clone. I used four dial-up lines to connect to each product, placing Hayes V-series 9600-bps modems at the host end and Telebit T1600 V.32 modems at each remote workstation.

BYTE's Benchmarks

Our test suite consists of three tests. Two measure critical performance factors: remote screen update and host processor speed. The third provides an overview of remote application performance.

The first test measures text-screen update speed at the remote workstation. I didn't time graphics modes explicitly, but I found all the products too slow to realistically consider them for running interactive graphics applications remotely. Screen performance depends on the type of graphics emulation each product uses and the efficiency of its remote-control software. For the Cubix QL 3001 boards, the only product that does not

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INTEL 80387 SX 16 MHz	$288
CYRIX 83D87-20 20 MHz	$288
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INTEL 80387-25 25 MHz	$468
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INTEL 80387-33 33 MHz	$568
WEITEK 3167-25	$598

SCANNER

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MICE

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ZNIX Super Mouse II w/Windows 3.0	$88
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MICROSOFT Mouse w/Windows 3.0	$158
MICROSOFT Mouse Serial or BUS	$99

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FRECOM FAX 96	$178
FRECOM FAX 96 1 Liner	$288
Editors Choice TF-555 FAX, Modem, Ans. Machine, Phone, Auto Switch	$148
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PRODUCT SUMMARY—DIAL-IN LAN PRODUCTS

Table 1: *Although these products include hardware, software, and stand-alone and plug-in solutions, each attempts to provide dial-in users with as many host resources as possible.*

Product	Description	Price (four-user)[1]	Network OS support	Dial-in session resources: Processor	Screen type	Available conventional memory[2]	Expanded-memory support	Extended-memory support
Alloy PC-Slave/286	Processor card with 1 MB of RAM and CGA, includes remote-control PC software	$4929	NetWare 2.1 and higher	12-MHz 286	CGA text and graphics	486 KB	No	No
Alloy 386/MultiWare 2.03 and 386/MultiNode	Multiuser operating system with network connection software and terminal interface boards, includes terminal software	$1734[3]	NetWare 2.1 and higher	Virtual 8086	Color text	486 KB	Yes	No
Cubix QL 3001	Processor card with 1 MB of RAM and VGA	$5580	NetWare 2.1 and higher	20-MHz 386SX	VGA text and graphics	533 KB[4]	256 KB[5]	Option[5]
Evergreen Systems FlexComServer 100 and CP-2286 Processor Kits	Communications server that includes system software, processor cards, and network card, includes remote-control PC software (pcAnywhere IV/LAN)	$8185	NetWare (all versions but ELS Level I)	12-MHz 286	CGA text and graphics	600 KB	200 KB[5]	Option[5]
J&L Information Systems Chatterbox 6000	Stand-alone unit that includes system software, processor cards, and remote-control PC software (Co/Session)[6]	$8780	NetWare, NetBIOS LANs	20-MHz 386SX	VGA text and graphics	472 KB	Option[5]	Option[5]
LANmaster IncomServ 2.10	Desqview-based software system for sharing a 386 system among several remote users, includes remote-control software (IncomReach) and multiport serial card	$2999	Any	Virtual 8086	Color text	441 KB	Yes	No
Novell NetWare Access Server 1.01	Multitasking software system for sharing a 386 system among several remote users	$1995[7]	NetWare 2.12 and higher	Virtual 8086	VGA text and graphics	463 KB	Yes	No
The Software Link PC-MOS 4.1 and PC-MOS Gateway 2.3	Multiuser operating system with network connection software	$890[3]	NetWare 2.15 and higher	Virtual 8086	CGA text and graphics	533 KB	Yes	No
Telebit Telebit ACS 2.20	Software that allows remote users to call into a central PC and take over other workstations on the local LAN includes remote-control software and multiport serial card	$3995[8]	NetWare, NetBIOS LANs	Host system dependent	Host system dependent	435 KB	Host system dependent	Host system dependent

Note: All these products support remote task reboot and task reboot on disconnect.
[1] Price for a four-user system. See also table 2, which includes cost breakdowns and a list of additional equipment required to set up a complete system.
[2] This figure assumes 60 KB used for NetWare IPX and resident shell.
[3] Price includes a five-user software license.
[4] Available memory using Co/Session; actual memory available depends on remote-control software used.
[5] Tested configuration; more memory can be added to card.
[6] Versions of Chatterbox shipped after our tests include pcAnywhere IV/LAN as remote-control software.
[7] Listed price is for a 15-user system—the only package offered.
[8] Price is for an eight-user configuration—the smallest system offered.

include remote-control software, I used Triton Technologies' Co/Session 5.0.

I tested each system using the most advanced graphics emulation supported. (Note that the conventional memory figures that are given in table 1 do not necessarily reflect this configuration; each system was configured for optimal memory use, which usually means CGA or more limited graphics.)

The most critical test is the FoxPro database application (figure 1a), which measures performance as a whole. This script repeatedly finds and updates entries in a collection of three related databases, which total just under 1 MB. It views each edit by popping up a window between changes.

Figure 1b shows what happens to performance as you add more sessions. I ran BYTE's CPU benchmark with one connection and then added users, up to a total of four. Our benchmarks turn off the automatic timer between iterations. Desqview-based systems switch tasks while the timer is off, distorting the performance curve in their favor.

continued

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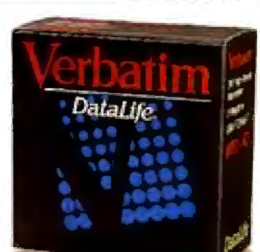

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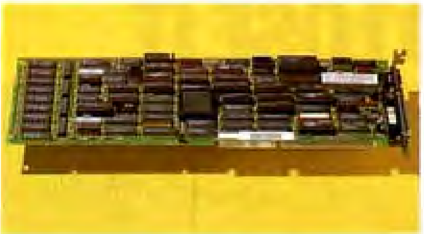
Alloy PC-Slave/286



PC-Slave/286 cards are single-board computers; each PC-Slave/286 has a 12-MHz 286 CPU with 1 MB of RAM and built-in CGA. These cards do not support extended or expanded memory applications. The PC-Slave/286 cards sell for $1195 each. With supporting software, a four-user package comes to $4929. Unlike Cubix and J&L Information Systems, Alloy doesn't offer a 386SX processor board.

The host computer can be a file server or a bridge. In effect, the machine's expansion bus becomes a small LAN segment that services the processor cards. I installed the PC-Slave/286 boards in a NetWare external bridge. Alloy recommends that you install no more than two PC-Slave/286 cards in a system because the boards have high power requirements and generate considerable heat. If you need to install more than two cards, you will need Alloy's XBUS4/AT expansion unit ($995), which adds four slots to the host system and has its own power supply and cooling fans.

Like diskless workstations, slave processor cards boot from floppy disk image files that go in the LOGIN directory of the NetWare server. As each slave boots from the server, it launches the host component of Link-PC, which waits for a caller to activate a session. When you connect to a board, you simply see a DOS prompt. Link-PC doesn't require passwords or provide any security beyond that required by the NetWare log-in. Alloy includes a NetWare value-added process, called SLVRESET, that lets you reset individual slave cards from the NetWare console.

If remote users are running Macs, Alloy offers Mac-Attach, which gives Mac users a monochrome, text-only terminal session with a PC-Slave host. The software is functional, but it isn't compatible with MultiFinder, so it won't work with System 7.0.

The PC-Slave/286 system ran reliably, but it performed more slowly than I expected. The BYTE CPU benchmark showed that slow memory accesses hampered the PC-Slave/286 cards on our tests. You can boost speed significantly by sacrificing CGA text—the FoxPro benchmark ran almost twice as fast as the published results when I used the monochrome terminal driver.

Alloy 386/MultiWare 2.03

A DOS-based multiuser operating system, 386/MultiWare gives remote users a virtual 8086 session on a 386 host. When combined with 386/MultiNode, it provides each session with access to any NetWare LAN. 386/MultiWare allows remote users or attached terminals to share the resources of a single 386 PC. Remote users have access to host memory (including EMS memory) and disk drives. 386/MultiWare coexists with DOS and is very easy to install.

Connecting terminals or modems requires some additional hardware; I connected dial-in users using two IMP-2 serial I/O boards from Alloy. The IMP-2 boards handle screen manipulation for the remote terminals. Because the IMP-2s handle color-text screens only, remote users can't have access to any graphics capability on the host machine.

Remote PCs connect to the MultiWare host using Link-PC, the same software bundled with the PC-Slave/286 product. Remote Mac users run Mac-Attach. Depending on how you've set up security, remote users may be required to provide a password to gain access to the 386/MultiWare host.

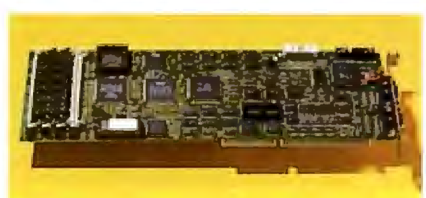
The 386/MultiNode software links this multiuser system to your NetWare LAN. Like MultiWare itself, MultiNode is easy to install. The installation program builds an IPX.COM based on a built-in list of supported network cards and parameters, which you supply (the canned list covers most common network interface cards). Once you have done this, each session can connect and log into the NetWare LAN via the usual IPX-NETx log-in sequence.

At $1734 (including IMP hardware, MultiWare, and MultiNode), MultiWare is one of the cheaper solutions straight out of the box. Even with the additional required hardware, MultiWare is a bargain compared to most other products in this review.

The MultiWare system is also very stable—I wasn't able to crash the system. But I was running only MultiWare-approved applications; if a remote user runs something that tries to put the processor in protected mode or to generate graphics, the system may lock up.

Performance drops off quickly as you add users. Figure 1a shows this dramatically, but it overstates the effect a bit. MultiWare allocates processing time unevenly among sessions. If two remote sessions launch simultaneously, one will get most of the processing time, and the other will get almost none. During tests with more than one user, the first session finished quickly, but because it held onto its share of the processor time, the other sessions took much longer to complete. Alloy is working on software that will allow MultiWare users to tailor performance parameters.

Cubix QL 3001



The QL 3001, although similar in philosophy to Alloy's PC-Slave/286 card, features considerably more powerful hardware: a 20-MHz 386SX processor, VGA, and 1 MB of memory (with SIMM sockets for up to 16 MB). Each card, which includes support software, sells for $1845. (Cubix also sells a 286-based card for $1040 and a 16-MHz 386SX card for $1395.)

continued

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ESTIMATED TOTAL COST COMPARISON FOR FOUR-USER REMOTE-ACCESS SYSTEMS

Table 2: *These figures represent what you could expect to pay to construct a four-user dial-in system using each of these products on your existing NetWare LAN, including all necessary hardware and software. Prices for peripheral equipment you'll need (shown in gray) are estimates.*

Alloy PC-Slave/286		Alloy 386/MultiWare and 386/MultiNode		Cubix QL 3001		Evergreen Systems FlexComServer 100 and CP-2286 Processor Kits	
Four PC-Slave/286 boards @ $1195	$4780	386/MultiWare (five-user)	$1734	Four QL 3001 boards @ $1395	$5580	Base FlexComServer	$2195
Remote-control software	149	Remote-control software	149	Network card	250	Two CP-2286 cards @ $2995	5990
XBUS4/AT expansion unit	995	Two IMP-2 boards @ $495	990	Remote-control software	780		
Network card	250	386 system with 4 MB of RAM	3000				
		Hard disk drive	500				
		Network card	250				
TOTAL COST	**$6174**	**TOTAL COST**	**$6623**	**TOTAL COST**	**$6610**	**TOTAL COST**	**$8185**

Notes: Cost estimates do not include NetWare, modems, cables, or remote PCs.
[1] Workstations can be primarily for local use but must be available when remote users connect

I installed four QL 3001 cards in a NetWare external bridge. Cubix doesn't specify a limit on the number of boards you can install, but going beyond four will tax the power supply of most systems.

As with the PC-Slave/286, the four cards form a network segment of their own that bridges to the physical network. Because of the overhead of packet routing on the NetWare bridge machine and because all four cards share the same connection to the network, remote users experience a slight performance degradation when multiple sessions try to access the file server simultaneously. Nevertheless, the QL 3001 turned in an excellent performance on our database benchmark. Only the Chatterbox 6000 fared better.

Cubix includes memory management software and an excellent set of utilities for monitoring and controlling the system. The memory manager can free up conventional memory by loading the network driver and shell into high memory. QLCONN lets you view and control a session taking place on a QL 3001 board from any workstation on the LAN, and QLSTATUS lets you get the status of any processor and reset it from another workstation. Because these are workstation utilities, you can run them from a remote system connected to a second QL 3001. This is useful if a session hangs and the local site is unattended (e.g., during off-hours).

The QL 3001 boards ran every application we have without a hitch, including Windows 3.0 with VGA graphics. If high performance is critical, check out the QL 3001 cards.

Evergreen FlexComServer 100

The FlexComServer 100 is a plug-and-play alternative to installing processor cards on your LAN. It consists of a 16-MHz 286 system bundled with Cubix processor cards, a network card, a floppy disk drive, and all the software you need to get a dial-in system up and running. Evergreen Systems also bundles a copy of DMA's pcAnywhere IV/LAN remote-control software. I tested the FlexComServer 100 ($2195) with two Cubix CP-2286 dual-286 processor cards ($2995 each). Evergreen was working to support the Cubix QL 3001 boards as we went to press.

Installation is easy. All you need to do is clear a space on the floor, set down the PC-tower-size FlexComServer, and attach your network cable and modems. You can connect a monitor and keyboard to the system (it includes a monochrome video adapter), but these aren't required.

On start-up, the FlexComServer loads CPAUDIT, a value-added process that continuously polls each processor to determine whether it is still active. If one fails to respond after a certain number of requests, CPAUDIT will reboot that processor.

Evergreen bundles management software (CPCONN) that runs from network workstations and lets you monitor the status of each processor, view sessions, and reboot them if necessary. CPCONN is similar to Cubix's software but slightly more sophisticated in its handling of status information. It also lets you configure pcAnywhere IV/LAN for each processor.

With the CP-2286 cards, which include 12-MHz 286 CPUs with CGA display circuitry, the FlexComServer 100 turned in respectable times on our benchmarks. pcAnywhere IV/LAN's fast screen handling gave the FlexComServer an edge on the screen update tests.

You'll pay considerably more for the FlexComServer than you would if you rolled your own system using processor cards and a clone AT machine. However, the system ran reliably, and its added management tools are outstanding.

ESTIMATED TOTAL COST COMPARISON FOR FOUR-USER REMOTE-ACCESS SYSTEMS (CONT.)

J&L Information Systems Chatterbox 6000		LANmaster IncomServ 2.10		Novell NetWare Access Server		The Software Link PC-MOS 4.1 and PC-MOS Gateway 2.3		Telebit ACS 2.20	
Chatterbox—one 20-MHz 386SX	$3095	IncomServ	$2999	Access Server	$1995	PC-MOS (five-user)	$595	Telebit ACS (eight-user)	$3995
Three 20-MHz 386SX boards @ $1895	5685	386 system with 4 MB of RAM	3000	WNIM+ serial card	895	PC-MOS gateway	295	Dedicated PC workstation	1000
Four network cards @ $250	1000	Hard disk drive	500	386 system with 4 MB of RAM	3000	Four EmuLink licenses @ $199	796	Network card	250
		Network card	250	Network card	250	Maxspeed serial card	595	Four 386SX systems @ $2000[1]	8000
						386 system with 4 MB of RAM	3000		
						Hard disk drive	500		
						Network card	250		
TOTAL COST	**$9780**	**TOTAL COST**	**$6749**	**TOTAL COST**	**$6140**	**TOTAL COST**	**$6031**	**TOTAL COST**	**$13,245**

J&L Chatterbox 6000

While software solutions like 386/MultiWare go to great lengths to emulate several PCs on a network, J&L Information Systems tackles the problem from a different angle. The Chatterbox 6000 is simply a large tower system that can contain just about all the hardware you'd find in six stand-alone PCs, including network cards, video graphics, and disk drives. In addition to simply providing centralized access to several PCs, the Chatterbox 6000 adds status lights, front-panel reset switches, and management software, all of which make it considerably easier to manage than a stack of PCs.

The Chatterbox 6000 consists of 20 AT bus slots on a backplane fed by a single power supply. The slots are divided into six clusters—one cluster has five slots, and the others have three. Except for power lines, each cluster has no connection with the others. You must use one slot in each cluster for a processor card and one for a network card. That leaves the remaining slots available for a memory board, a hard disk drive controller, or other add-in boards. The case also includes room for four half-height or six third-height externally accessible disk drives.

The Chatterbox's front panel features an array of LEDs that describe the modem status and network status for each processor card. The Chatterbox also provides hardware reset switches for each processor on the front panel.

I tested four 20-MHz 386SX processor cards in the Chatterbox. These cards (13¾ by 7 inches) are considerably bigger than standard AT cards but are complete PCs on a card. In addition to the processor and chip set, each has a serial port, a floppy disk drive controller, a keyboard connection, and 1 MB of RAM. If you have very high memory requirements, you can upgrade each processor card to include up to 8 MB of RAM.

You can set jumpers on the processor cards to make them reboot on one of several modem signals, so they can automatically reboot on modem conditions (e.g., if the remote user hangs up). A VGA daughtercard plugs into the side of the main processor board. With four of these processor cards ($1895 each), the Chatterbox 6000 rings up at $8780.

To make the Chatterbox 6000 a dial-in communication server, you need to add a network card for each processor. You can add network cards with boot PROMs to configure the processors as diskless workstations, or you can add floppy or hard disk drives so that the processors boot up locally.

I installed the Chatterbox 6000 in a diskless boot configuration. J&L bundles remote-control software with the Chatterbox. My system came with Co/Session, but J&L began bundling pcAnywhere IV/LAN with the Chatterbox as we went to press.

Once remote users connect, they can expect the performance of a dedicated 20-MHz 386SX PC. The only bottleneck is the speed of the remote connection. The Chatterbox did well on the single-user tests and easily bested the other products when I added two or more sessions.

Although it's one of the most expensive solutions, the Chatterbox is also the fastest and the most stable. Its all-hardware approach to multiple sessions and session isolation makes it a fast and robust product.

continued

Reports from the Front

Sharon Fisher

Many organizations are finding unique ways to support remote computing sessions on their LANs. Along the way they've had to overcome a few unexpected hurdles. Most see their current solutions as transitional, pending the arrival of more sophisticated client-server applications. Here are three stories from the front lines.

A Library Goes On-Line

The Loma Linda University Medical Center Library uses Cubix bridge systems to provide remote access to an extensive CD-ROM information network. According to campus network coordinator and medical library/information center director Paul Kittle, doctors, students, and other staff dial into the Total Online Medical Material Integration (TOMMI) system to gain access to more than 27 gigabytes of data from medical databases and on-line medical journals. The data resides on 42 CD-ROM disks in six CBIS CD servers.

Remote PC and Mac users run PC MacTerm II and pcAnywhere III remote-control software to connect to Cubix 12-MHz 286 processors with 1 megabyte of RAM and EGA display capabilities. Remote users log onto a NetWare 2.15 file server and then can access the CD servers.

Two 286 host machines each support six 9600-bps sessions on Cubix 2286a boards. Traffic requirements dictated that the Cubix bridge computers and the CBIS CD-ROM servers sit on their own 10Base-T LAN segment rather than attach directly to the library's ARCnet. Kittle bridged the 10Base-T and ARCnet segments; a second bridge connects the 10Base-T LAN to the university's fiber distributed data interface (FDDI) backbone, which allows direct access to the CD-ROM information network for users on LANs at other campus locations.

Kittle divided the processor boards between two bridge machines to spread the network traffic between two nodes and avoid a single point of failure. He also found that adding more processor boards overheated the host computers. "The cards got really hot when I first installed them," he says. "I ended up having to space them one slot apart to improve circulation."

The six CD server towers, two Cubix bridge machines, and 12 modems all sit in Kittle's 8- by 10-foot office. With 12 connections to maintain, using standalone machines was out of the question. Kittle considered both NetWare Access Server and J&L's Chatterbox before settling on Cubix. "The pricing on the Access Server was what hurt me. The Cubix boards were more practical. I didn't have to worry about space and didn't have to buy more network cards and maybe extra hub and cabling if I used the Chatterbox. I wanted maximum punch for minimum dollar."

Kittle is waiting for Cubix to introduce a processor board with extended VGA so that his users can take advantage of medical journal illustrations. He acknowledges that transmission of these screens back to a remote host can take several minutes—even at 9600 bps—but says that doctors are willing to wait if it saves a trip to the library.

Natural Gas Network

Natural Gas Clearinghouse (NGC) depends on its Advanced Revelation database at its Houston headquarters to track the sale, purchase, and movement of natural gas. To accommodate users in the company's Chicago, Denver, and Pittsburgh offices, Information Center Supervisor Warren Ashworth installed NetWare Access Server (NAS) on three 33-MHz 386 systems.

Up to 18 remote users connect to the 280-MB database simultaneously via NGC's wide-area network (WAN) or dial-up connections. Most users connect to the NAS machines through their local NetWare LAN. A Racal-Vadic or Symplex statistical multiplexer then aggregates and compresses session traffic and sends it over a 56,000-bps or 9600-bps leased line to the Houston office. The statistical multiplexer in Houston demultiplexes the traffic and routes it directly to the ports on one of the three NAS machines. Each NAS machine has five ports connected to the multiplexer; a sixth connects to a 9600-bps modem to allow dial-up connections.

Novell claims that NAS supports up to 15 sessions, but this did not work with users running Advanced Revelation. "When you're slicing that many sessions on one 386, NAS just isn't very effective," Ashworth says. He minimized the problem by assigning users to a specific NAS port and dividing the heaviest users among the three NAS machines.

Having multiple servers improves performance and still takes less space than using a dedicated host PC for each remote user. They also make NAS less cost-effective. "We're not able to fit as many sessions on one 386 as we would like," Ashworth says, "but we're able to get the same level of performance we had with our 12-MHz PCs running pcAnywhere."

Ashworth is pleased overall with NAS and plans to add more servers to his growing network. Ultimately, he hopes to migrate the database to a less network-intensive client-server architecture. Remote users could then launch the database directly through remote bridges rather than using a remote-control product such as NAS.

Internal Revenue Service

The Internal Revenue Service's southeast regional headquarters in Atlanta uses J&L's Chatterbox 6000 to let remote users run a variety of applications from NetWare file servers.

The NetWare 2.15 LAN has three Chatterbox 6000s, each with six 12-MHz 286 processors, that serve 30 remote users. Remote users run 9600-bps sessions through the Treasury Consolidated Data Network, a private X.25 WAN, using Triton Technologies' Co/Session.

Users in remote offices run a wide variety of applications on the LAN, including several database applications, WordPerfect, dBase IV, and Lotus 1-2-3, says Stephen J. Foley, regional telecommunications specialist. Foley has fully automated establishing remote sessions; remote users don't even see Co/Session menus, and Co/Session unloads itself automatically when the work has been done.

Foley started out using Novell's NetWare Communications Server, which supports inbound sessions using pcAnywhere III and requires a dedicated PC for each session. "We got tired of stacking up PCs for people to connect to," Foley says. "The Chatterbox puts everything in one box."

For the most part, Foley is satisfied with performance. "The average response time is about what you'd get if you were running an old 8088 PC," he says. "The CGA graphics take about twice as long as they would on an 8088, but we do very little with graphics."

Foley sees several advantages to the Chatterbox versus NAS. "We felt that it was better to have a dedicated processor for each user. When you're sharing a processor with NAS and a process locks up, you have to reboot the entire server." With the Chatterbox, Foley can reset individual processors. The Chatterbox is also network operating-system independent, while NAS supports only NetWare LANs.

Remote users could run some applications on their own PCs, but centralizing the applications provides for better control, Foley says, because many remote users are computer novices. Since the sessions run over a private WAN, Foley doesn't incur any extra cost to keep users on-line. Still, Foley sees the current setup as transitional. "This is an interim solution until we can develop a more robust distributed processing environment."

Sharon Fisher is a San Francisco-based freelance writer specializing in data communications. You can reach her on CompuServe as 76012,1147, on the Internet as slf@well.sf.ca.us, and on BIX as "sharonfisher."

LANmaster IncomServ 2.10

IncomServ is a Desqview-based multitasking environment that gives several remote users virtual sessions and access to expanded memory on a local 386-based host system. The four-user package, which contains Desqview, QEMM, a multiport serial card, and LANmaster's host and remote software, costs $2999.

Unlike the other products reviewed, IncomServ does not provide each dial-in user with a unique NetWare log-in. Instead, the host system has a single log-in that all dial-in users must share. Therefore, users calling into an IncomServ host all have common access rights to network servers. This approach makes IncomServ more flexible than other products. It's not NetWare specific and should work with any LAN. However, security becomes impossible to manage if you need to have remote users with broad network privileges.

Remote users dial into the IncomServ host using IncomReach remote-control software. I had some problems getting IncomReach to work with our test Telebit modems, and the software allows for only minimal reconfiguration. LANmaster said that it was aware of some compatibility problems with Telebit modems. I wouldn't recommend using IncomReach with anything other than a true Hayes modem.

Once the remote users connect, they see a log-in menu that requests an ID and password, followed by a utilities menu for file transfers and a preconfigured menu of applications that the network administrator has made available. All interaction between remote users and applications goes through this menuing system unless the administrator makes DOS itself a menu option.

The menu system may make IncomServ easier for occasional users, but it takes up a sizable chunk of memory in each session. You can free up some memory by using QEMM to load programs and device drivers into upper memory. LANmaster recommends that you use a CGA video adapter in the host system and make the upper video memory-address space available to QEMM.

IncomServ delivered excellent performance for a single user. Performance dropped quickly as I added sessions but was still acceptable with three users running. Unfortunately, IncomServ tended to crash when I added a fourth user even though the host system's 4 MB of RAM satisfied IncomServ's minimum memory requirement. Problems ranged from locking up the entire host to execution errors with error messages from the IncomServ software. Overall, I found IncomServ too unsteady to count on with more than three simultaneous sessions.

Novell NetWare Access Server 1.01

Novell's answer to the problem of remote access is NetWare Access Server, a Desqview-based software product that uses a 386 computer as a host for up to 15 remote sessions. NAS, which includes remote-control software for both PCs and Macs, costs $1995. To accommodate four users, you'll also need to install Novell's four-port WNIM+ board ($895) in your host system. NAS includes all the server software, remote-control software, and a new version of IPX.OBJ that allows the access server to handle multiple log-ins from a single IPX address.

Novell was finishing an update to version 1.01 as I prepared this review. The new version, which should be out by the time you read this, will provide support for third-party serial cards and make available another 80 KB of conventional memory.

I booted the NAS machine from a floppy disk on my 25-MHz 386 host system. The ideal machine for NAS is a high-powered 386 or 486 with a floppy disk drive, CGA, and lots of memory. Novell recommends at least 1 MB plus 750 KB for each user; you'll need more if you run expanded-memory applications. As with LANmaster's IncomServ, you'll want to make as much high memory available as you possibly can.

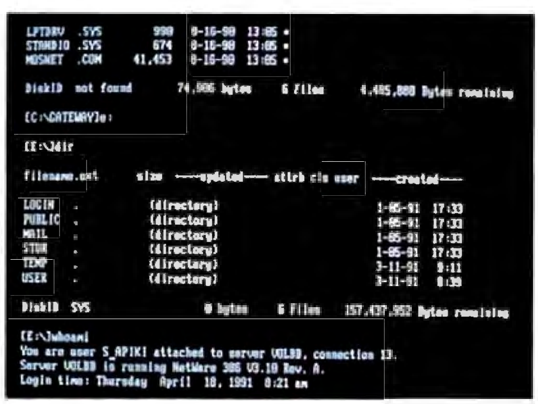
The NAS host has a console interface that lets the network administrator configure access server parameters, view sessions on the host, and reset sessions. Sessions don't exist before users dial in, so there is no waste of clock cycles or RAM on unused sessions. When a user connects, NAS starts up a session and hands control over to the remote user by firing up ANYWNAS, a bundled version of the host component of pcAnywhere III.

Remote users run the bundled OnLAN/PC software (pcAnywhere III); remote Macs use OnLAN/Mac. OnLAN/Mac maps the Mac keyboard to the PC keyboard in an intuitive fashion and handles cut-and-paste operations between the local Mac and the remote session. I ran it successfully with a beta version of System 7.0. OnLAN/Mac also features color screen emulation, which, although attractive, is harder to read than monochrome mode.

When remote users make a connection, they see a greeting message, followed by a NetWare log-in prompt. Users log into the server using NetWare user IDs and passwords. If the log-in process fails, NAS breaks the connection. You can configure NAS to restrict access only to NetWare accounts that have passwords. This clean, simple interface between remote user and network is one of NAS's strong points.

NAS is fast with one user connected but slows down predictably as you add to the load. Novell claims NAS is usable with up to eight users, but the limit was closer to four on our test 386 system. NAS was dependable when running clean applications, but ill-behaved applications can bring down all the sessions on the server. If you intend to run standard, well-behaved applications, NAS's stable operation, good console utilities, and good user interface make it a worthwhile solution.

The Software Link PC-MOS 4.1



Like 386/MultiWare, PC-MOS is a multitasking, multiuser operating system that lets several users establish computing sessions on a single 386 or 486 host system. PC-MOS Gateway offers PC-MOS clients access to NetWare. Each client can connect to the PC-MOS host and then establish its own log-in on a NetWare LAN.

Unlike MultiWare and Desqview, which run on top of DOS, PC-MOS is a complete operating system in itself. Although PC-MOS is designed to be DOS-like to both applications and users, the operating-system commands are somewhat different, and, according to The Software Link, some applications may not run properly without modification. Most DOS applications, including those that require expanded memory, will run without problems. The applications that I used over the course of this review, including XyWrite, FoxPro, dBase, Quattro Pro, and Lugaru's Epsilon editor, all worked fine.

Once PC-MOS is installed, any user can add tasks and switch among them with relative ease. You can assign each task a security level, serial port, and terminal type, and you can view remote tasks with a host task that has sufficient

security privileges. However, no task can have a larger memory partition than the initial start-up task. To boost each task's memory, you need to tune memory allocations within the first megabyte, just as you would with QEMM and Desqview.

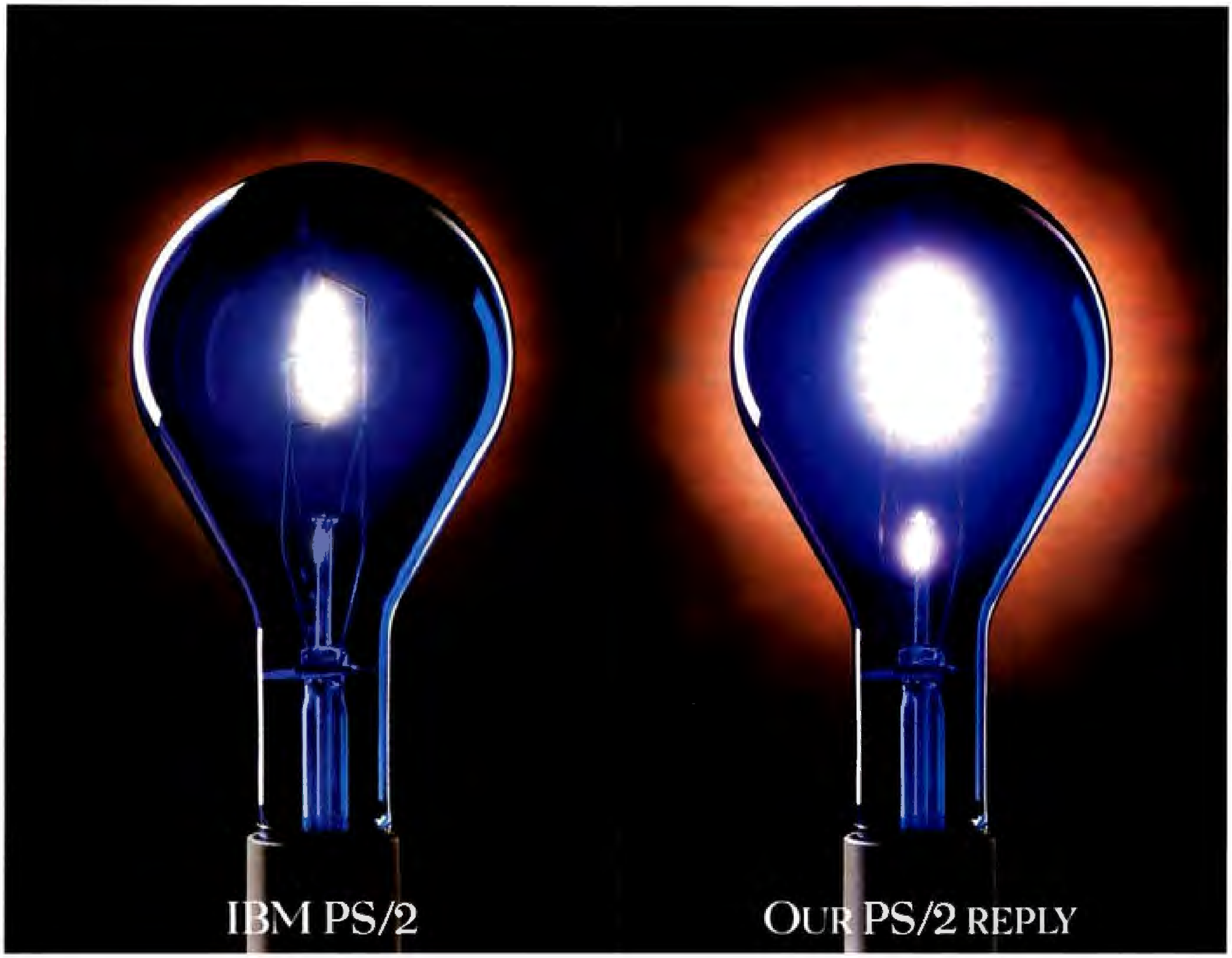
Remote users run PCEmuLink, The Software Link's terminal emulation package for PCs. PCEmuLink is tricky to set up, but once installed it's easy to automate. A third software package, PC-MOS Gateway 2.3, connects PC-MOS clients to a NetWare LAN. PC-MOS Gateway consists of several device drivers, a new version of IPX.OBJ, and an executable program called MOSNET. Most of the installation process involves creating a version of IPX that can install as a PC-MOS device driver. Installing the network software in this way allows all the memory partitions to share a physical connection to the network.

To connect to the NetWare LAN, remote users dial into the PC-MOS host using PCEmuLink. Depending on security levels, PC-MOS may require a user ID and password. Next, users launch the MOSNET program to connect to the server; MOSNET has the same effect as running a DOS shell like NET3. Each task can log into and out of the server as required, and each task has a separate NetWare log-in.

I found PC-MOS a reliable, if somewhat sluggish, solution for connecting remote users to NetWare. But at $595 for five users plus $295 for PC-MOS Gateway, it's the least expensive solution I tested. Because PC-MOS is not DOS-based, remote users could run into compatibility problems in environments where they're running a wide variety of applications. In most cases, where remote users will run just a few applications, PC-MOS is a good, low-cost alternative.

Telebit ACS 2.20

Telebit ACS's way of providing remote connectivity is unique. The product (formerly PACS Plus from ParaData) is a software package that centralizes asynchronous connections on one PC and then redirects remote-control sessions to available PCs across the network. The modems, pooled at a local communications server, work with both dial-in and dial-out sessions. Telebit ACS dynamically allocates modems between inbound and outbound



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sessions. For processing power, Telebit ACS relies on idle processors (i.e., other workstations) on the LAN. The eight-user version, the smallest configuration Telebit sells, costs $3995.

Telebit ACS requires that you dedicate a workstation as the communication server. An intelligent multiport serial card handles I/O processing, so the host machine can be a slow PC. But because the serial card requires access to low-memory addresses, you must install it in a workstation that has exactly 512 KB of RAM.

The communication server boots up and launches Telebit ACS from the network. Initially, no processors are available for remote control. You must make workstations available on the network by running the host software, which registers each host machine with the communications server. In this way, modems and host processors are available through the communications server in a many-to-many matching. As long as there is one free modem and one free processor, remote users will be able to connect.

When remote users dial in (using a bundled copy of Remote2), Telebit ACS presents them with a list of available host machines. The names in the list are logical assignments and can be configured for each workstation. Remote users will also have access to any local drives on the host, so host PCs should not contain any private data.

Telebit's management software allows you to view the status of sessions in progress and gather communications statistics from the communication server's console. A separate utility lets you run the console program from any workstation on the LAN.

Performance is completely dependent on the type of workstation that is available for takeover. On our test LAN, four 386SXes running Remote2 demonstrated excellent performance. But Remote2 and Telebit's host TSR program together take up nearly 90 KB of RAM; with both these and the network driver loaded, memory can become quite scarce. You will certainly want to install memory management software if you are running large applications.

Telebit ACS requires that you have workstations on the network that you can afford to use for remote access. The cost comparison chart (see table 2) includes the price of four full workstations. However, Telebit ACS is really designed to take advantage of idle workstations already in place. The company says that most Telebit ACS users have batch files that automatically register a PC when the system logs off the network and unregister it when a local user logs on.

Telebit ACS is not appropriate for every environment. If your users have confidential data on workstations, Telebit ACS's pooling approach is probably going to meet with some resistance. However, if you have dial-out needs to match your dial-in requirements and are likely to have workstations available when remote users require them, Telebit ACS can be an efficient, cost-effective solution.

Remote Picks

Almost every product in this review performed well. Depending on your mix of performance and cost requirements, you probably could come up with several excellent solutions from among the packages presented here.

Remote-access installations fall into two categories. The first is general-purpose, where users may run one of many applications. The second type is used primarily for a single program (e.g., software that updates a database).

If you run a network where users are likely to run untested applications, or if you have no control over what users run, none of the software solutions is bulletproof enough to meet your needs. In a general-purpose environment, only independent processors offer the session isolation needed to ensure reliability; that means added hardware. For these users, J&L's Chatterbox 6000 has the most reliable configuration, plus excellent speed.

On the other hand, if your dial-in users will be running only one or a few applications (as most probably will), a software solution can be safe and economical. Of these, Novell's NAS offers the best combination of management tools. It also ran reliably. And while it may seem like an unlikely candidate for running DOS applications on NetWare, PC-MOS is a fine alternative if low cost is a high priority. ■

Steve Apiki is a testing editor for the BYTE Lab. You can reach him on BIX as "apiki."

COMPANY INFORMATION

Alloy Computer Products, Inc.
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Marlborough, MA 01752
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(508) 481-8500
fax: (508) 481-7711
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Cubix Corp.
(QL 3001; ComCube Station)
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Carson City, NV 89706
(800) 829-0550
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fax: (702) 882-2407
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Evergreen Systems, Inc.
(FlexComServer 100)
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(415) 897-8888
fax: (415) 897-6158
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J&L Information Systems
(Chatterbox 6000)
9238 Deering Ave.
Chatsworth, CA 91311
(818) 709-1778
fax: (818) 882-1424
Circle 1403 on Inquiry Card.

LANmaster
(IncomServ)
1401 North 14th St.
Temple, TX 76501
(800) 441-6189
(817) 771-2124
fax: (817) 771-2379
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Novell, Inc.
(NetWare Access Server)
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(800) 638-9273
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The Software Link, Inc.
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(404) 448-5465
fax: (404) 263-6474
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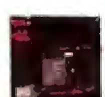

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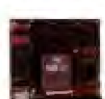

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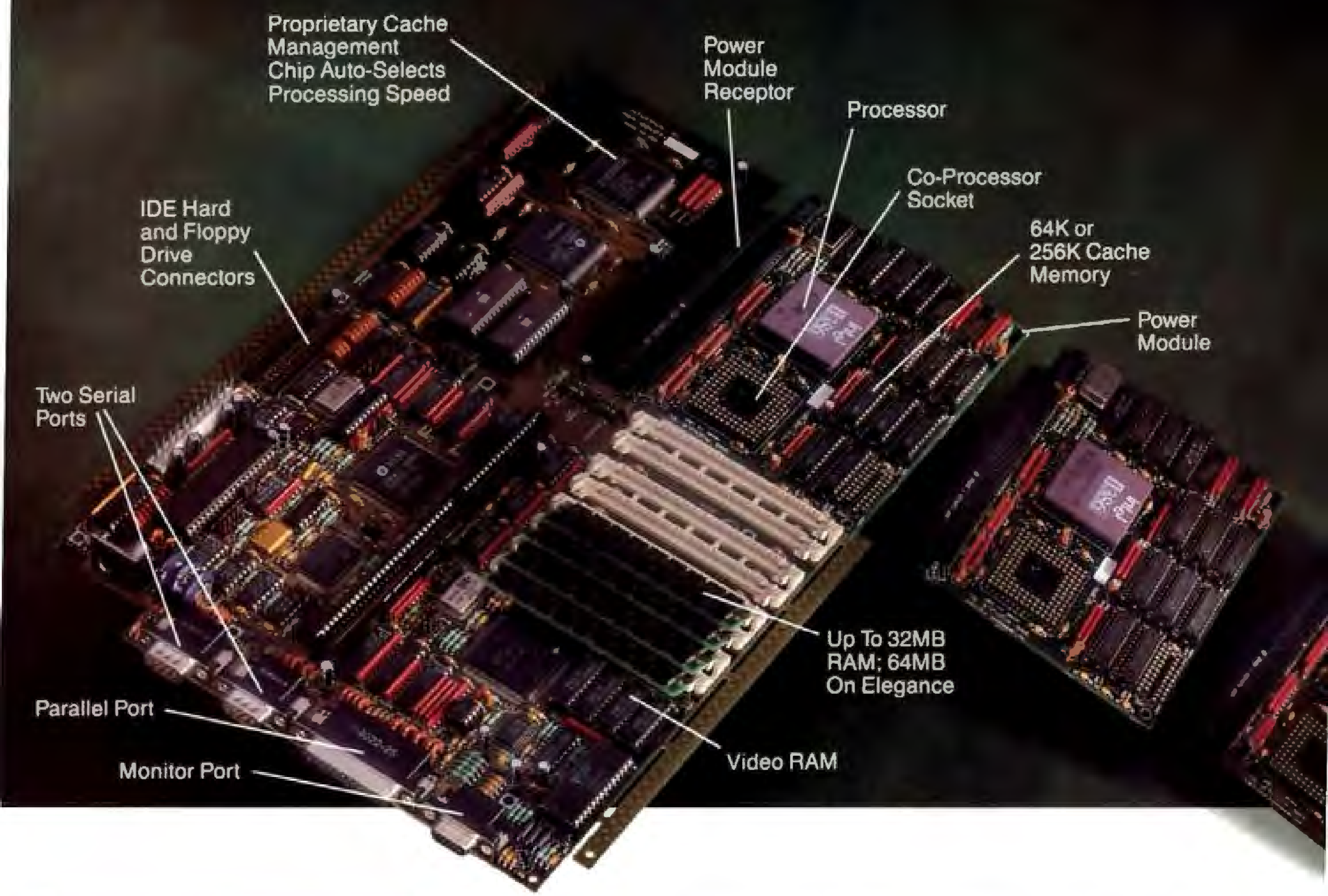

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HARDWARE

Five New SPARC-Based Workstations Compete with Sun

TOM YAGER

Sun Microsystems started the SPARC revolution with its own systems, so it's no surprise that the first batch of non-Sun SPARC systems are showing up with nearly identical features. The SPARC chip is a processor developed by Sun that promises to become a standard processor commodity for Unix, just as Intel's 80x86 processors have in the DOS world.

To compare how well the so-called SPARC clones perform, I selected a representative set of SPARC systems, based mostly on their availability. The group included systems from Solbourne Computer, Opus Systems, CompuAdd, Mars Microsystems, and RDI Computer. Each system was hooked into the BYTE Unix Lab's network and was run with a variety of system and applications software. The new BYTE Unix benchmarks were run as well (for details, see the text box "BYTE Updates Unix Benchmarks" on page 213).

A SPARC-compliant workstation can be expected to include a SCSI port, an Ethernet port, two serial ports, audio I/O, an integrated mouse, and a Sun-style keyboard. The typical display is either monochrome or 1152- by 900-pixel, 256-color graphics. A high-density, 3½-inch floppy disk drive is also standard.

Peripheral devices are connected externally to the SCSI bus or internally via Sun's SBus. SBus cards are smaller than postcards and generally have no DIP switches or jumpers to set. Unlike the ISA bus, the SBus doesn't require you to know anything about the board's interrupt vector, port number, or memory-buffer address; SBus boards are "plug and play," mostly configuring themselves into your system. If special drivers are required, you can load them dynamically into SunOS without rebuilding the Unix kernel.

The Solbourne S4000

Solbourne Computer has more experience with SPARC-compatible systems than anyone besides Sun. The review unit I tested was pretty well decked out: It came with a 16-inch color monitor, 40 megabytes of memory, and two 200-MB floppy disk drives. The price of this configuration is $20,095. The S4000 is unique among the systems I reviewed due to its maximum memory capacity: With an expansion card, the S4000 can be taken to 104 MB.

The value that Solbourne adds to the base SPARC configuration is significant and comes in three forms: software, accelerated graphics, and file I/O performance. Solbourne's port of SunOS release 4.0 includes all the pieces licensed by Sun (and discussed above) plus some extras that Solbourne throws in, giving the S4000 an edge over some other SPARC systems. Release 4.0 is a couple of releases behind Sun and can cause minor compatibility problems with applications built with 4.1 or higher libraries.

Solbourne's OS/MP 4.0 (*MP* refers to Solbourne's multiprocessing extensions, not used in the S4000) is most notably augmented with the inclusion of Solbourne's own X Window System server and accompanying tools. The X server itself (based on X Window 11 release 4) is remarkable only in that it's included with the S4000. More thrilling by far is Solbourne's swm window manager. In a single application, Solbourne has managed to build in both OSF/Motif and Open Look behavior. The behavior is user-configurable, and the emulation is quite good. In addition, swm offers a virtual desktop—a logical screen that can be many times larger than the physical display. To move the physical screen to a different area on the logical screen, you simply move a dotted-line box around in a special window. The window provides a bird's-eye view of the logical screen, complete with window positions and sizes marked by properly scaled rectangles. Nice.

To accompany swm—and, presumably, to offset Sun's own DeskSet tools for OpenWindows—Solbourne provides a number of graphical front-end applications to frequently used programs: debugging, revision control, appointment scheduling, file management, E-mail, Usenet news reading, message sending, and X Window font editing and window property querying. Tools like these make life easier for those who, like me, live with their workstations throughout the entire workday.

Finally, Solbourne makes its standard software offering complete with its Object Interface toolkit. This C++ class library lets developers write graphical applications that are GUI independent. Presently, OSF/Motif and Open Look interfaces are supported. It's a little ironic that the toolkit is standard but a C++ compiler is not.

On the performance side, the S4000

BYTE ACTION SUMMARY

- **WHAT SPARC-BASED WORKSTATIONS ARE**
  Fast, inexpensive Unix workstations that are compatible with Sun Microsystems' SPARC RISC systems.
- **LIKES**
  Plenty of variety in standard features and packaging, while still remaining true to SPARC's promise of binary application compatibility.
- **DISLIKES**
  A couple of systems showed great potential that wasn't fully realized at the time of the review. The RDI BriteLite portable SPARC system performed as promised, but with an LCD screen too small to run many commercial Unix applications without frustration. The Mars Mariner 4i added DOS compatibility with a real 386 processor and ISA bus but took away the SPARC-standard SBus.
- **RECOMMENDATIONS**
  The Solbourne S4000 was the best system overall, incorporating enhancements in file and graphics I/O performance and adding applications to the standard configuration. The CompuAdd SS-1 was the price leader, delivering excellent SPARC compatibility for a very competitive price.
- **PRICE**
  CompuAdd SS-1: $9695
  Mars Mariner 4i: $14,110
  Opus Personal Mainframe 5000: $12,995
  RDI BriteLite: $10,800
  Solbourne S4000: $20,095

again distinguishes itself by including, as standard, enhancements to color graphics and file I/O. The color configuration includes an accelerated graphics card that speeds X Window and SunView performance noticeably. I will not try to quantify that improvement (X Window benchmarking tends to be unpredictable), but it easily outclasses the typical SBus color frame-buffer boards.

The S4000 also earned my admiration for its file I/O performance. Solbourne's claim to fame is as a vendor of high-speed servers, and the company quietly borrowed some of that fast I/O technology for the S4000. The performance numbers were so good that I think this machine qualifies not only as a graphics workstation, but as a file server as well. An S4000 with a string of external SCSI devices (the case has only enough room for two 3½-inch drives) would make a formidable and supremely affordable file server. For installations that can't afford a stand-alone file server, the S4000 is an excellent choice; you can use a single system as a desktop unit and as a file server for a reasonably sized cluster of systems.

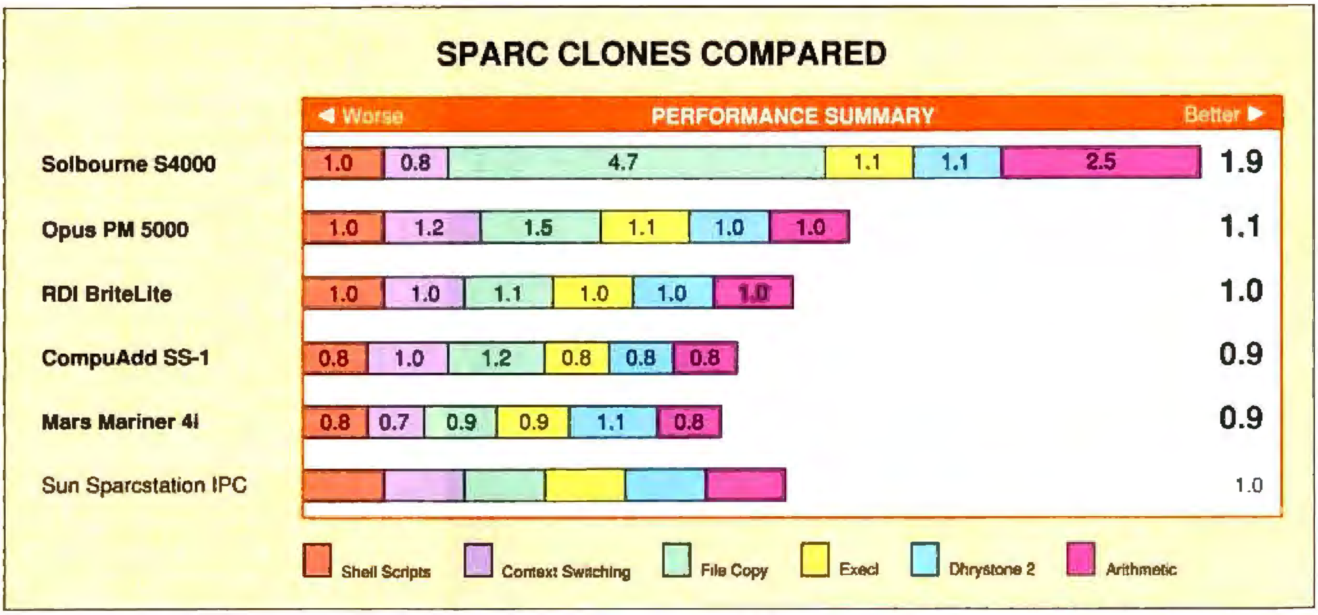
The Opus Personal Mainframe 5000

Opus Systems has made a name for itself by providing upgrade kits that give your PC the speed of more powerful computers. The PM 5000 (although *Personal Mainframe* is a slight overstatement) is Opus's first SPARC-compatible system. Packaged in the familiar, tall pizza box, the PM 5000 is a Sparcstation-1 design: three SBus slots, room for 64 MB of SIMM memory, and the typical SPARC system array of I/O devices and ports. Opus manufactures its own system board and does its own operating-system development, giving it a Solbourne-like edge over some of its competition.

The review configuration was a PM 5000 with 16 MB of memory, a 207-MB hard disk drive, a 150-MB internal tape drive, and a 19-inch color monitor. The price for this configuration is $12,995. Opus's SunOS-compatible operating system, OpusOS, is a port of SunOS 4.1, ensuring a high level of compatibility with even the most recent applications. Opus also offers an X Window plus OSF/Motif GUI product and plans to provide Sun's Open Windows 2.0 as soon as SunSoft makes it available. Opus's software, like the others, lacks Sun and Solbourne tools and enhancements (e.g., the graphical debugger and mail tool).

The unique range of hardware options available, however, makes the Opus offering special. You can purchase the PM 5000's motherboard, called the Opus Engine, separately. (More than a dozen companies plan to release SPARC systems based on Opus's motherboard.)

Opus also makes the PM 500, a complete SPARC system on a PC-compatible card (see photo 1). This card, installed in a PC-compatible system, allows DOS and SPARC applications to run side by side. You use hot keys to switch between Unix and DOS. The card has a SCSI controller on-board (for performance and compatibility, since you can't use your PC's hard disk for Unix), and it even includes two SBus slots for expansion



The Solbourne S4000 was a standout in the BYTE benchmark test results due to its performance in the Arithmetic and File Copy tests. For more details on the tests, see the text box "BYTE Updates Unix Benchmarks" at right.

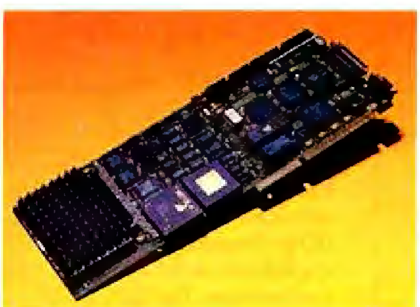


Photo 1: *The Opus PM 500 is a complete SPARC system on a PC-compatible card.*

cards. (One can be occupied by a color frame-buffer board—not included as standard.) Opus also offers this card installed in self-contained cases, ranging from a conveniently sized squat tower to a full-size tower case with lots of hard disk drive bays.

I've spent as much time with the Opus PM 5000 system as I've spent with the Sun Sparcstation IPC that is my main work system. For the several months I've had them, both have run around the clock without any involuntary downtime or data loss. The same may well be true of the other systems in this review, but it was the PM 5000's solid performance and reliability over that length of time that convinced me of SPARC's bright future. Opus's intimate knowledge of SPARC hardware and software gives it an edge in problem solving and product support. The company would do well to beef up its stockpile of value-added software, but its variety of configuration options makes Opus Systems a serious contender in this category.

The CompuAdd SS-1

Of the systems I reviewed, the CompuAdd SS-1 has the least added value. This system is very basic, with neither standard X software nor a set of productivity-enhancing tools. The SS-1's operating system is the Opus SunOS 4.1 port. The review unit was shipped with 16 MB of memory, a 16-inch color display with a Trinitron monitor, and a 210-MB hard disk drive. At $9695, the price is the best of the lot.

The SS-1 is probably typical of future SPARC-compatible systems: It provides basic SPARC functionality at a competitive price. Taken with the systems I reviewed, it fares a little worse than the others because of its lack of added value. What CompuAdd brings to this party, however, is its marketing savvy and support structure. CompuAdd has done well with its PC-compatible systems, mostly through direct sales to end users.

The Mars Mariner 4i

This company's name (Mars Microsystems) somehow makes you expect interesting things, and the Mariner 4i delivers. As with the Solbourne S4000, the 4i's added value is plentiful and obvious. Unfortunately, though, some of this added value limits the machine's compatibility with other SPARC systems.

The heart of the 4i's unique hardware is something familiar to many BYTE readers: an ISA bus. It's not just an ornament; *everything* in the 4i is built around the ISA bus, excluding the SPARC-standard SBus. The great advantage to ISA is, ostensibly, the ability to plug in common and inexpensive PC peripherals. Of course, *using* those peripherals is another matter. Unless someone (such as Mars) writes a driver for you, you'll have to create your own. As for whether ISA-bus devices can get along with SPARC, the 4i makes a convincing case on its own: The disk drive controller is an Adaptec AHA-1542 ISA board—the most popular PC SCSI controller.

The main reason for including an ISA bus in the 4i is this machine's dual-purpose architecture. Like Opus's PM 500 plug-in card, the 4i can run both DOS and SunOS programs. DOS programs run in a VGA or Super VGA window, but only under SunView (for now). An X version of the VGA window service is planned but was not available in time for this review.

The 4i's DOS-in-a-window runs on an optional 386 coprocessor board, supporting even protected-mode programs. I ran Windows 3.0 and a number of other DOS programs to test the system's DOS compatibility. Because of the system's ISA bus, real VGA, and real 386, I encountered only minor problems with certain software that tried to take direct control of one of the PC-specific devices (e.g., the keyboard or the mouse). The

BYTE Updates Unix Benchmarks

Ben Smith

The BYTE Unix benchmarks that we published in March 1990 in an article by that name were expected to fill our needs for several years. In only a few months, we began to see that Unix workstation performance was going to make our benchmark design questionable. The flaw was that the benchmarks timed a fixed number of loops; if there were too few loops, the duration of the test was too short to be reliably timed. Perhaps we could have increased the number of loops and been safe for another few years. But when the IBM RISC System/6000 produced results in the hundredths of seconds, it became obvious that we needed to redesign our benchmarks.

Now the work on version 3 is complete. The new design increases precision on faster workstations, because we turned the measurement upside down: Instead of counting the time to execute a fixed number of loops, we now count loops executed in a fixed period of time. The results are then massaged into easily digested numbers: loops per second and loops per minute.

Because this marks a drastic change in the testing methodology, these new benchmarks mean new baselines and indexes. We took advantage of the opportunity by ringing in a baseline system that more accurately represents the state of the Unix market: the Sun Sparcstation IPC. So every Unix benchmark table or graph you see will have its baseline index generated by a 25-MHz, LSI logic-based SPARC system with 24 megabytes of memory.

We also changed the benchmark tests that are used to generate the new index:

- Double-precision arithmetic
- Dhrystone 2 without register variables
- Spawning a process (`execl()`)
- File copy throughput in 5 seconds
- Pipe-based context switching
- The shell script with eight concurrent scripts running

Instead of just summing up the indexes of each test to get the overall index, we use the average. This means that the baseline value is 1 instead of 6 (a bit easier to compare). Remember to take the overall index with a barrel of salt. Although it's tempting to view an overall index of 3 as meaning "three times the performance of the baseline," it doesn't mean that at all. You need to look at the individual test results to understand a system's performance characteristics.

The benchmarks are freely available from BIX and on the Usenet. Thanks to the many users who sent suggestions for version 2, we all have a much better set of tools for benchmarking Unix systems.

Ben Smith is a BYTE technical editor. He can be contacted on BIX as "bensmith."

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well-behaved applications worked just fine and with the performance one expects from a 386.

There is significant potential here, as with the Opus PM 500, for applications that run under Windows or some other familiar PC interface while calling on the more powerful SPARC CPU to get the job done. However, if you have expensive caches of DOS software, you can more immediately move up to SPARC power without cutting your ties to the older technology.

The Unix side of the 4i is much like that of the other systems. It runs on a 25-MHz Cypress CPU. The review unit was shipped with 16 MB of memory, a 207-MB hard disk drive, a 150-MB internal tape drive, and a 19-inch color monitor. The system's operating system is Tatung's port of SunOS 4.0, subject to the same minor compatibility problems as those of the Solbourne system. At review time, Mars had no shipping X port, but one is promised.

The 4i is the only system in this group about which I have serious misgivings. There are already dozens of SBus expansion boards, and the size and the ease of installation of these boards is part of SPARC's formula for success. I can understand making the ISA bus available, but not at the expense of the SPARC-standard SBus.

To its credit, however, the 4i is an innovative design. I'd add SBus to it, but even in its current state, it will be a machine to watch. Perhaps its DOS compatibility will help pull in some nervous PC users.

The RDI BriteLite

Even for people who don't need them, miniature systems seem to attract an incredible amount of attention. People have been waiting for RDI Computer's product to appear. Now that I've had a chance to see it, the most significant comment I can make is, "They did it."

This is no laptop. It out-hefts the formidable Mac Portable for weight and awkwardness. What the BriteLite has is compatibility. I'd rate it more compatible with the Sun IPC than any other system here, because the BriteLite uses a real Sun IPC motherboard. RDI packaged this 25-MHz system into a case with a flip-up LCD screen, a 120-MB hard disk drive, 8 MB of memory, a downsized keyboard (still with all of Sun's special keys), and a 2-hour battery. All the IPC's original ports are available in the back of the machine (and there's a pair of SBus slots inside).

In the reviewed configuration, the BriteLite's LCD screen has a resolution of 640 by 480 pixels. Since the Sun standard is a 1152- by 900-pixel resolution, the BriteLite's LCD screen can display roughly the upper-left quarter of the entire screen area. RDI supplied me with a floppy disk that had a virtual screen handler on it. With that program, you can run programs that use the full Sun resolution, but scrolling is not automatic. Typing text in a window larger than the screen is an ordeal, at best. The BriteLite includes a connector for a Sun-compatible monitor that operates at full resolution. But if you are going to have to plug in a monitor, why not simply carry Sun's own IPC?

I have seen the BriteLite with a full-resolution LCD screen at trade shows,

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but it wasn't shipping at the time of this review. Even with the magical scrolling software, I found the BriteLite's 640- by 480-pixel display unusable for any but the simplest activities. Virtually all SunOS programs expect the standard resolution, and so do I.

Salespeople, software developers, network troubleshooters, and others who need a SPARC system that can be set up and taken down in a hurry will benefit from the BriteLite, but I can't recommend the unit with the smaller display. While 640 by 480 pixels may be fine for Microsoft Windows, it's no match for X Window or even SunView.

One last curiosity that RDI plans to release in the future is Companion, a Macintosh emulator. RDI and Companion's developer are still working out licensing details, but it will be a small thrill to sit at a Unix workstation and see a Mac screen pop up in a window.

Nobody's Perfect

Every system I looked at had at least some warts, ranging in size from tiny to basketball-size. It's common these days to pull out any Brand-X PC from its box and expect it to run every DOS program ever written. That's a small wonder; PC vendors have had a decade to get it right. Considering the age of Sun's SPARC licensing program, I was mightily impressed by the quality of the best of these machines.

Which machine is the best? The Solbourne S4000's added value makes it, in some ways, a better machine than even the real thing (Sun). The file I/O performance suits this machine to file serving, and the accelerated graphics makes it a perfect desktop graphics machine. I would like to see Solbourne do a SunOS 4.1-compatible operating system, but that lack didn't dampen my interest in the machine.

The runner-up was a closer race, but I give second place to the Opus PM 5000. The offering of a PC add-in SPARC board figured into the decision; but mostly, I strongly believe that a company that develops its own hardware design and operating-system port is in a better position to serve its customers and react to changes. Opus's technical-support staff breezed through every test I put it through.

I cannot really recommend the RDI BriteLite with its 640- by 480-pixel resolution, although it is usable with a full-size display. It was the only portable SPARC system available at the time of this writing.

The Mars Mariner 4i's lack of an SBus is a disappointment. It may, however, satisfy those who need a high degree of DOS compatibility.

The CompuAdd SS-1 basic SPARC system is just that: basic. That's not a flaw, but when the market is defined by added value, a machine that is no more (and a little less) than other entries in the same category might get overlooked. CompuAdd's track record in aggressive marketing, responsive support, and price competition may serve it well. I had no qualms about the quality of its product. ■

Tom Yager is a BYTE Lab technical editor and author of Applications Programming with PC UNIX *(Addison-Wesley, 1991). He can be reached on BIX as "tyager."*

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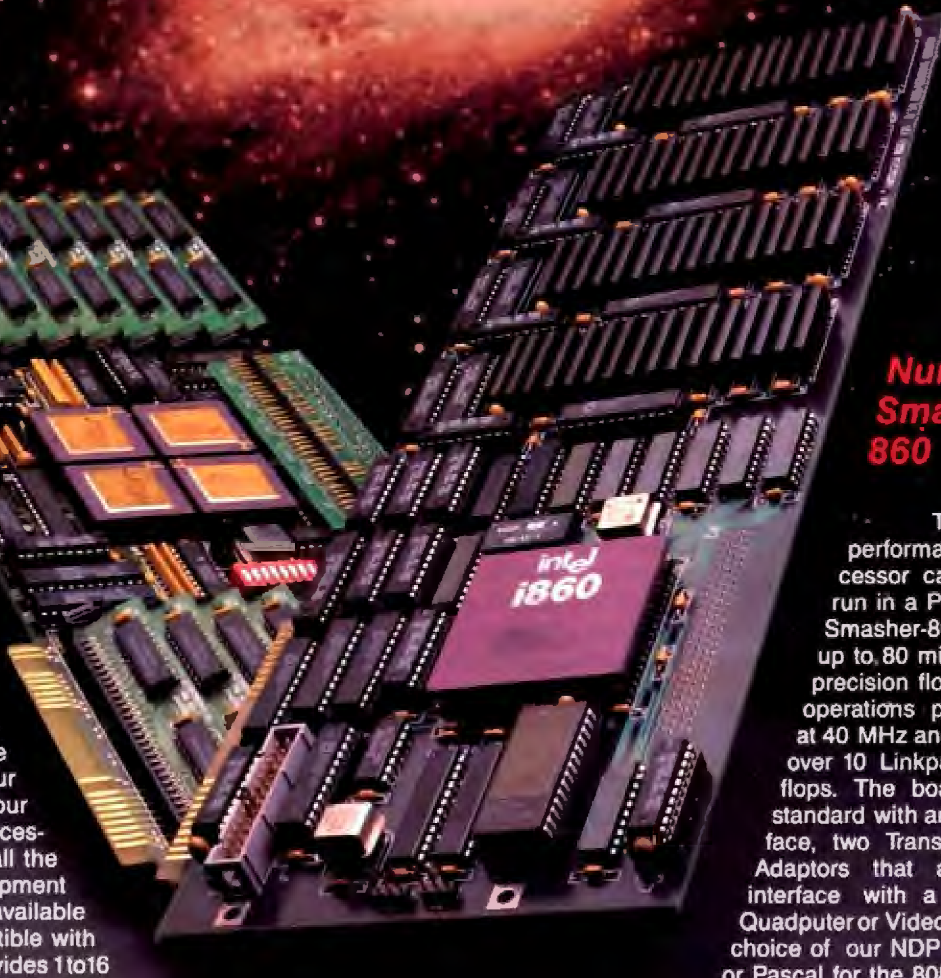

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INTRODUCING

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As a desktop, Moby Brick offers blazingly fast performance and enormous storage capacity. It has the same award winning design and nearly silent operation as the original 386SX Brick.

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Massive Power and Storage

Moby Brick is only about the size of a ream of copy paper and weighs 8.9 lbs., yet it packs full desktop power with either a 20 MHz 486SX or 33 MHz 486DX processor with up to 32 MB RAM. The new Intel 486SX is faster than a 33 MHz 386DX; the 486DX is twice as fast and includes a built-in numeric coprocessor. A modular processor board allows easy upgrades from the 486SX to the 486DX at any time.

Bricks use fast, reliable IDE Conner hard disks ranging from 44 MB up to 510 MB. The unique BIOS integrated disk cache (up to 8 MB) offers lightning quick access times. The bus is selectable between 8 MHz (AT standard) or 10 MHz which improves video, disk and network performance. Other standard features include a 2,400bps modem, 3.5" 1.44 MB floppy, 180 pin docking connector and an ISA 16-bit internal half length expansion slot. The "Stretch" Brick, which is 7" longer, accepts one full and one half length card. The rugged aluminum case with shock absorbing rubber corners is available in granite or beige along with color coordinated keyboards and monitors.

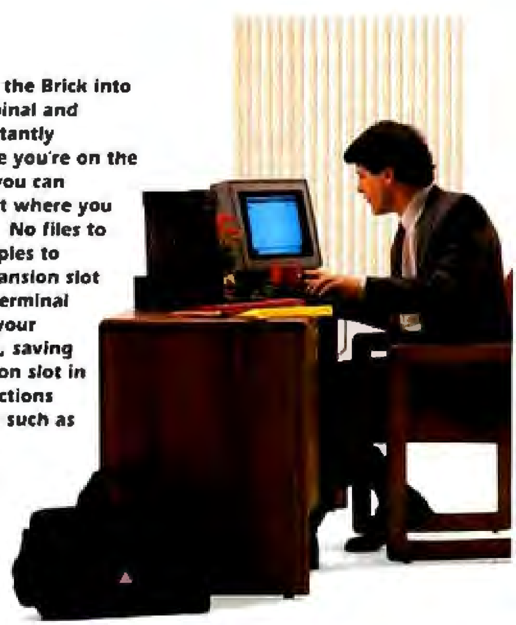
Extraordinary Graphics

Moby Brick features built-in 16-bit Super VGA graphics with 1 MB RAM. Maximum resolution is 1024 x 768 non-interlaced. The Edsun CEG (optional at no extra charge) provides antialiasing to double the apparent resolution and provides 32,000 simultaneously displayable colors for stunning photo-realistic graphics. Now you can say good-bye to the jaggies, even on low resolution 640 x 480 monitors or overhead LCD projectors. Fast, HI-RES drivers for all major applications are provided, including a Display List Driver for Autocad.

Good to Go

The innovative Ergo design provides perhaps the best benefit—versatility. You can use the same Moby Brick as a fast, quiet, stylish desktop at each of your regular destinations, such as your home and office. The optional Docking Terminal provides instant hook-up of all cables as well as a second 16-bit 3/4 length

6:25 a.m. You can start your day before heading to the office. An hour of quality work time before the onset of office interruptions (or at home in the evening) can be the most productive time of your day. With up to 510 MB of storage you can keep everything with you. All your files, addresses, even the ones you didn't think you needed, are at hand.



8:35 a.m. Drop the Brick into its Docking Terminal and everything is instantly connected. Since you're on the same computer you can immediately start where you left off at home. No files to transfer, no floppies to switch. The expansion slot in the Docking Terminal can be used for your network adapter, saving the internal option slot in the Brick for functions you need off-site such as a fax board.

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expansion slot. The matching VGA LCD display module (available in August) turns Moby Brick into a portable, go anywhere solution. The LCD features a 64 gray scale controller and the latest Sharp thin film, super twist, backlit LCD technology.

Innovative Software

The Brick's system software has features not available in any other PC. (You might expect this from Ergo, since we're a leader in DOS Extender software with customers like Borland, Fox, and Cadam.) This includes a reprogrammable BIOS with user tunable keyboard control, password protection, and non-volatile owner identity. Updates to the latest release are just a phone call away. This BIOS also includes an integrated disk cache that is significantly faster than add-on software caches. System and video shadow RAM are provided, plus a (192K) block of high memory above 640K for loading high TSRs, networks and other resident utilities.

All Bricks include the new DOS 5.0, and your choice of Windows 3.0 plus Adobe ATM with 13 fonts, a Logitech mouse *or* DESQview/386 with QEMM. Whichever environment you choose, your Brick will come fully set up, fine-tuned and ready to go. There's even on-line Hypertext manuals for the Brick and DOS. All Bricks are 100% IBM AT-compatible and support DOS, OS/2, UNIX, X/Windows and Novell.

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Bricks are available directly from Ergo—the same people who design, manufacture and support them. As a result, they sell for very attractive prices. However, a good deal is only one of the reasons you'll enjoy doing business with Ergo. We offer unlimited toll-free technical phone support, overnight repair service, a one year warranty and a no nonsense, 30 day satisfaction guarantee.

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Standard Features
(Brick and Moby Brick)

- 1024 x 768 Super VGA adapter supports EGA, CGA, MDA monitors
- Integrated cached IDE hard disk contuller with up to 8 MB cache size
- 2,400bps Hayes compatible modem
- 2 serial, 1 parallel port
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Options

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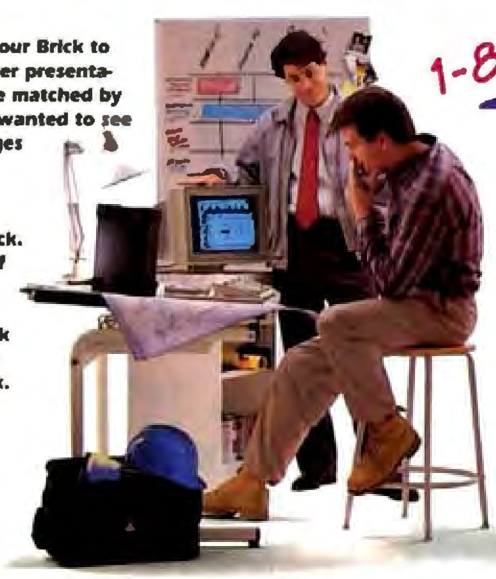

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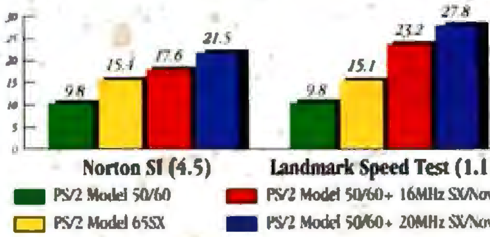

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APPLICATION

Photo-Realism Reigns When AutoShade Meets RenderMan

GREG LOVERIA

AutoShade, with its RenderMan extension, created this photo-realistic kitchen scene. Note the light sources emanating from the windows and overhead fixtures, and the resulting reflections in the refrigerator and floor tiles.

The most anxious moments for any CAD engineer or designer come when he or she shows the final wireframe drawings to clients or a project manager. After a few grunts and nods of approval, someone invariably asks, "How will it look when it's finished?"

Since 1987, AutoShade has helped AutoCAD users answer this question by letting them apply solids attribute shading directly to their wireframe drawings. Autodesk's AutoShade upgrade takes CAD drawings a step closer to realism. The $1000 version 2 includes Pixar's RenderMan extension, which lets AutoCAD users create photo-realistic images in 16.8 million (24-bit) colors from their wireframe models and drawings. This may help expand Autodesk's end-user markets into company art and desktop publishing departments or even into the realm of fine arts. Bundled with version 2 is AutoFlix—a frame/cel animation utility—and with a little ingenuity, the software could find applications in video productions.

Although version 2 performed as advertised (RenderMan's 24-bit images looked striking), the software is not simply "load-and-go." I struggled just to install it correctly. And while some might characterize the program's intricacies as "flexible," these intricacies could easily confuse new users. In my case, however, the end results proved worthy of the efforts put forth.

RenderMan Realism

Some early algorithms now used in Pixar's RenderMan source code were initially formulated at Lucasfilm's Industrial Light and Magic division. Today's RenderMan lets you assign three-dimensional object surface properties from "shaders" such as wood, marble, plastic, and glass. You can modify shaders for matte or glossy finishes and create new shader properties and settings from scratch or from scanned images. Standard RenderMan features include antialiasing, texture mapping, depth-of-field cue, motion blur, and 3-D transparency. Besides Autodesk, Pixar has licensed RenderMan to other OEMs, including CADkey, Intergraph, and Truevision.

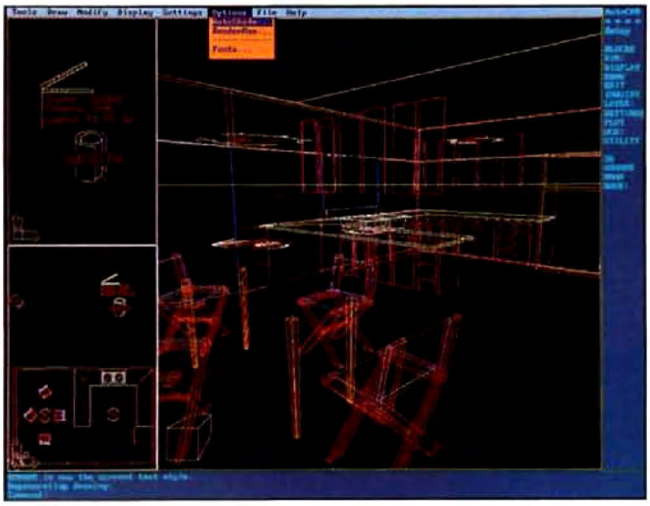
In addition to the RenderMan extension, AutoShade 2 enhancements include smooth shading of mesh objects and new scripting commands. You also can now adjust light settings using the VLIGHT command. Version 2 offers resizable surface-property and light icons. And using the Finish command, it's possible to assign reflective-lighting attributes (ambient, diffuse, and specular) for individual surfaces.

The software has relatively stiff system requirements: 4 megabytes of RAM, a 386 or 386SX system with a math coprocessor, and DOS 3.3 or higher to implement Phar Lap's 386|DOS-Extender. The installation manual (more than 100 pages) recommends 6 MB of RAM for optimal performance. When the system memory fills, the software pages temporary files to the hard disk, which should have at least 20 MB of free space.

I tested AutoShade in single- and dual-monitor configurations with AutoCAD releases 10 and 11 using a Zeos International 486/25 tower with 8 MB of RAM, DOS 4.01, a 344-MB SCSI hard disk drive, and a Weitek WTL4167 math coprocessor, which, when enabled, improved RenderMan speeds by about 30 percent. For VGA and Autodesk Device Interface testing at 1024- by 768-pixel by 8-bit resolutions, I used a Relisys RE-1520 and, later, an Optiquest 3000 multisync monitor. Diamond Computer's SpeedStar and Definicon's CADRace CEG display card, both 1-MB Super VGA adapters, sped 256-color AutoCAD regenerations. The Super VGA cards use Panacea's display-list drivers and Definicon ADI drivers, respectively.

In a dual-monitor configuration, I performed 16- and 24-bit render testing using Truevision's TARGA 16 and AT Vista adapters with a Relisys RE-5155 RGB analog monitor at the TARGA-required 15.75-kHz horizontal scanning frequency. Pointing devices included a Microsoft Mouse and a Summagraphics 1201 digitizer pad with a four-button puck.

Autodesk's single-monitor system drivers for the main workspace display



Screen 1: *I captured this screen of a 3-D wireframe kitchen sample model, shown here within AutoCAD. Note the plan and perspective camera views, the AutoShade/ RenderMan menu selections, and light-source placement. (File-to-slide conversion courtesy of Image Center)*

area range from CGA monochrome monitors to Super VGA 256-color displays using manufacturer-specific ADI drivers. Output-rendering device drivers for dual-monitor systems include Hercules graphics, Orchid TurboVGA, and Truevision's 16-, 24-, or 32-bit TARGA adapters. The company ships a Null driver for rendering AutoShade script batch-mode files directly to the hard disk. Rendered-output resolutions (determined by display device) range from VGA through Super VGA resolutions to 512- by 482-pixel by 16-, 24-, or 32-bit color using TARGA adapters or the null-rendering device. AutoShade saves rendered images to RND, TGA, and TIF rendered-output file formats.

Installation Blues

I initially ran AutoShade with AutoCAD release 10. Installation was simple (I just typed INSTALL and answered a few questions) but time-consuming; it takes about 30 to 45 minutes to uncompress files from the eight 3½-inch floppy disks to the hard disk.

As with most software, environment and path settings are critical. After installation, I started the program, but errors stating "Cannot find RMAN .EXE" prevented the program from executing. After calling Autodesk, I discovered that the installation program does not automatically set all environment variables. In addition, for release 10 operation, the entire contents of the SHADE2 \ ACADSUPT subdirectory must be manually copied into the main ACAD subdirectory to replace existing Lisp files. This *is* noted 27 pages into the installation manual, but I had overlooked it. Given the lengthy installation procedure, these problems should have been addressed automatically. The subdirectory contents problem did not appear when installing for AutoCAD release 11.

Shading and Rendering

Both AutoShade 2 and the RenderMan extension are postprocessors—that is, AutoCAD is used first to create 3-D entities and define and place cameras, lights, surface finishes, and scenes as ACAD blocks. In release 10, the ASHADE.LSP routine loads manually from the command prompt as MENU ASHADE; this is automatically loaded in release 11.

AutoShade supports two types of light sources: point lights, which radiate light 360 degrees like uncovered light bulbs, and directed lights, which emit parallel beams in one direction. The VLIGHT command sets light intensities and light target/distance coordinates. In RenderMan, you can add spotlights, which function much like directed lights but emit directional beams in cones. Spotlights allow full control over cone delta angles, RGB light colors, shadowing, light intensity, and shadow perimeter drop-off.

You can set and position any number of cameras using AutoCAD *x,y,z* point coordinates and the VCAMERA function. The cameras appear as blocks within the drawing. The CAMVIEW command provides orthographic projection from the camera angle; DVIEW then sets distance and zoom ranges of perspective scene views. Camera focal lengths for setting the field of view are just about boundless: I experimented using ranges from 1 mm to 1500 mm. Setting a long camera focal length such as 300 mm allows zooming in on specific drawing targets (see screen 1).

Clipping (or cropping) allows you to specify how much of the drawing will be encompassed in an imaginary box with walls known as *clipping planes*. When you alter clipping values, the clipping planes move in or out and are measured from camera line of sight to a target point along the camera view plane. You change values from a pop-up dialog box. When you have adjusted values properly, this box lets you view, shade, and render inner cross sections and cutaway views of models.

continued

BYTE ACTION SUMMARY

- **WHAT AUTOSHADE 2 DOES**
  It provides a relatively low-cost way to shade AutoCAD 3-D models and wireframe drawings. With the Autodesk RenderMan extension, you can create photo-realistic renderings of your 3-D AutoCAD models in full 24-bit (16.8 million) color. With AutoFlix, you can create moving FLI animations of your renderings at Super VGA resolutions.
- **LIKES**
  Smooth shading of mesh objects, extensive light settings, and resizable surface-property and light icons. The RenderMan extension offers PC users the same photo-realism technology used by professional animators and film producers.
- **DISLIKES**
  Program installation and setup procedures can be difficult, if not downright frustrating. The complexity of the software may intimidate some users and requires a high degree of patience, as well as DOS and AutoCAD knowledge.
- **RECOMMENDATIONS**
  For photo-realism in AutoCAD, choose AutoShade 2 for some of the best images we've seen come off a desktop PC system.
- **PRICE**
  For new users (includes RenderMan and AutoFlix), $1000; upgrade from version 1, $500; version 2 upgrade without the RenderMan extension, $100.
- **FOR MORE INFORMATION**
  Autodesk, Inc.
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Screen 2: *This collection of 3-D bottles shows various RenderMan surface shaders, including swirling, transparency, and wireframe shader attributes. (Images courtesy of Autodesk/Pixar)*

Selecting RenderMan from the AutoCAD pull-down menus will load the RMAN.LSP routines. The RMSETUP command allows selection of preset rendering attribute blocks for scenes, such as slow or fast rendering for high- or low-quality renderings, as well as object color correction and antialiasing attributes.

Surface Control

RMPROP is perhaps the most often used (albeit complex) command in RenderMan. It controls surface-property attributes and their application of texture maps, known as *surface shaders*, to 3-D entities. You also use RMPROP to modify, assign, and create AutoCAD blocks for scene atmosphere densities and color, as well as object displacement values, opaqueness, and object rendering rates. To assign surface attributes, the software assigns a block name first to the shader and then to a 3-D entity using the AutoCAD Color Index hierarchy.

When using ADI drivers for 256-color Super VGA display in AutoCAD, it's easy to select shader assignment colors by clicking on an object directly; otherwise, you have to refer to an external color index.

Once you select a shader assignment color, you choose a surface shader from a few of the 30-plus possibilities, including glass, clouds, marble, wood, plastic, metal, carpet, and granite (see screen 2). You can extensively modify surface shaders, although some of the modification commands appear cryptic at first.

The procedure can be complex and drops you out of AutoCAD's GUI to a DOS text-prompt/command-line process. On the low side, I sometimes used at least 20 different commands to modify the surface shaders. The "Enter scalar 'Ka' " and "Enter scalar 'Ks' " shader modifier prompts refer to ambient and specular light properties, respectively, but you must look in the manual to discover this. Some shaders, such as wood, let you set frequency of the grain swirl patterns as well as repetitiveness of the overall texture map. You also assign shader smoothing or matte attributes during this procedure. Once assigned, a shader AutoCAD block is created and placed anywhere in the drawing for reference.

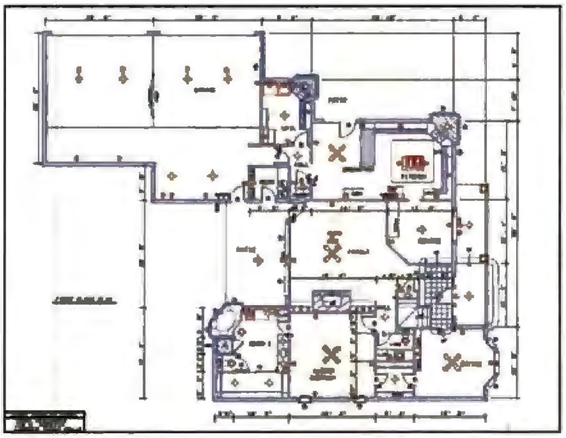
Before exiting AutoCAD, you create a film-roll file of the edited drawing via the FILMROL command while the *internal* ASHADE or RMAN.LSP routines are still loaded. Film-roll files contain 3-D objects, surface finishes, and all camera and lighting attributes needed for the external AutoShade-RenderMan rendering programs. SHADE2, at the command prompt, invokes a batch file that sets additional environment variables and paths for the shading and rendering processes and starts the external AutoShade program.

Viewing Results

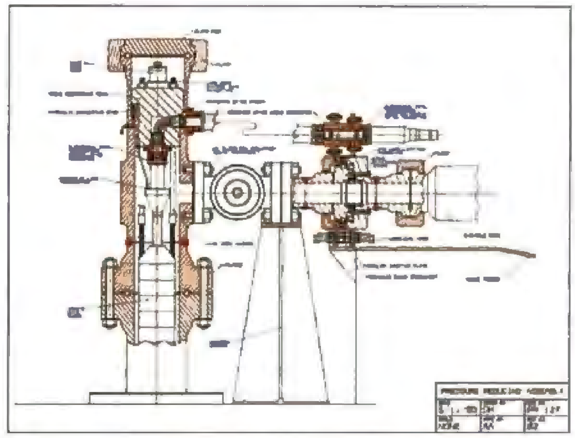
The external AutoShade workspace is a point-and-shoot GUI with pull-down menus and pop-up dialog boxes. Once you load film-roll files, you tap the F2 key within AutoShade to view plan or camera/scene perspective wireframe drawings that detail camera and light placements.

To view shaded scenes, you simply press the F3 key, which invokes the Fast Shade option for previews and rough drafts. F4 invokes the Full Shade feature, where full smoothing and lighting attributes are applied. You can save shaded scenes as RND files. I was particularly impressed with AutoShade's stereoscopic image feature, which generates shaded scenes in stereo pairs using an

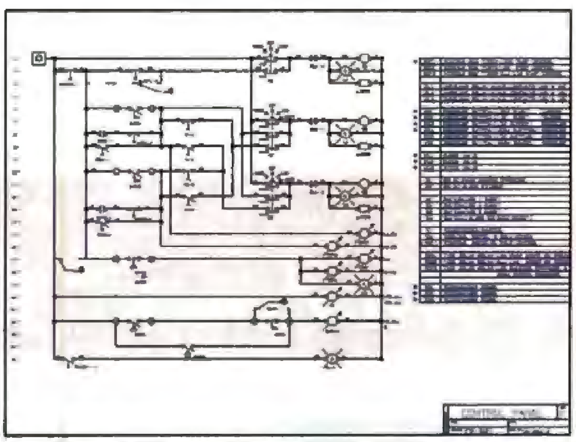
WHAT MAKES A BEST SELLER A BEST SELLER?



A great plot begins with a great idea, easily translated through every phase of design with Generic CADD 5.0.



Deadline pressure is a thing of the past. Designs can be quickly edited and annotated to produce final working drawings.



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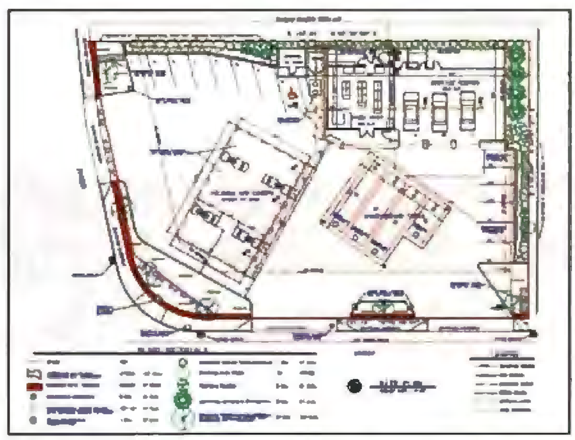

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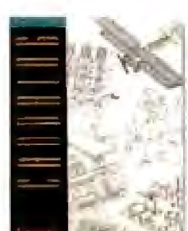

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interocular angle-displacement algorithm. You can view the stereo image's full 3-D depth (without special glasses) using "crossed-eye fusion." It sounds terribly corny, but it does work. (A file called 3D_SCENE.ZIP has been uploaded to the "multimedia.listings" area on BIX for those who wish to experiment further with crossed-eye fusion.)

To create final 24-bit photo-realistic scenes, you invoke the RenderMan extension from within the AutoShade GUI. Fortunately, any object's surface shader assignment can be changed by object color, and any shader's attributes can be modified from pop-up dialog boxes; otherwise, you'd have to exit and reenter AutoCAD to perform any modifications.

AutoShade transfers film-roll file data and scene attributes to RenderMan via RIB (RenderMan Interface Bytestream) files. Autodesk RenderMan automatically creates and compiles a RIB file for its use at rendering time, or a preexisting RIB file can be used that allows cross transfer of image-rendering data between software and systems using Pixar's RIB specifications. Compared to other shading and ray-tracing programs, the actual RenderMan ray-tracing process is extremely fast, and the resulting images are spectacular.

With AutoFlix, users can also create kinetic animations, interactive movies, and model walk-throughs using RenderMan image frames compressed to 320- by 200-pixel by 8-bit Animator FLI files. AutoFlix comes with its own tutorial manuals and could warrant a standalone review on its own merits. Due to space constraints, AutoFlix can't be detailed here; I can only mention that it's unique.

CAD users contemplating photo-realistic imaging should note that AutoCAD is a prerequisite for generating film-roll files to use AutoShade 2 or the Autodesk RenderMan. Also, numerous other 24-bit ray-tracing packages are available, such as the $995 Big D ray tracer from Graphics Software or the QRT shareware ray-tracing program that functions using command-level instructions. Another alternative solution to achieving 24-bit rendering and animation is Autodesk's own $2995 3D Studio software (see "Low-Cost 3-D Animation Materializes for PC Users," April BYTE).

Patience Pays Off

As with any Autodesk product, AutoShade's documentation and tutorials are superb, but judging from the complexity of the software, questions are bound to arise. End-user support issues are resolved by Autodesk authorized dealers, not Autodesk directly, so be certain to purchase the software from dealers with a high degree of CAD knowledge.

Judging from the detailed 24-bit renderings achieved, my overall rating of the software would have to be excellent, especially at this price. If you're an AutoCAD user with some patience, AutoShade with Autodesk's RenderMan extension should be your software choice for photo-realistic imaging. ■

ACKNOWLEDGMENT

I'd like to acknowledge Bryan Ellis for his assistance with the AutoShade installation and configuration procedures.

Greg Loveria is a computer graphics and desktop publishing consultant, animator, and technical writer in Binghamton, New York. He can be contacted on BIX as "loveria."

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HARDWARE

Full Ethernet Networking Without a Wire in Sight

HOWARD EGLOWSTEIN

It happens in every network installation: There's one pesky location that's simply too hard to reach with conventional wiring. Or perhaps you're setting up a temporary network and simply have no need for permanent wires. Do you have to keep those nodes off the network? Motorola doesn't think so.

The Altair wireless Ethernet is a system of radio transceivers that extend a thin- or thick-wire 10-megabit-per-second Ethernet system where no LAN has gone before. Altair differs from WaveLAN, NCR's lower-frequency, 2-Mbps wireless LAN (see "WaveLAN: A Network with No Strings Attached," June BYTE) in that it uses a hub system and operates in the 18-gigahertz region of the radio band.

An Altair "microcell" consists of a Control Module that manages the flow of information to and from each User Module. The CM typically connects to the system file server, host, or main Ethernet backbone, while the UMs get placed near workgroup clusters (see the figure). To cover wider areas, you simply use more microcells as needed. Altair units can be set to one of a few frequencies, and their restricted range allows two microcells to coexist in tight areas.

The Altair system. Shown here are the Control Module (CM) and two User Modules (UM). The grillwork hides a special six-sector microwave antenna. The back panel has connections for power, thin and thick Ethernet, and, on the CM, a special RS-232 cable for UM security registration. Installation can be as simple as placing the unit on your desk and connecting the Ethernet cable.

BYTE ACTION SUMMARY

- **WHAT ALTAIR DOES**
  Substitutes microwave radio technology for wired Ethernet connections.
- **LIKES**
  Convenient hookup; totally transparent operation; connects through any Ethernet card and cable—no special adapter required.
- **DISLIKES**
  The price may be high for some installations; network response is slowed on some networks.
- **RECOMMENDATIONS**
  Well-suited for environments where running standard cabling is impractical.
- **REQUIREMENTS**
  Workstation with thick- or thin-wire Ethernet connector; network environment restricted to within 200 feet of Control Module.
- **PRICE**
  Control Module, $3995; each User Module, $3495.
- **FOR MORE INFORMATION**
  Motorola, Inc.
  Altair Product Operations
  3209 Wilke Rd.
  Arlington Heights, IL 60004
  (800) 233-0877
  (708) 632-4723

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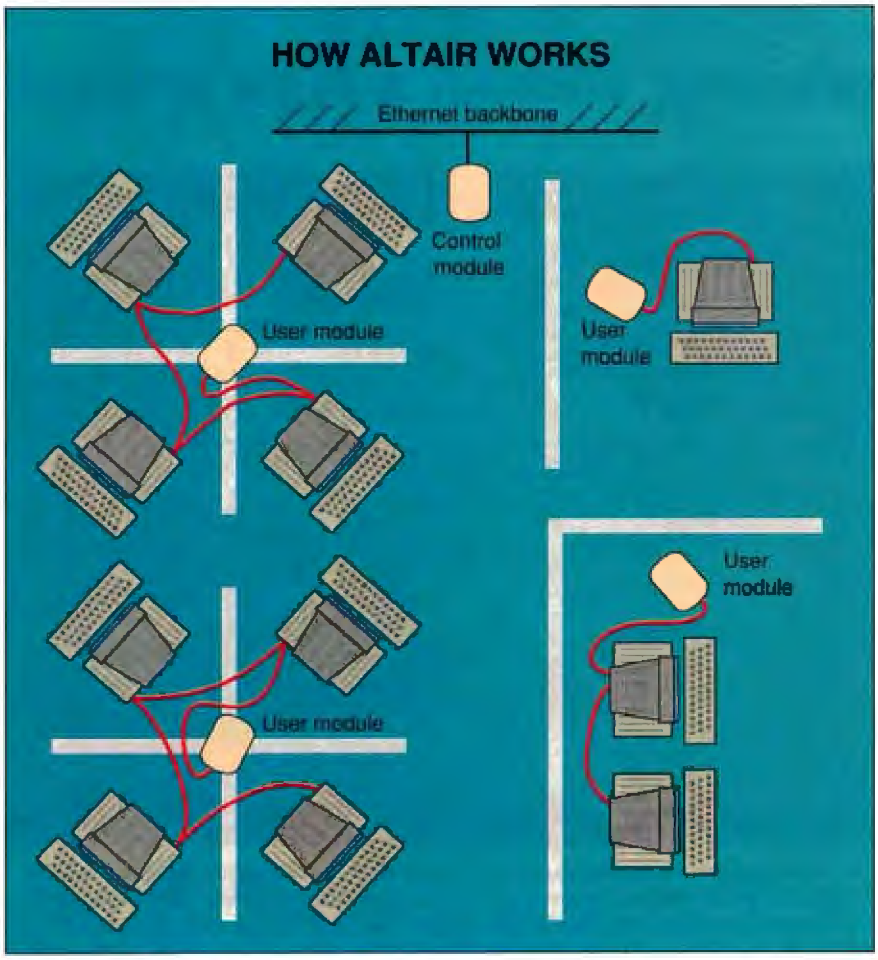
Beam Me Up, Scotty

Motorola based the Altair on long-proven packet radio techniques. To picture how this works, imagine yourself at a cocktail party. Conversations are going on around you, and you want to ask a question. You wait until everyone is quiet and then jump in and ask. If no one else starts talking at the same time, your question will be heard and someone can answer you. If someone else does start talking at the same time, you'll smile, wait a bit, and listen for another chance to talk.

To make conversation easier, imagine that your host puts a large clock on the wall. Everyone agrees to start talking only at 15-second intervals. That way, if you start your question at the same time as someone else, you will have to wait until the 15 seconds are up before trying again. The advantage here is that you spend less time competing and more time talking. (An outsider listening in might



A typical Altair topology isn't totally wireless: You cable up to four workstations to each User Module, which then makes a line-of-sight connection to the Control Module. You cable the Control Module to your file server, host, or network backbone. Motorola suggests mounting the modules high to avoid obstructions.

think you're all a bit loony, though.)

The first scenario describes the Aloha protocol, named at the University of Hawaii, where it started as a packet radio network protocol in the 1970s. Altair uses a variation of the second scenario, "slotted" Aloha, to manage communications between the UMs and CM. If a workstation has an Ethernet packet to send, it sends it to the UM, which requests a slot, waits for confirmation from the CM, and then sends the data.

With so many radio signals running around, you also want to be sure that no one outside the microcell can pick up the signals. When a UM is powered up, it identifies itself to the CM by its Ethernet address and picks up the CM's scrambling key. Any packet going between the UM and the CM is scrambled using a combination of the frame sequence number and this key. For added security, you can give the CM a list of up to 32 UMs authorized to operate in the microcell. Any other UM trying to exchange packets in the microcell will be ignored.

Between microcells, Altair relies on properties of the microwave medium. Low-power microwaves (in this case, 25 milliwatts) have little penetration power. Motorola suggests a maximum range of 130 feet in open air, or 40 feet through up to three interior walls. An exterior or load-bearing interior wall will kill the signal. Two microcells on the same floor can coexist as close as 200 feet apart, but microcells on adjacent floors can't see each other, since the microwaves won't penetrate the floor.

Nothing Like Being Wired

Connecting an Altair microcell couldn't be simpler. The test network came with the CM and three UMs. I started in the Unix lab by simply disconnecting some existing thin Ethernet cabling and replacing it with Altair units. The CM went to the primary host, and groups of workstations connected to the UMs.

Typically, the CM sits in the geographic center of the microcell, on top of a cubicle wall. In our test network, the distances from UM to CM ranged from 2 feet to about 10 feet. To get a better idea of Altair's range, I moved the units to a temporary Novell network and placed one of the UMs on a rolling cart with a long extension cord. The system worked flawlessly from 102 feet when unobstructed. When a metal pushcart rolled through the transmission path, the UM's status light blinked, indicating a communication failure. However, the network recovered without any loss of data.

In theory, Altair's 10-Mbps transfer rate shouldn't present any limitation to today's PCs. In fact, a test on the Unix LAN with TCP/IP protocol showed a file copy across the network to run at 56 kilobytes per second, both wired and wireless. Novell NetWare was different.

When NetWare operates, each transmitted packet requires a response. On a wired system, this response happens quite fast. Altair's radio protocol adds to each packet a bit of overhead that can slow down the network considerably. I copied some large files to and from a NetWare 386 file server over a wired link at 194 KBps, and then over Altair. With the added overhead, the best I could get was 69 KBps. I then ran some applications over the link and found the performance to be noticeably slowed but acceptable. Motorola says that typical users will see little or no speed degradation running Novell, but from my brief time with the system, I'm not sure I'd agree.

The Altair is ideally suited for situations in which you can't run cabling through a wall or simply don't want to run anything permanent. One beta tester I spoke with is considering the Altair technology to equip a facility that will be occupied for only six months.

But Altair technology doesn't come cheap. The CM unit costs $3995, and each UM sells for $3495. If you place the maximum of six workstations on a UM, you can drop the per-node cost to approximately $700. Industry estimates of wiring Ethernet systems range from $200 to $1000, depending on the situation. For tough wiring situations, the Altair may do more than save you money—it also could be your only solution. ■

Howard Eglowstein is a testing editor in the BYTE Lab. He has a B.S. in architecture and design from MIT. You can reach him on BIX as "heglowstein."

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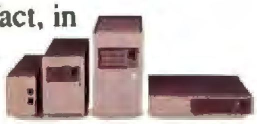

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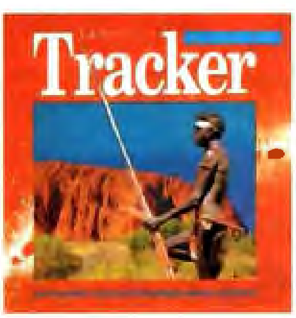

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Server-Based UPSes Promise Order During Power Problems

The Para Systems (top) and Zentao UPSes monitor power conditions and alert network workstations if a power failure occurs.

In the beginning, the rule was one person, one computer, and one uninterruptible power supply (UPS)—a simple setup. If the power failed, the user simply stopped working, saved his or her files, and shut down the computer.

Today, thanks in part to the proliferation of LANs, the situation is more complicated. The computer in question may be a network server with several workstations running off it. The server may be in a remote location where a user does not constantly monitor it; thus, a UPS that simply powers one workstation or the server on a LAN is not sufficient. If the power fails, other workstations on the LAN would not know if anything were amiss. Only after the UPS battery power was depleted would the failure be apparent. By then, network operations would cease, and files could be damaged or destroyed.

Network Ready

This month's Reviewer's Notebook takes a return look at network-ready, standby UPSes that provide the usual power-backup capabilities and some extra capabilities for networks (see " 'Smart' UPSes Alert LANs to Power Problems," May BYTE). For this review, I have selected the Para Systems Minuteman AT800 and the Zentao UPS 750L. Each supports servers running NetWare 386 and provides power-monitoring software. The Minuteman has a power rating of 800 volt-amperes while the UPS 750L is rated at 750 VA. Both UPSes use sealed lead-acid batteries (gel cells).

These UPSes connect to the server or workstation via a serial or special interface port. A TSR monitoring program running on the server or workstation checks the port for a signal from the UPS that the power has failed. If a voltage sag or power failure does occur, the monitoring program is alerted. Should the power failure continue beyond a preset time, the program sends a message to all the workstations on the LAN, instructing users to save their files and log off.

The UPS sends continuous updates to the monitoring program on the batteries' condition. When the batteries are just about completely exhausted, the program sends a message to all the workstations to log off immediately. The program then closes all the files on the server and sends a signal to the UPS to shut down. This "active" status of the UPS protects computers that are unattended or in remote locations.

Minuteman AT800

The front panel of the Minuteman includes a set of six LEDs that display normal AC operation, battery status, AC failure condition, overload condition, AC

BYTE ACTION SUMMARY

- **WHAT LAN-BASED UPSES DO**
  Combined with "smart" software, they inform network users about a power failure, broadcast log-off messages, and automatically shut down the network server. By monitoring battery levels and power quality, they can help head off damage from faulty power conditions.

- **RECOMMENDATIONS**
  The Para Systems Minuteman AT800 offers a simple interface, easy-to-install software, and good documentation. However, the BYTE Lab's choice for best UPS in this category still goes to American Power Conversion's entry (see " 'Smart' UPSes Alert LANs to Power Problems," May BYTE).

- **PRICE**
  Minuteman AT800, $879; Network Manager for Novell NetWare 2.x and 3.x and AT&T Unix System V release 2.3.2, $109

  UPS 750L, $469; UPS Monitoring Kits: UPSC-02 for MS-DOS, $149; UPSC-04N for Novell NetWare 3.x, $299; and UPSC-04X for AT&T and SCO Unix, $299.

- **FOR MORE INFORMATION**
  Para Systems, Inc.
  P.O. Box 815188
  Dallas, TX 75381
  (800) 238-7272
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  fax: (214) 446-9011
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fault condition (i.e., low or excessively high voltage), and fuse condition. The back panel has four 120-VAC output receptacles and a UPS monitoring interface.

The Minuteman uses its own Network Manager package as the monitoring program. Network Manager resides on a Novell server and executes as a background task. You can load it as either a value-added process or a NetWare loadable module (NLM), depending on the NetWare version running on the server. Network Manager communicates with the UPS through an RS-232 serial port on the server.

The Network Manager installation program prompts you for the serial-port selection, the length of time the UPS uses the battery before shutting down the server, the wait time before the UPS signals a power failure, the amount of time from when the program detects a low-battery condition until it sends a message and executes the Novell DOWN command to shut off the server, and the grace period after the server is shut down until the Network Manager turns off the UPS.

The Network Manager performed well on the BYTE Lab's test LAN. During the power-off test, the program sent the appropriate warning messages to the workstation. After the specified time had elapsed, it closed all the files, and the UPS shut down.

The documentation for both the Minuteman and Network Manager is well written and easy to follow.

UPS-750L

Designed to sit under your monitor, the UPS 750L has a main power switch, an alarm reset, and separate power switches for the computer and monitor. Two LED bar graphs show the load level and the battery condition. Separate LEDs show power and UPS operation. Like the Minuteman, the UPS 750L's back panel has two 120-VAC output receptacles and a UPS monitoring interface.

The UPS 750L comes with the SafeWare Intelligent UPS Monitoring Kit. SafeWare uses an 8-bit interface card, which you install in the server or workstation, and an NLM monitoring program running on the server to connect to the UPS. A DB-9-to-DB-15 cable connects the server to the UPS.

The SafeWare installation program copies several files onto the server's hard disk in a user-specified subdirectory. Other files are copied to the SYS:SYSTEM subdirectory. The installation program then appends the system log-in script. Next, you type LOAD INSTALL in on the server machine to access the Novell Installation Options menu so that you can edit the AUTOEXEC.NCF file. You can enter the commands LOAD UPS TYPE=STANDALONE PORT=231 DISCHARGE=5 RECHARGE=1 to set the parameters for the UPS into AUTOEXEC.NCF and save the file. These commands determine how much time passes after a power failure before the program sends a message to the workstations, and the amount of time before the batteries are completely depleted that the UPS will shut down. On rebooting the server, the UPS.NLM module will run as the monitoring program.

Another TSR, SW.EXE, has to run on every workstation connected to the UPS. The combination of the NLM monitoring program, the SW.EXE program, and a _PROFILE.PAR file also lets you store the shutdown commands for any programs running on a workstation.

Like Network Manager, SafeWare performed well on the BYTE Lab tests. Unfortunately, after the tests were completed, the UPS indicated an overload condition and stopped working. I attribute the failure to the rough handling the unit received when it was shipped from the manufacturer in Taiwan.

The UPS 750L's documentation was not as well written as the Minuteman's. The installation instructions for SafeWare were not well organized, and the manual had several spelling errors.

Zentao claims that new monitoring software that does not use a special interface card but runs through a serial port will soon be available.

Sags and Holdups

The primary function of a UPS is to keep your computer running when the utility power fails. To test this, I charged the battery in each UPS for several days. I then connected each UPS to a network server computer. Next, I installed a variable transformer between the UPS and the utility power to control the voltage and to simulate brownouts and power failures. For the tests, I ran each UPS on a two-station Ethernet LAN running Novell's NetWare 386 version 3.1.

The power load that a computer presents to a UPS depends on the equipment installed in the server or workstation. For these tests, the server was a Zeos 486/33 with an EISA bus, 4 megabytes of RAM, a 319-MB SCSI hard disk drive (a Seagate ST4376N) and controller, 5¼-inch 1.2-MB and 3½-inch 1.44-MB floppy disk drives, a tape backup drive and controller card, a Novell NE-2000 thin-wire Ethernet network-adapter card, a VGA card, and a Zeos 12-inch VGA color monitor. The computer was powered by a PC Power and Cooling 450-watt power supply; the monitor was rated at 120 VAC 1.2 A, which equals a 144-W load. This provided a maximum load of 594 W on the UPS.

The workstation not powered by the UPS was an IBM AT with a Mylex LNI390A thin-wire Ethernet network-adapter card.

My first test determined the "trigger" voltage where the UPS would switch over from the utility to battery power in the event of a brownout or voltage sag. At the start of the test, the voltage to the server was 120.5 VAC. When I lowered the voltage, the Minuteman was triggered at 106.1 VAC and the UPS 750L at 103.5 VAC.

The next test measured the holdup time (i.e., the amount of time the UPS powers the server in the event of a power failure). The Minuteman ran for 17 minutes, 1 second, and the UPS 750L ran for 21 minutes, 50 seconds before automatically shutting down.

Ready and Waiting

The Minuteman's best features are its four AC outlets, well-written documentation, simple installation, and good performance with Novell's NetWare. However, it requires a dedicated serial port for the monitoring program.

The UPS 750L provides a more convenient size and design, slightly better holdup time, and good performance with Novell's NetWare. It also costs less. Unfortunately, it has only two AC outlets, requires a slot in the server for its interface card, is not easy to install, and lacks well-written documentation.

So which should you choose? It's a close call; both these UPSes can protect your network server. I prefer the Minuteman AT800 because it is easy to install. But taking into consideration the UPSes that the BYTE Lab looked at in May, American Power Conversion's Smart-UPS 900 edges out these latest competitors, despite its higher price of $999. The Smart-UPS 900 has a smart-boost feature for dealing with brownouts, six AC outlets, and PowerDoctor software that allows you to monitor the UPS in real time. ■

—Stan Wszola

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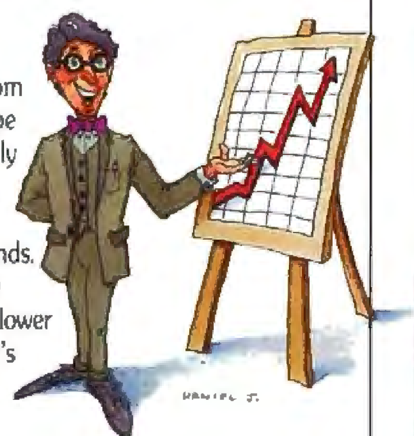

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STEVEN J. MASTRIANNI

OS/2 DEVICE DRIVERS

A practitioner's guide to development of an asynchronous RS-232 terminal driver for OS/2 in C

OS/2 device drivers continue to be a limiting factor in the acceptance and use of OS/2. DOS drivers abound, but OS/2 drivers are scarce as hen's teeth—for a variety of reasons. OS/2 drivers are more complicated than DOS drivers. They've got to handle context switching and priorities and accommodate dual-mode operation (real versus protected)—issues foreign to many DOS programmers. In this article, I'll describe how to build an asynchronous RS-232 terminal driver for OS/2 in C, complete with interrupt handler and timer support (the code you'll need to build this driver is available on BIX; see page 5 for details). Once you've seen how that's done, you'll have the basic understanding you need to write OS/2 drivers for other types of devices.

The Nature of the Beast

OS/2 device drivers, like other multitasking drivers, shield applications from the physical characteristics of I/O devices (e.g., timing or I/O port addressing). An application in need of I/O service transmits a request to the OS/2 kernel, which in turn calls a driver. The device driver handles all the hardware details, such as register setup, interrupt handling, and error checking. When the request is complete, the device driver massages the data into a format recognizable by the application. It sends the data or a status indication to the application and notifies the kernel that the request is complete. If the request cannot be handled immediately, the driver may either block the requesting thread or return a Request Not Done status to the kernel. Either way, the driver then relinquishes the CPU so that other threads can run.

DOS device drivers do not have a direct OS/2 counterpart. They are simple single-task polling drivers. Even interrupt drivers under DOS poll until interrupt processing is complete. DOS device drivers support one request at a time, and any subsequent requests from the DOS kernel will cause the system to crash.

In contrast, an OS/2 driver must manage overlapping requests from different processes and threads, and it must therefore be reentrant. It must also handle interrupts from the device and interrupts from a timer handler. In addition, the OS/2 driver must oversee switches from protected mode to real mode. It must accomplish these operations in an efficient manner, allowing other threads to gain access to the CPU, and, most important, it must do all these tasks reliably. Because it operates at ring 0, the OS/2 driver is the only program that has access to critical system functions (e.g., the interrupt system and timer). The driver therefore must be a trusted program, because any error in the driver can cause a fatal system crash.

OS/2 device drivers must also be bimodal, which means they must operate in real mode and protected mode. The interrupts must continue to be processed, and the requests must be completed, even if the user switches from the OS/2 prompt to the DOS compatibility box and back. They must be able to deinstall when requested, releasing any memory used by the driver to OS/2. Additionally, OS/2 drivers may support device monitors, programs that monitor data as it is passed to and from the driver. Fortunately, OS/2 offers a wide range of system services called Device Helper routines, or `DevHlps`, to provide this functionality.

Tools of the Trade

Designing an OS/2 device driver requires a thorough understanding of the role of a device driver, as well as a solid working knowledge of the OS/2 operating system and design philosophy. Debugging OS/2 drivers can be difficult, even with the proper tools. The OS/2 device driver operates at ring 0 with full access to the system hardware. However, it has almost no access to OS/2 support services, except a handful of `DevHlp` routines. Many driver failures occur in a real-time context, such as in the midst of interrupt handling. It may be difficult or impossible to find a driver problem using normal debugging techniques. In such cases, it is necessary to visualize the operation of the device driver and OS/2 at the time of the error to help locate the problem.

The most important tool for driver development is the driver debugger. Generally, I use the kernel debugger from Microsoft, which comes with the Device Driver Development Toolkit, or DDK. Several other companies offer good driver development tools. A more complete version of this article in book form and a complete C-callable `DevHlp` library can be purchased from PSS. PentaSoft offers a C-callable interface to the `DevHlp` routines. OS Technologies offers a driver debugger that is OS/2 version-independent. And FutureWare offers a driver debugger and a C-callable interface to the `DevHlp` routines.

I write all my device drivers, including the interrupt and timer handlers, in Microsoft C 6.0. A device driver written in C can be written in approximately half the time it would take to write the same driver with the Microsoft Macro Assembler. In special cases, especially when writing drivers for very fast devices or where performance is extremely critical, it only makes sense to write a few subroutines in assembly language. Mostdrivers, however, work fine when written in C.

continued

Anatomy of an OS/2 Device Driver

OS/2 drivers receive requests from the OS/2 kernel. When the driver is originally opened with a DosOpen call, the kernel returns a handle to the program that requested access to the driver. This handle is used for subsequent access to the driver, and the driver name is no longer used (or needed).

When an application makes a call to a driver, the kernel intercepts the call and formats the driver request in a standard driver data structure, called the *request packet*. The request packet contains the data and pointers that the driver uses to honor the request. In the case of a DosRead or DosWrite, for example, the request packet contains the physical address of the caller's buffer. In the case of an I/O control operation (IOCtl), the request packet contains the virtual address of a data and parameter buffer. Depending on the request, the data in the request packet will change, but the length and format of the request packet's header remain constant. The kernel passes the driver a bimodal pointer to the request packet. This bimodal, or tiled, address is a pointer valid in either protected mode or real mode, because the processor may be in either mode when the driver is called.

How does the kernel know which driver to send the request to? Drivers are loaded by the OS/2 initialization code at boot time, and the kernel keeps a list of the installed drivers by name. Before a driver is used, it must be DosOpened from the application. The DosOpen specifies an ASCII-Z string with the device name as a parameter. The kernel compares this name with its list of installed drivers, and if it finds the name, it calls the Open section of the driver Strategy section to open the device. If that operation succeeds, the kernel returns a handle to the application to use for future driver access. The ASCII-Z name is never used again while the device remains open. The device handles

Listing 1: *The OS/2 kernel and device drivers communicate by way of request packets.*

```
typedef struct ReqPacket {
 UCHAR   RPlength;
 UCHAR   RPunit;
 UCHAR   RPcommand;
 USHORT  RPstatus;
 UCHAR   RPreserved[4];
 ULONG   RPqlink;
 union {
   UCHAR   avail[19];
   struct {
     UCHAR      units;
     FPFUNCTION DevHlp;
     char far  *args;
     UCHAR      drive;
     } INIT;
   struct {
     UCHAR      units;
     OFF        finalCS;
     OFF        finalDS;
     FARPOINTER BPBarray;
     } INITExit;
   struct {
     UCHAR      media;
     PHYSADDR   buffer;
     USHORT     count;
     ULONG      startsector;
     USHORT     reserved;
     } ReadWrite;
   struct {
     UCHAR      media;
     PHYSADDR   buffer;
     USHORT     count;
     ULONG      startsector;
     USHORT     sysfilenum;
     } CReadWrite;
   struct {
     UCHAR      subcode;
     ULONG      reserved;
     } Shutdown;
   struct {
    USHORT      sysfilenum;
    } OpenClose;
   struct {
     UCHAR      category;
     UCHAR      function;
     FARPOINTER parameters;
     FARPOINTER buffer;
     } IOCtl;
   struct {
     UCHAR      char_returned
     } ReadNoWait;
   struct {
     UCHAR      media;
     UCHAR      return_code;
     FARPOINTER prev_volume;
     } MediaCheck;
   struct {
     UCHAR      media;
     FARPOINTER buffer;
     FARPOINTER BPBarray;
     UCHAR      drive;
     } BuildBPB;
   struct {
     UCHAR      count;
     ULONG      reserved;
     } Partitionable;
   struct {
     ULONG      units;
     ULONG      reserved;
     } GetFixedMap;
   } s;
 } REQPACKET;
```

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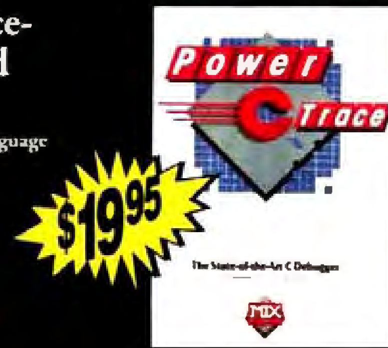

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are usually assigned sequentially, starting with 3 (0, 1, and 2 are claimed by OS/2). However, the handle value should never be assumed. The ASCII-Z device name is located in the device driver header.

The OS/2 Request Packet

An OS/2 device driver consists of a Strategy section and optional Interrupt and Timer sections. The Strategy section receives requests from the kernel in the form of a request packet (see listing 1). The Strategy section verifies the request and, if possible, completes the request and sends the result back to the kernel. If the request cannot be completed immediately, the driver optionally queues up the request to be completed at a later time and starts the I/O operation if necessary. The kernel calls the Strategy section directly by finding its offset address in the device header (see listing 2).

The first entry in the request packet is the request-packet length, filled in by the kernel. The second parameter is the unit code. When a driver supports multiple logical units, the value stored here selects among them. The third field is the command code. The command code is filled in by the kernel. This is the code used by the `switch` statement in the Strategy section to decode the type of request from the kernel. The next field is the status word returned to the kernel. This field will contain the result of the driver operation along with the Done bit to notify the kernel the request is complete (this is not always the case; the driver may return without the Done bit set). To make things easier, I use a union to access specific types of requests and place the request-packet structures in an include file.

Building the Device Header

A simple OS/2 device driver consists of one code segment and one data segment, although more memory can be allocated if necessary (by means of `DevHlp` routines). The first data that appears in the data segment must be the device-driver header.

The device-driver header (see listing 2) is a fixed-length, link-list structure that contains information for use by the kernel during INIT and normal operation. The first entry in the header is a link pointer to the next device the driver supports. If no other devices are supported, the pointer is set to −1L. This terminates the list of devices supported by this driver. If the driver supports multiple devices, such as a four-port serial board or multiple-disk controller,

Listing 2: *The driver header tells OS/2 that a driver exists, names the driver, and points to the driver's code segment.*

```
DEVICEHDR devhdr = {
 (void far *) 0xFFFFFFFF,
 (DAW_CHR | DAW_OPN | DAW_LEVEL),
 (OFF) STRAT,
 (OFF) 0,
 "DEVICE1"
 };
```

Listing 3: *The device attribute word, embedded in the driver header, defines special device characteristics.*

```
#define DAW_CHR      0x8000
#define DAW_IDC      0x4000
#define DAW_IBM      0x2000
#define DAW_SHR      0x1000
#define DAW_OPN      0x0800
#define DAW_LEVEL    0x0080
#define DAW_GIO      0x0040
#define DAW_CLK      0x0008
#define DAW_NUL      0x0004
#define DAW_SCR      0x0002
#define DAW_KBD      0x0001
```

the link is a far pointer to the next device header.

The next entry in the device header is the attribute word (see listing 3), followed by a one-word offset to the driver Strategy section. Only the offset is necessary, because the driver is written in the small model with a 64-kilobyte code segment and a 64-KB data segment (this is not always true; in special cases, the driver can allocate more code and data space if needed).

The succeeding entry is an offset address to an interdriver communications routine if the driver supports IDC. (The DAW_IDC bit in the device attribute word must also be set; otherwise, the `AttachDD` call from the other driver will fail.)

The last field is the device name, which must be eight characters in length. Names with fewer than eight characters must be padded with blanks. Remember, any mistake in coding the device-driver header will cause an immediate crash and burn when booting.

Providing a Register Interface to the C Driver

OS/2 device drivers are normally written in C, using the small model, which means 64 KB of data and 64 KB of code (code and data space may be increased in special cases). The driver .SYS file must load the data segment before the code segment. When you write an OS/2 driver in C, you must provide a mechanism for putting the code and data segments in the proper order, and you must also provide a low-level interface to handle device and timer interrupts. Because the device header must be the first item that appears in the data segment, you have to prevent the C compiler from inserting the C start-up code before the device header. You may also have to provide a method of detecting which device is being requested for drivers that support multiple devices. The small assembly language program in listing 4 takes care of these requirements. The `_acrtused` entry

point prevents the C start-up code from being inserted before the driver data segment. The segment-ordering directives ensure that the data segment precedes the code segment.

Note the _STRAT entry point. How does this get called? Remember, this is the address that is placed in the driver's data-segment device header. The kernel, when making a request to the driver, looks up this address in the device header and makes a far call to it. The assembly language routine then calls the C mainline. Thus, the linkage from the kernel to the driver is established.

Why is there a `push 0` at the beginning of the _STRAT routine? That's the device number. Each device supported by the device driver requires a separate device header, and each device header contains an offset address to its own Strategy section. Using the assembly language interface, the routine pushes the device number on the stack and passes it to the driver Strategy section for service.

The Strategy Section

The Strategy section is nothing more than a big `switch` statement (see listing 5). Common driver requests, such as `DosWrite` and `DosRead`, have standard function and return codes. The driver may ignore any or all of these requests by returning a Done status to the kernel. This tells the kernel that the request has been completed. The status returned to the kernel can also include error information that the kernel returns to the calling program.

Note that in the case of a standard driver function, the kernel will map the error value returned from the driver to one of the standard return codes. It is therefore impossible to pass any special return codes to the application via a standard driver request. If you attempt to do so, the kernel will intercept the special return code and map it to one of the standard return codes. The only way to return a special code to the application is by means of an `IOCtl` request. `IOCtls` are used for special driver-defined operations (e.g., port I/O). `IOCtls` are accessed when the application issues a `DosDevIOCtl` call with the driver's handle. This flexibility allows the driver writer to customize the device driver to fit any device. For instance, if you had a serial driver that monitored bus traffic and reported the occurrence of one or more special characters, you could use an `IOCtl` read and pass back the character in the return code.

Listing 5 shows the skeleton of a Strategy section. Note the switch on the request-packet command. Several standard driver functions have command codes predefined in OS/2. The driver writer can act on or ignore any of the requests to the driver. Although it would not make sense, the driver could ignore the `Open` command, issued by the kernel in response to a `DosOpen` call. Or, more logically, the driver can refuse to be deinstalled by rejecting a Deinstall request.

The INIT call is made only once, during system loading in response to a DEVICE= in CONFIG.SYS. The call is made in the INIT mode from ring 3, but with I/O privileges. The INIT routine is where you would insert the code to initialize your device, such as configuring a UART or sending a disk to track 0.

The very first thing you *must* do in the initialization code is to save the `DevHlp` entry-point address in the driver's data segment. This is the only time the

continued on page 348

JIM REEKES AND
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MACINTOSH SOUND REVEALED

New capabilities make the Mac—always a top performer in sound—even better

When it was first introduced in 1984, the Mac broke all manner of conventions. Its GUI, composed of windows, menus, and icons, was the Mac's most obvious departure from conventional PCs. Not so obvious—unless you happened to activate the wrong on-screen button and trigger a beep sound—was that the Mac was vocal: Built-in circuitry gave it remarkable sound-reproduction abilities.

With the introduction of the Mac IIsi and Mac LC, the Mac no longer serves as simply a playback device: You can record sounds from either an input jack or a microphone. While the Mac's original sound capability made it useful for some limited multimedia work, this recording feature opens up all sorts of new applications. With a Mac IIsi or LC or other suitably equipped Mac, you can record voice mail, add emphasis to a presentation, or annotate documents.

Several features give the Mac an edge over other systems when it comes to making sound. First, its sound resolution uses 8 bits of data, rather than the 1-bit sound of, say, a PC compatible. Second, the Mac's sound hardware is built in—there's no need to install an expansion board. Third, you can count on the sound capability being there when you need it: Sound playback is an integral part of the computer. Finally, the Mac has a Sound Manager, a set of related calls dedicated to sound manipulation, similar to the army of QuickDraw calls that handle graphics. The Sound Manager lets you generate sound or music through a standard programming interface. Therefore, by using the Sound Manager, any Mac application yields consistent acoustic results, whether it runs on a Mac IIsi (which uses a custom sound chip) or the Mac Plus's five-year-old design (which uses a programmable array logic chip).

This article takes a closer look at the Mac's sound capabilities and the Sound Manager that controls it all. First, however, you need a firm understanding of sound itself and how a computer uses it.

Catching the Wave: Digital Sound

Sound is the transmission of mechanical energy by pressure waves through a medium such as air or water. A simple sound wave (*waveform*) can be visualized as a sine wave. The pressure density of the medium at a given moment is the wave's *magnitude*. The wave's *amplitude* is the largest magnitude in a periodic wave. Periodic waves are made by objects, such as a tuning fork or a bell, whose vibrations repeat at specific intervals. So, a waveform's *period* is the length of time for one complete repetition of the wave, and the waveform's frequency is the rate at which it repeats or cycles. Frequency is measured in cycles per second, or hertz.

Equipment such as a microphone can convert pressure waves into analog voltages that correspond to the pressure intensity of the waves (i.e., a low pressure generates a low voltage, while a high pressure results in a high voltage). These voltages can be sent over a wire and converted back into mechanical energy by a speaker. The speaker cone travels in proportion to the amount of voltage it receives, so a high voltage causes a large movement in the speaker cone, creating a high-pressure wave, while a low voltage causes little speaker cone movement and so produces a low-pressure wave. This is roughly how early telephones operated (nowadays, portions of them operate digitally).

However, computers deal not with analog voltages but with bits. Many types of A/D converter (ADC) circuits can convert (or digitize) a microphone's voltages into bits. A 1-bit sound system is only capable of two magnitudes: on or off. The more bits you use to record a sound, the more magnitudes you can represent. As mentioned earlier, the Mac's sound circuitry can handle 8 bits of information, so it can reproduce 256 magnitudes or levels, creating a decent copy of the waveform. These digital values are sent to a D/A converter (DAC) circuit, which converts them to voltages that drive the Mac's speaker, reproducing the wave.

So far, so good. But because sound is a phenomenon based on time as well as magnitude, things get a bit more complicated. To reproduce a sound accurately, you have to sample (digitize) it at twice the source's highest frequency. This frequency is termed the *Nyquist frequency*, from a theory by Shannon and Nyquist that states that this number of samples is required to completely represent a waveform. Put another way, you have to sample a 10-kHz sound at 20 kHz to accurately copy the signal. The rate at which sound samples are captured or played in an interval is known as the *sample rate*.

You also have to play back the data at the same rate to reproduce the frequency of the original waveform. For example, if you play a tone at half the rate at which it was sampled, you halve the frequency—an undesirable action if you want an exact reproduction of the tone. Thus, the maximum sound frequency that a computer can handle becomes a factor of how fast it jams bits into the DAC circuits. Even the PC can exploit sound's time-based nature to generate a wide variety of tones: It accomplishes this by turning its speaker on and off at different rates. The Mac Plus, SE, and Classic's sound circuitry can pump out samples at a maximum rate of 22.2545 kHz.

To put the Mac's sound ability in perspective, here's how it stacks up against familiar acoustic devices. A quality analog home stereo system can reproduce frequencies of up to 16 kHz, the upper limit of an average person's hearing range. Digitally reproducing the stereo's frequency range requires a 32-kHz sampling rate. A digital CD player uses 16-bit samples with a 44.1-kHz sample rate. This provides 65,535 sound levels and

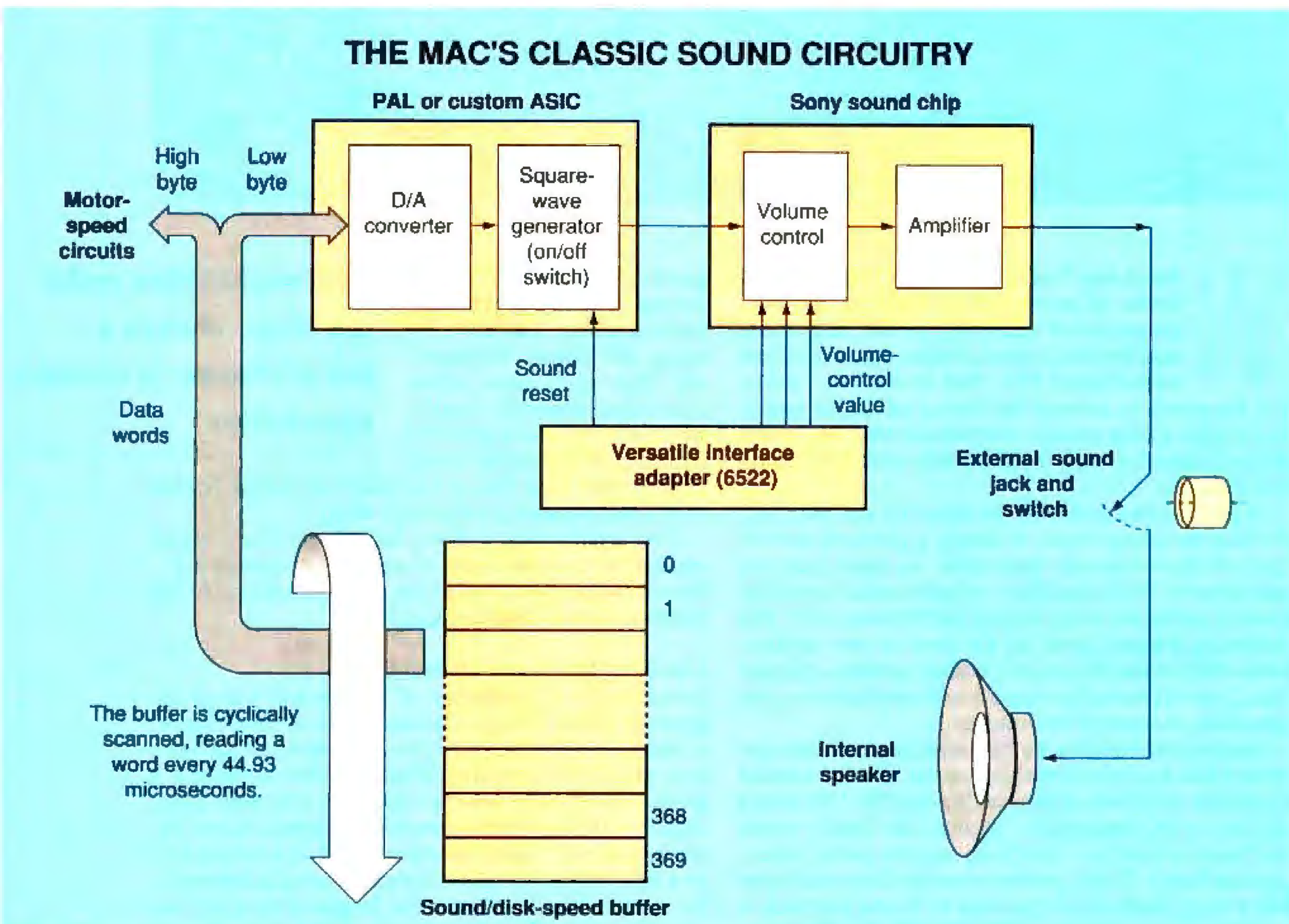
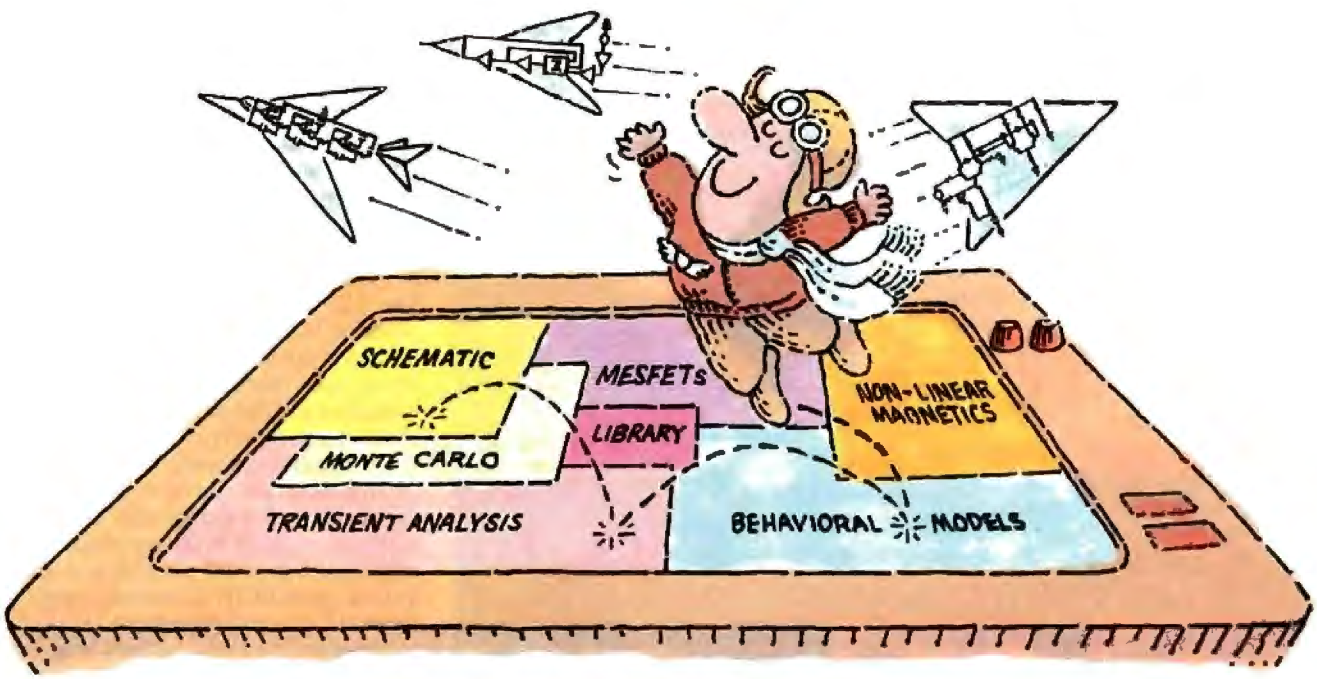


Figure 1: *This block diagram shows the "classic" sound design in the Mac Plus, SE, and Classic. The sound buffer data is interleaved with the Sony disk speed buffer. The Sound cdev sets the digital volume value.*



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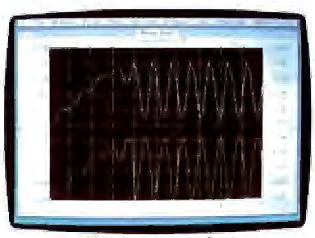
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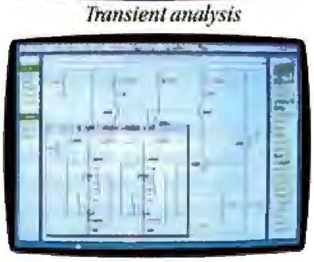
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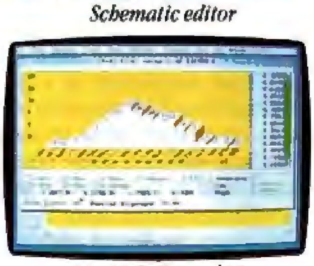
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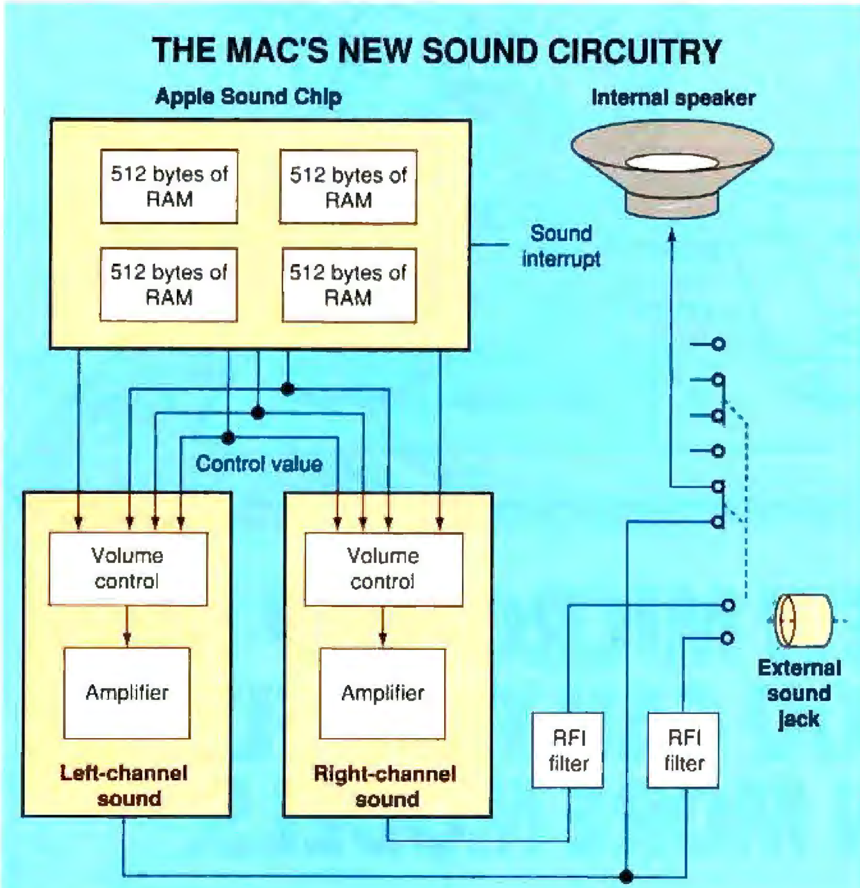

Figure 2: *The introduction of the Mac II brought a new sound circuitry using the Apple Sound Chip, which supports stereo sound. Since the ASC implements much of the classic design's software in silicon, it provides complex sound generation using little CPU overhead.*

can accurately play back frequencies of up to 22 kHz. Remember that the Mac uses 8-bit samples and a 22.3-kHz sample rate to produce signals with 256 levels and a maximum frequency of 11 kHz.

A modern phone system uses digital sampling and multiplexing techniques to pack numerous conversations onto a single wire. It digitizes these signals using 8-bit samples at an 8-kHz sample rate. So while the Mac's sound system poses no threat to CD manufacturers, its acoustic qualities are far better than what you get with a telephone.

A Blast from the Past: Classic Sound

A review of the original Mac 128K's 1984 hardware design is in order here, since the Mac Plus, SE, and Classic still use it. For simplicity's sake, I'll refer to this design as "classic." Figure 1 shows a general block diagram of the classic sound circuitry. The sound buffer resides in main memory and holds the digital sound samples. This buffer is 370 words long, but because the sound buffer is interleaved with the Sony disk buffer, only the high byte (even address) of every word contains sound data. The buffer's low bytes store values that control the motor speed for a single-sided floppy disk drive.

The sound circuitry scans this buffer at a fixed rate, reading out the data. The circuitry converts these digital values into square waves, where each wave's width is proportional to the value read. This train of square waves is a pulse-width-modulated signal. A Sony sound chip converts the PWM signal into a voltage whose magnitude at a given instant is determined by the pulse width. A 3-bit volume-control value in the versatile interface adapter chip adjusts the final amplitude of the output signal. You set this volume-control value through the eight detents on the Sound cdev's volume control. The sound is also routed to an external jack that provides a high-level (8 volts, peak-to-peak) signal.

Why is the sound buffer 370 bytes in size? Because the sound and video circuitry are tightly interrelated in the classic design. The Mac's screen-refresh rate (i.e., the time it takes to completely paint the screen with an image) is 60.15 Hz. The 512- by 342-pixel screen is composed of 342 horizontal scan lines. After the video circuits paint a scan line from left to right, the monitor's electron beam is blanked and slewed back to the left side of the screen to start a new scan line.

During this *horizontal blanking interval*, the sound circuits fetch a byte. When the beam reaches the screen's bottom, it is slewed invisibly to the top, making 28 additional horizontal retraces as it goes. This is a total of 370 horizontal blanking intervals per screen refresh, thus accounting for the sound buffer's size.

The jump to the top of the screen is called the *vertical blanking interval*. During the VBL, the sound software copies the application's data into the sound buffer. This synchronizes the sound-buffer updates to the hardware's buffer scans. In addition, it explains the classic design's maximum 22-kHz sample rate: Since the screen-refresh rate is 60.15 Hz, the effective sound sample rate becomes 370 × 60.15, or 22,255 bytes per second.

A Sound Driver, as described in *Inside Macintosh, Volume 2*, was used to operate the classic hardware. It supported three sound-generation modes: square-wave, four-tone, and free-form.

The square-wave mode produced square waves to make simple sounds, like beeps. The four-tone mode created four different sounds simultaneously, each with a different waveform, phase, and frequency. Waveforms were 256 bytes in length and stored in the sound buffer. Digital waveform values were stored as offset binary, where a wave's zero-crossing is represented by the value 128, the largest negative amplitude has a value of zero, and the largest positive amplitude has a value of 255. The free-form mode simply played what was in the sound buffer. The Sound Driver allowed you to alter the rate at which the sound buffer's waveforms were "sampled" and so change the frequency of the sound. The latter technique is similar to the PC's trick of creating different tones by switching the speaker at different rates.

But as its name implies, the Sound Driver was a device driver. This provided a sort of consistency in that its use was similar to writing I/O to a disk or a serial port. Unfortunately, this meant that to play sounds, you had to be adept at handling device drivers. The Sound

MACINTOSH SOUND CAPABILITIES

Macintosh	Sound hardware	Remarks
Mac Plus, Mac SE, Classic	PWM	No stereo support
Mac II, IIx, IIfx; Mac IIcx, IIci; Mac Portable	ASC	Stereo on external jack; left channel only on internal speaker
Mac SE/30, Mac IIsi	ASC	Stereo on external jack and internal speaker; IIsi has sound input
Mac LC	Custom ASIC	Stereo not supported; has sound input

Figure 3: *A summary of the Macintosh family's sound output capabilities. The Sound Manager provides consistent acoustic results on each computer, and it supports sound input on the Mac IIsi and LC.*

Driver supported some high-level calls, but these relied on low memory globals. These calls began to fail when MultiFinder started maintaining separate copies of the low globals during task switching. Finally, the Sound Driver could make huge demands on the CPU: While the square-wave mode took only 2 percent of the processor's time, the free-form mode could use 20 percent, and the four-tone mode required 50 percent.

The New Wave

With the introduction of the Mac II in 1987, Apple eliminated most of the limitations to the classic design. The solution was twofold. First, a custom Apple Sound Chip (ASC) replaced most of the classic software. This off-loaded sound generation from the CPU onto dedicated silicon while providing new capabilities such as stereo sound. A new Sound Manager took over the Sound Driver's job and provided an easy-to-use interface.

Figure 2 shows a diagram of the new sound circuitry. The ASC generates and sends two PWM signals (one for each stereo channel) to separate Sony sound chips. For all Macs using the ASC except the SE/30 and the IIsi, only the left channel's output is sent to the internal speaker; for the SE/30 and IIsi, both channels are combined at the speaker. The sound jack for all ASC-equipped Macs supports both stereo channels, and the output is 1.5 V peak-to-peak, or standard line level.

The ASC normally supports an output sample rate of 22 kHz; it can even manage a 44-kHz sample rate, but not without disturbing other time-critical interrupts. It contains 2 kilobytes of internal data buffers that replace the classic design's sound buffer; thus, it uncouples sound-buffer updates from the VBL. These buffers can be configured as either two 1-KB buffers or four 512-byte buffers that support monaural or stereo sound. The ASC reads a value in these buffers every 44.93 microseconds—the same sample rate as the classic horizontal blanking interval.

Many of the sound functions that exist as ROM code in the classic software are implemented in the ASC's hardware. The ASC supports the same three Sound Driver modes: square-wave, four-tone (now called *wave-table*), and free-form (now called *sampled-sound*). Square-wave and wave-table waveforms can be stored in the ASC's buffers, and you can program the ASC to loop through the data cyclically to produce a signal. The ASC can adjust the frequency of a stored waveform by sampling the stored waveform at different rates. Since the ASC

handles these operations itself, this eliminates the processor overhead that the classic design requires.

In the sampled-sound mode, the ASC buffers act as a first-in/first-out buffer. At 22 kHz, the 1-KB buffer will empty in 46 milliseconds. When the ASC samples half of the buffer, it triggers an interrupt that signals the Sound Manager to send more data to the FIFO buffer. As long as the Sound Manager begins to fill the buffer before it empties (another 32 ms), there won't be a gap in the sound.

The original version of Sound Manager was shipped in System 5.0 to support the new ASC hardware in the Mac II–class computers. Unfortunately, the Sound Manager was not included as part of the operating system for non-ASC machines such as the Mac Plus or Mac SE. This made it difficult to develop sound software that operated across the entire product line. When System 6.0 was developed, the Sound Manager was ported to all machines and so closed the gaps in the programming interface.

Although the version 6.0 Sound Manager solved some problems, other features weren't complete—wave-table support for non-ASC Macs was lacking, and stereo capability was not included for ASC Macs. As part of System 7.0, an enhanced Sound Manager fixes bugs in the previous release and adds new features; it was actually introduced in System 6.0.7 to support the Mac IIsi and LC's built-in sound-input hardware (see figure 3).

New and Improved

The Sound Manager is now responsible for all generated sounds. Even SysBeep, formerly an operating-system utility call, has been incorporated into it. The Sound Manager is designed to be hardware-independent. It achieves this by using special code resources called *synthesizers*. Synthesizers are stored in the System file as resource type snth, and they function like device drivers in that they process Sound Manager requests and drive the hardware appropriately.

Each of the three supported sound modes has its own synthesizer. The Sound Manager actually has six synthesizers: three for ASC-equipped Macs (one for each sound mode), and three for classic-design Macs. The Sound Manager uses the synthesizer appropriate for the Mac type and the sound mode.

I've already described the three operating modes that the synthesizers support. To summarize, the square-wave synthesizer operates essentially as before. The wave-table synthesizer uses stored waveforms, but waveforms are

now 512 bytes in length to fit within the ASC's internal buffers. The sampled-sound synthesizer plays both recorded sounds and computed sounds; it plays them at the original rate or at a different frequency on request.

Recorded sounds are played from memory or a file; they are either sound resources of type snd or an Audio Interchange File Format file. Sound resources are stored in a file's resource fork; they contain a header of descriptive information and either Sound Manager commands (see below) or sampled-sound data stored as offset binary. As a resource, sounds can be cut and pasted to other applications or documents. An AIFF file stores sound data in a file's data fork in a format other applications can use or for export to other computers.

To create sounds, you issue sound commands to the Sound Manager. These commands let you load wave tables, play a waveform and change its pitch, play a sampled sound and change its pitch, change a playing sound's amplitude, or stop playing a sound. To give you an idea of the scope of these commands, the Mac's default beep sound is an snd resource that issues a series of commands that set the frequency and amplitude of a square wave, play it for an interval, and then play this interval repeatedly while lowering the wave's amplitude to zero.

The Sound Manager normally places commands into a queue called a *channel*. Certain commands can bypass the channel—say to play something immediately or to flush the channel of pending commands. Under System 7.0, the Sound Manager can operate more than one sampled-sound channel concurrently: Different applications place commands in their respective channels, and the Sound Manager mixes the sounds. Note that this capability applies only to the sampled-sound synthesizer. The square-wave and wave-table synthesizers run the ASC in a different mode that can't be used while the sampled-sound synthesizer operates. Only ASC-equipped Macs can support multiple sound channels.

The limits of the multichannel sampled-sound feature are a function of the Mac's processing power. A Mac II can handle several channels of stereo sound without degrading system performance, while a Mac Portable can only support one channel before performance lags. The System 7.0 Sound Manager performs load-balancing for sound operations; that is, it determines whether there is adequate processor time available to honor CPU-intensive requests. If there is insufficient processor time, the Sound

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Manager tries a less-demanding form of the operation; for example, a command to open a channel of stereophonic sound might instead create a channel of monaural sound. This way, the Sound Manager can produce the best-quality sound on any hardware configuration.

If you've ever digitized sounds, you know that the higher the sample rate, the more data is sampled, and the larger the file required to hold the data. One minute of data sampled at 22 kHz occupies more than 1.3 megabytes of disk space. The Sound Manager has a set of routines that compress and expand audio data to help minimize the storage problem.

Known collectively as Macintosh Audio Compression and Expansion, these routines compress sound data at ratios of 3 to 1 and 6 to 1 on all Macs. The MACE routines can expand the compressed audio on the fly (real-time expansion) or into a separate buffer (buffered expansion) for playback later. Real-time expansion makes heavier demands on the CPU than buffered expansion does. The compression/expansion algorithms introduce some signal degradation, so the 3-to-1 compression ratio is recommended for high-quality sounds, and the 6-to-1 ratio for voice data only.

Play and Record

The enhanced Sound Manager lets you play one or more sampled sound files continuously from a hard disk while other applications run. Only Macs equipped with ASCs support this routine. The file can be either snd resources or AIFF. This play-from-file routine double-buffers the data to reduce RAM usage. The capability could support, for instance, background music for a presentation.

On the Mac IIsi and LC, the Sound Manager lets you record sounds through an audio input jack at the computer's rear. You plug in a microphone or a sound source (e.g., a CD player). Any application can then call the Sound Manager to display a sound-recording dialog box. From this box, you can stop, pause, or play back the recording. Recordings are sampled at 11 or 22 kHz with 8-bit resolution. If a stereo signal is input, the two channels are mixed before they're digitized. The sound can be stored as an snd resource or as an AIFF file.

The Mac IIsi's sound input consists of the input jack and the preamplifier, an ADC, a switched capacitor for filtering, a serial-to-parallel converter, a dedicated 1-KB FIFO buffer, and control logic that the Sound Manager uses to operate the circuitry. As the FIFO buffer reaches the halfway mark with captured audio

data, an interrupt occurs, and the Sound Manager copies the data from the buffer. Because this buffer is separate from the ASC's buffers, the Mac IIsi supports simultaneous sound recording and playback.

The analog portion of the Mac LC's sound-recording circuitry is similar to the IIsi's. However, the LC uses a custom application-specific IC that mimics most of the ASC's functions to handle digital sound. The LC has only one 1-KB FIFO buffer, located in the main RAM. This setup creates two limitations: The LC doesn't support stereo output, and it can't handle simultaneous sound input and output.

Sound Advice

As you can see, even the original Mac had better sound capabilities than other personal computers. The addition of the ASC expands the Mac's acoustic ability still further while freeing the CPU to handle other tasks. The enhanced Sound Manager provides a consistent across-the-line programming interface while providing generous sound manipulation tools, such as playing sounds from disk. Its load-balancing feature allows reasonable acoustic reproduction on all Macs.

Since the Sound Manager is part of the Mac OS, you can share sound data with other applications or cut and paste voice messages between documents. Because the Sound Manager is hardware-independent, it lets existing Mac applications take advantage of better sound-reproduction equipment as it appears. For example, synthesizers can be written that address third-party digital-signal-processing NuBus boards or operate future Macs with CD-quality sound circuitry.

In addition, the sound-input capability of the Mac IIsi and LC will be an integral part of all new Macs. This ensures that Mac software can rely on sound input if necessary, and it demonstrates Apple's commitment to sound for its computers. The Sound Manager thus provides today's sound capabilities while paving the way for tomorrow's applications. ■

Jim Reekes is a software engineer for Apple Computer. He became interested in electronic music while majoring in music composition at California State University–Fullerton, working with a voltage-controlled synthesizer and tape recorders. He is responsible for updating the Mac's Sound Manager software. You can contact him on BIX c/o "editors." Tom Thompson is a BYTE senior editor at large. He can be contacted on BIX as "tom_thompson."

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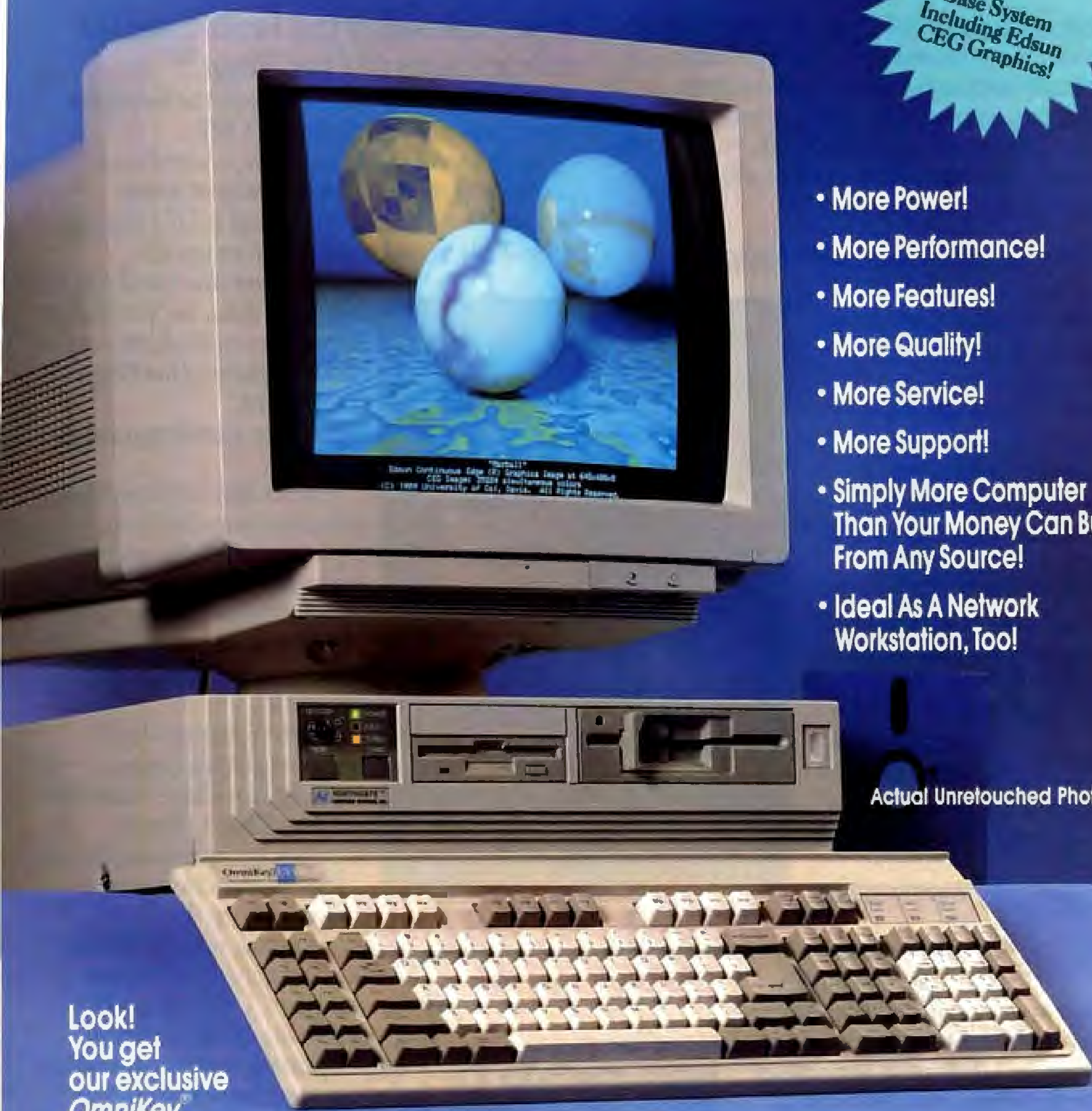

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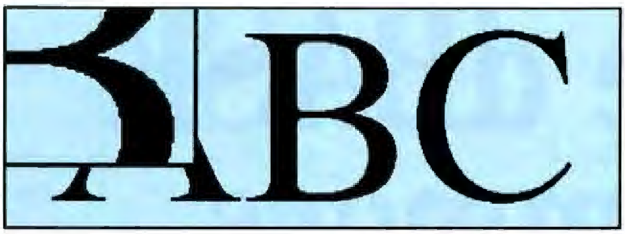

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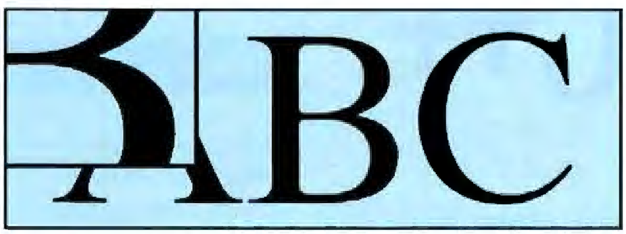

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BARRY NANCE

A DISK-BASED PRINT SPOOLER

Three free programs for print spooling, system switching, and archiving

If you have Windows or OS/2, you already have a print spooler. If your PC is on a network, you almost certainly have a print spooler. And you have a print spooler if you've installed a memory-expansion card in your PC. Your word processor may even have a background print option that turns it into a print spooler. So who cares about yet another print spooler? Doesn't everyone have Windows?

No. There are millions of PCs running applications that print long listings and reports without help from either Windows or a network. Often, these applications take absolute control of the computer until the printer finishes. And, ironically, the spool utilities that come with memory cards often take up too much memory. The free software offered this month is intended to solve just such problems.

"Spooler" is a disk-based print spooler. Its print buffer is a disk file on your hard disk drive; you specify the size of the buffer when you start Spooler. It can even print to a disk file—useful for those times when you need to see the output but don't want to waste printer paper. Spooler is a small TSR program that takes up about 6 kilobytes of RAM, and you need DOS 2.0 or higher and a hard disk drive. It comes with a separate SpoolCtl utility for changing parameters on the fly.

Using Spooler

When you run Spooler, the program creates a file SPOOL.FIL in the current directory. If you indicate that output should go to a file rather than to the printer, the output file is also written in the current directory. When you tell Spooler to remove itself from memory, it automatically deletes SPOOL.FIL.

You specify Spooler's options on the command line. The parameters are as follows: buffer size (in kilobytes); print priority (a number from 1 to 10, with 1 giving the most attention to the foreground application and 10 the most to the printer); a *Y* or *N* to indicate whether Spooler should insert formfeeds between printouts; and, optionally, the name of an output file if you want to "print to a disk file."

For example, you might invoke Spooler with `spooler 500 2 n` to create a 500-KB buffer/spool file, set a background priority of 2 (out of a range of 1 to 10), and say "don't insert formfeeds between printouts." Another example: `spooler 50 5 y printer.fil` would create a 50-KB disk buffer, use a priority of 5, insert formfeeds between printouts (if the last character of a printout isn't already a formfeed), and then write all the material out to PRINTER.FIL instead of to the printer.

Run the SPOOLCTL.EXE utility to change the print priority or the formfeed switch, or to cancel the printout. You can also use SpoolCtl to remove Spooler from memory or to just bypass Spooler.

Programming Techniques

I used Microsoft Macro Assembler 5.1 to write SPOOLER.ASM, and Turbo C 2.0 to write SPOOLCTL.C. You'll need the BIOS.INC and DOS.INC files supplied with MASM to assemble Spooler. If you want to understand more about how it works, you'll find the book *Undocumented DOS* (Addison-Wesley, 1990) an invaluable reference.

Spooler may not be the "prettiest" utility in the world, but you may find it useful for those times you impatiently wait for the printer to release its grip on your PC so you can get back to work. ■

MAC/Tom Thompson

System Picker Gives You a Choice

With the release of Apple's System 7.0, MacFolk find themselves caught in that shadowy twilight zone where they occasionally have to retreat to System 6.0.x because of a few ornery—but essential—Mac applications.

If you have a spare hard disk drive, the solution is to load System 6.0.x on one drive and System 7.0 on the other. The Jekyll-and-Hyde Mac OS switch becomes just a matter of changing the startup disk and rebooting. For those who have only a single hard disk drive, the System Picker 1.0b5 utility saves the situation.

With both operating systems on a hard disk drive, System Picker first locates and then lets you set which System Folder—and thus which OS—boots the Mac. You can select how many folders deep it searches while looking for a System Folder. System Picker is free and was written by Kevin Aitken at Apple.

UNIX/ Ben Smith

Making shar.Z Files

The question: How to toss a collection of files around as a single file so that it can be broken back out into its individual components. The Unix answer is `shar`, the shell archiver. Unlike the many file archiver programs that require the archiver for unarchiving (i.e., breaking the bundle into its parts), a `shar` file is actually a Bourne shell script, so running the script performs the breakout.

There are shell scripts that make `shar` files, but the best programs are C programs. Michael Kersenbrock's version is very extensive. Work done by D. Wecker includes a switch for `unsharring` on systems that don't have the Bourne shell.

Combine `shar` with `compress`, the compression program that uses the Lempel-Ziv algorithm, and you have the programs that produce the format used for distributing most of the freely available Unix software.

Editor's note: *You can obtain source code (and executables, when available) of Software Corner programs via Demolink and BIX. They are also available in a variety of disk formats. See page 5 for details. We solicit your contributions for this column. If you've written a program or utility that you think others might find useful, let us know. We'll pay $50 for any program we use. Write to: Software Corner, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*

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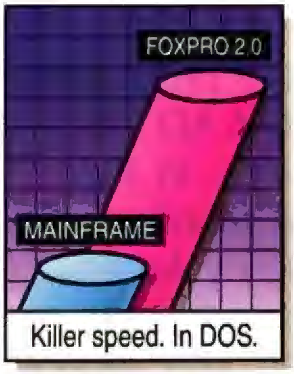

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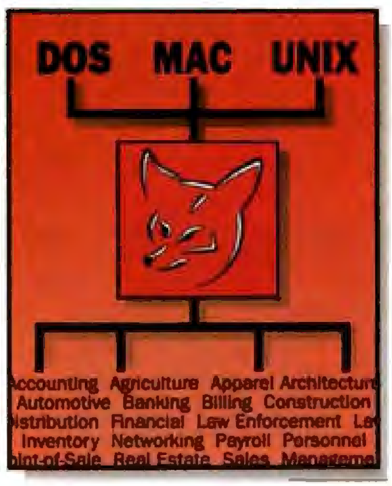

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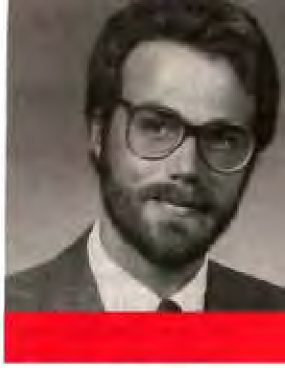

MARK J. MINASI

LASERJETS, FONTS, AND WINDOWS

I am tired of the PostScript crowd having all the fun. I mean, I've got industry-standard Hewlett-Packard LaserJets—the original, a Plus, a II, and a III—but now that I'm using Windows, I'm font-hungry. I want that puckish capital *Y* that Palatino users have. So I look to PostScript, or something like it. Yes, PostScript printers are a lot cheaper these days, but I've got a bunch of LaserJets. What, I wondered, can I do? I've tried waiting for them to die, but HP equipment has this annoying habit of immortality. So I needed more fonts. As it turned out, it's a long road—longer than I expected.

Now, under Windows, you can't just buy a font for your printer—you also need one for the screen. Otherwise, once you've selected Avant Garde for your text, Windows can't show you that text in Avant Garde, as it needs a screen font to match the printer font. If Windows does not have Avant Garde, it looks at the fonts that it does have and picks the closest-looking typeface, which may end up looking ridiculous.

Did you ever wonder why the Notepad insists on printing text in Courier? It's because the application is written to use the system screen font. When Windows tries to print, it matches the printer fonts to the already-selected screen font. Courier is the closest match it can find.

In the case of Notepad, the programmer's font choice (for the screen) drives the system's decision to use a particular font on the printer. Most applications work the other way around: The developer lets the user choose a desired printer font, and Windows picks the closest available screen font. If you haven't got an Avant Garde screen font, it's still possible to create documents on the printer using Avant Garde. However, most of the value of Windows is gone, because what you see on the screen is markedly different from what you get on the printer.

So, if you're planning to get more fonts by buying one of those "25,000 fonts in one" cartridges, ask the vendor: Does the cartridge come with a driver to tell the Windows LaserJet printer driver about all the fonts the cartridge contains? Does it also come with screen fonts to match the printer fonts?

One that does is Pacific Data Products' latest zillion-in-one cartridge, PacificPage PE. Designed for the LaserJet III, it has 14 font families, ships with Windows drivers, and has a retail price of $399. (A font family is something like Times Roman. One font family generally consists of four typefaces: normal, bold, italic, and bold italic. Dingbats and other symbol fonts generally have only one font in the family.)

Teach your old (or new) LaserJet to do PostScript tricks

You Say Raster, I Say Vector

Windows knows about two kinds of fonts: *stroke* (also called *vector*) and *bit map*. Stroke fonts are simplistic fonts composed solely of line segments. They have no filled-in areas, and the font designer must represent curves as collections of many tiny line segments. The Modern, Script, and Roman (not Times Roman) typefaces are the examples that come with Windows. Stroke fonts don't look great, but they do have one virtue: Because they're composed of line segments, they're infinitely rescalable.

In other words, the bad news is that they look lousy; the good news is that they can easily be made to look lousy in any size you like. Another plus is that the set of line segments that describe a typeface is fairly small, so an entire typeface can be stored in little disk space. No one sells add-on stroke fonts for Windows.

Bit-map fonts look really good, but they must be produced by a font-generation program. The most common example of a bit-map font generator is Bitstream Fontware—the Dutch and Swiss typefaces you get with Word, WordPerfect, or almost any word processor these days. The idea is that you buy a file that describes a typeface like Palatino, Helvetica, Courier, or whatever. Then you run it through a *font engine*—a program that reads this file and generates the font in a specific size, producing a bit map that represents the typeface in only that size.

Font generation requires a ton of calculations to size and resize characters, so it takes time and benefits tremendously from a math coprocessor. Fortunately, it need be done only once for each size font. And the result is good-looking type.

Bit-map fonts have two disadvantages. First, they take up a lot of space on your disk. I use 10-, 12-, 14-, 18-, and 24-point fonts, leading to a font file that's over half a megabyte in size—and that's

ILLUSTRATION: TIM CLARK © 1991

in only one typeface! Second, you have only the sizes that you pregenerated. If you have 10 and 12 points pregenerated, and you find that you'd like to use some 11-point text under Word for Windows, you have to drop everything and run the font-generation program, which creates the 11-point font, taking up more space on the disk.

Bitstream and competitors have programs that supplement their font engines so they will produce screen and printer fonts simultaneously. (Bitstream's Wysifont is an example.) When buying soft fonts, be sure the vendor offers a Windows screen-font generator.

So it looks like the way to match PostScript's range of fonts is to buy a bunch of soft fonts and generate the sizes you desire. Unfortunately, this is impractical. Try to match the 35 PostScript typefaces and pregenerate bit maps in a few popular sizes, and you're talking about filling 30 MB of disk space.

A better answer, I thought, would be the approach that is used by PostScript itself: *outline fonts*. Outline fonts combine the best of stroke and bit-map fonts. They're compact to store, come in all sizes, and look great.

When buying soft fonts, be sure the vendor offers a Windows screen-font generator.

Outline fonts are like stroke fonts in that they are described in a manner that allows resizing, but the description is richer. Rather than being restricted to line segments, outline fonts are described with Bézier curves or quadratic B-splines and can contain filled-in areas. There is still a font engine, as in the bit-map fonts, but it's hooked into Windows. When a program needs, say, 14-point Bodoni, the engine springs into life and generates the bit map for 14-point Bodoni. But it's only a temporary bit map.

There's the potential weakness of outline fonts. If you use a particular size outline font (e.g., 12-point Times Roman) all the time, you waste a lot of CPU time because its bit map must be generated every time you use it, rather than just doing it once, as in the case of pure bit maps. In reality, however, most outline-font schemes are smart enough to cache bit maps, greatly reducing this possible problem.

So outline fonts are the answer, right? All I need to do is get a set of font description files, install an outline font engine, and I'm in business? Well, not quite. You see, Windows doesn't support outline fonts. (OS/2 does, but that's another story.) Windows 3.1 with TrueType will, when it arrives late this year or next year. But today's Windows does not support them.

There are a few add-on outline engines (e.g., Bitstream FaceLift, Adobe Type Manager, and Zenographic Supertext), but they fall far short of the mark. They tend to work acceptably inside a Windows application, but try to transfer rich text between applications and the fonts seem to disappear, converting everything to Times Roman or Helvetica.

If You Can't Beat Them...

Until TrueType appears, the answer seems to be: If you can't beat them, join them. Make the LaserJet speak PostScript. There are three approaches to that; two are hardware answers, and one is a software answer. The software solution is to install any one of several PostScript TSR program interpreters (e.g., Freedom of Press, GoScript, or PreScript). But PostScript TSRs tend to suffer from speed, memory hungriness, and a lack of Windows-awareness.

On the hardware end, you can buy either a PostScript cartridge for your printer or an add-in board for your PC. Most add-in boards are fairly expensive but fast. I use the QMS JetScript board in a LaserJet II. The JetScript used to cost almost $2000, but HP offered it to LaserJet II owners last year for only $500. It involves a board in the laser printer, one in the PC, a cable between them, and some software. Again, a fast solution, but not a simple one.

The last and probably the best approach is to get a PostScript cartridge. Pacific Data Products first cracked the code needed to figure out how to put PostScript compatibility into a regular LaserJet II cartridge with PacificPage. Since then, Adobe and HP have also come out with PostScript cartridges for the LaserJet II. The Adobe cartridge is quite good and can be found for $280.

For the LaserJet III, PacificPage PE will do PostScript. You can get turbocharged PostScript from your LaserJet III with PacificPage XL, a combination of the PE cartridge and an add-in accelerator board that fits in the LaserJet III memory slot. That combination is new and lists at $999. I haven't seen it yet, but the company claims that it speeds up printing by eight times.

So I got a PostScript cartridge. And you know what? It turns out that the PostScript crowd doesn't have all the fun.

Once you install the generic LaserWriter printer driver, you discover that WYSIWYG has WYSI-went. You can't see Century Schoolbook, Avant Garde, Park Avenue, or a bunch of other fonts. Then it dawned on me that the screen fonts had to come from somewhere. As a PostScript printer is a printer with a bunch of scalable fonts and a font engine, so too must be the Windows screen drivers! So you're back to buying Adobe Type Manager, or FaceLift, or the like. (By the way, if you buy Pacific Page, the company will send you a free ATM-like program that will make your screens match your cartridge-equipped printer.)

Don't misunderstand—you can get great PostScript printer output without those programs, but the screen won't resemble the printed output very much. Ah, well.

So there you have the many ways to skin the font cat in Windows. Simple, eh? Hmmm, how cheap *can* I find a Mac Classic, anyway? ■

Mark J. Minasi is a managing partner at Moulton, Minasi & Company, a Columbia, Maryland, firm specializing in technical seminars. He can be reached on BIX as "mjminasi."

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the fastest animal,
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"*Svinga* is a Zimbabwean word for a stack of firewood, which seemed a great name for a HyperCard-based Zimbabwean information resource," explain Svinga's authors, Paul Messiter-Tooze, Maulosi Nyakuwa, and Tony Mechin. Svinga is a CD-ROM that holds a HyperCard Home stack that branches to other resource stacks. These stacks provide text, graphics, spoken language, and music that explain the country of Zimbabwe in an entertaining and effective way.

Working away in their small company, Media Technology of Harare, Zimbabwe, Svinga's authors have done a great job with limited resources. All their development work was conducted in HyperCard 1.2.2 on a Mac Plus with a SyQuest Technology removable hard disk drive. This is nothing special in terms of hardware or software, but it does speak volumes about how useful the Mac can be for specialized development purposes. You don't need a Mac IIfx and a full set of MPW languages to get good work done.

Once the Svinga stacks were written and debugged, the authors produced a premaster WORM (write once, read many times) CD-ROM with the help of Meridian Data, 5615 Scotts Valley Dr., Scotts Valley, CA 95066, (408) 438-3100. The authors sent the final version of the stack on a SyQuest cartridge, along with the music tracks recorded as digital audio (16-bit, 44.1-kHz) on Betamax tape, to be mastered by CD-ROM, Inc., in Golden, Colorado.

Besides all the good things that the Svinga disk has to say about HyperCard development, it also points out that multimedia developers can bring their projects to fruition on CD-ROM with just a little bit of perseverance. After all, Harare is hardly next door to Scotts Valley or Golden.

Because HyperCard 1.2.2 was used, the card size is fixed at the standard 512-by 342-pixel size and cannot be changed. Although you can use HyperCard 2.0v2 to run the stacks (as I did), you will not get any of the features of 2.0 (e.g., resizable, scrollable windows; color PICT windows; or other visual aids that would enliven the stack), as shown in the screen shot.

Still, the developers have done a great job in using the full measure of the tools given them in HyperCard 1.2.2, and they've made sure that the CD-ROM can be run off any compatible player that is hooked to a basic Mac Plus.

The stacks include information on Zimbabwe's history, geography, infrastructure, agriculture/fisheries/forestry, mining and geology, economics, animals, national parks and tourism, and arts and culture. You even get a quickie time calculator that converts your local time to Zimbabwe time, as well as a special section that discusses the Southern African Development Coordination Conference. The SADCC is an economic grouping of nine countries: Zimbabwe, Zambia, Malawi, Botswana, Angola, Mozambique, Lesotho, Swaziland, and Tanzania.

This is just a quick example of the kind of stuff that Svinga includes. While it's not always ultrahigh-quality info (these guys didn't have Grolier's CD-ROM budget), it's always different enough that you'll keep navigating through the hypertext until you find the gem that you want. While Svinga is anything but a HyperCard tour de force, it shows off the practical aspects of this software on even the

ILLUSTRATION: TIM CLARK © 1991

The Svinga stack in operation.

most basic Macintosh.

Nice job, Media Technology.

Software of the Month: Earthquest 2.0

If you haven't gotten your fill of informational HyperCard stacks with Svinga and want to expand your scope a bit, give Earthquest 2.0 a try. The beauty of Earthquest is that it's both a personal learning tool and a tool that teachers can use in classes from grade 5 through sophomore year in college.

Rather than separate study into traditional disciplines, Earthquest combines natural history, ecology, geography, sociology, political history, economics, and other topical areas into a unified presentation. In fact, Earthquest does one of the best jobs I've yet seen at giving a worldwide viewpoint to topics that typically are much more parochial in their scope.

For teachers and schools interested in Earthquest, lab packs are available at a reduced price. Keep in mind, however, that these Earthquest stacks don't like to live on small, underpowered Macs: You'll be disappointed with anything less

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than a Mac SE/30 or a Mac II. A color display will let you display icons and internal MacroMind Director movies in their full glory. Like most of the rest of the Mac world, Earthquest makes it clear that the default Mac has become a hard disk drive-equipped 8-bit color Mac II with a paged memory management unit installed.

Tip of the Month: Inexpensive Desktop Publishing

"Macintosh software often costs too much." For the most part, I have to agree with this common complaint. One Chicago-area company, Timeworks, has a different idea about software pricing, though. It specializes in software for the average user. With its excellent desktop publishing (DTP) system, called Publish It Easy, Timeworks proves that inexpensive doesn't have to mean underpowered.

Unlike the high-priced DTP programs (PageMaker, FrameMaker, and QuarkXPress, to name just three), Publish It Easy for the Mac lists for just $249.95. Street prices bring it in well under $200.

Like the more expensive applications, Publish It Easy can combine text and graphics on a page to form a multiple-column, multiple-section document. In fact, I found laying out pages easier with Publish It Easy than with PageMaker, and I have been using PageMaker for years. The program can incorporate text from your favorite word processor (e.g., Word, WordPerfect, Works, MacWrite 5.0 and II, and WriteNow) and graphics from your favorite graphics program (Illustrator, MacPaint, SuperPaint, FreeHand, FullPaint, and many others) into your DTP document. It can also edit scanned images so that they look sharp or have some special visual effect added to them. You can even wrap text around irregularly shaped objects, something that it took PageMaker four versions to get right.

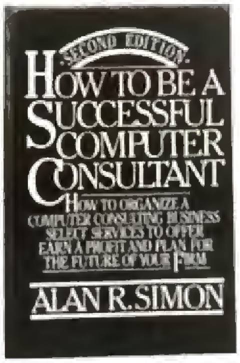
Publish It Easy manipulates text in many other ways. It can justify text along a horizontal or vertical orientation, so you can create vertical headlines that look professionally keylined.

The application includes a complete native word processor with a 112,000-word spelling checker and a 240,000-word thesaurus. Thus, you don't have to own another word processor to create your text, which saves you more money.

In addition to the text features, Timeworks throws in a whole slew of graphics features. You get a complete set of drawing and painting tools (you can even use spot color on your document and have it print out as spot color separations), so you can create your own document graphics. The graphics tools even let you airbrush at resolutions of from 72 to 2540 dots per inch, so you can produce very high-quality copy from your laser printer as well as from a service bureau's imagesetter.

Publish It Easy can print to any printer that supports either Apple's QuickDraw and Color QuickDraw or Adobe's PostScript page-description languages. In practical terms, this means that you can use Publish It Easy now on your low-quality printer and upgrade to a higher-resolution printer without having to buy any more software or change your original document.

One of Publish It Easy's best features is its libraries and *proxies*. This oddly named feature lets you experiment with your document design. You can try different page styles and layouts instantly



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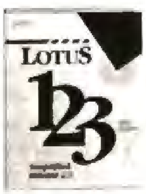

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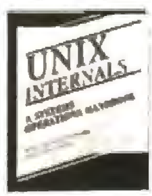

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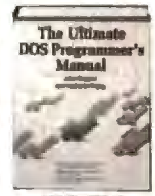

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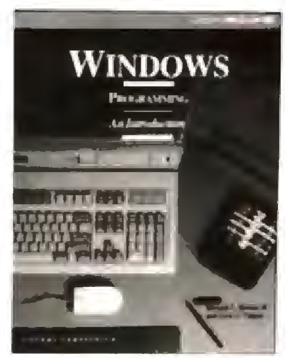

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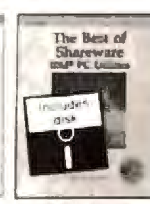

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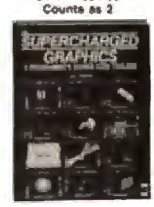

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Publish It Easy isn't perfect. There may be good reasons why you need some of the specific tools in expensive DTP programs. But for many home and small-business computer users, it offers all the DTP power that will ever be needed. While Publish It Easy doesn't replace the high-priced DTP programs, it should give users of them something to think about. And if you are a bargain hunter like me, you'll find that Publish It Easy does just about everything a DTP program should do, and does it well. ■

Don Crabb is the director of laboratories and a senior lecturer for the computer science department at the University of Chicago. He is also a contributing editor for BYTE. He can be contacted on BIX as "decrabb."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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DAVID FIEDLER

SURVIVALIST'S GUIDE TO UNIX

Call me paranoid. Or accuse me of expecting the worst. It's just that, after working with computers for nearly 25 years, I've seen and heard things that would make your hair stand on end (mainly because some of them involve direct lightning hits!). The list includes everything from experienced system administrators who refused to back up their system to novices who were "just looking around" and erased their `/bin` directory.

There are various ways of surviving hardware or software problems with Unix. I'm writing this for system owners, but that doesn't stop you from protecting yourself if you're a user on a large system. You can always make sure your own files are backed up, and it wouldn't hurt to bug the system manager or administrator to make sure that other precautions are being taken.

Lawyers, Guns, and Money

You might want to sue someone or shoot your computer when it finally fails you—and it will—but often, the guilty party can be found by peering into the nearest mirror. Sure, maybe it wasn't your fault the disk crashed, but haven't you noticed the funny noises it's made lately? Have you regularly cleaned around the cooling fan intakes to make sure that air can flow through the computer without interruption? And you always make verified backups, right?

OK, I'm not perfect, either. But I have managed to get into a routine of regular daily backups, and Friday afternoons generally find me quite agitated unless I've already done my weekly backup. If you find it hard to remember, you might use your calendar file or other scheduling program to provide additional help, or even the `at` or `cron` facilities on Unix. You can even just load up a tape in the evening and run the backup from `cron` in the wee hours of the night, unless you need multiple tapes.

Or you could simply lose all your data. That will surely remind you for the next time.

The Great Backup Question

One of the biggest problems with Unix is deciding which backup strategy to use. There are three main backup programs: `cpio`, `tar`, and `volcopy`. My favorite is `cpio` because it can be used fairly efficiently to back up an entire file system, yet you can use it to restore single files, if necessary. And it can also be used to reorganize an active file system's data blocks for faster disk access (by remaking the file system and then restoring the `cpio` backup of that system).

Listing 1 is a shell program I use for daily backups of recently changed files, using `cpio` and a 60-megabyte cartridge tape. The `find` command lets you choose how many days of files you want to back up (I use three on Monday to get the weekend files). The uppercase *C* option used for `cpio` selects an optimum blocking factor, while lowercase *c* ensures that the tape can be read on another machine portably, if necessary. I point this out because *c* once enabled me to transfer all the files on my failed system to a machine with an entirely different architecture. I needed it only one time, but it was there.

The second program, `tar`, is a favorite of many old administrators. However, I like it best for dumping a few files to a floppy disk, rather than doing entire backups. Since it deals with an entire file system at a time, `volcopy` can be used to restore a single file only if you have a spare disk partition that's at least as large as the partition that was backed up originally.

Perhaps the optimum backup strategy might be to do monthly backups of each file system using both `cpio` and `volcopy`, weekly `cpio` incremental backups of the entire system (to be saved until the following month), and daily `cpio` incremental backups of all files that have changed. This is a reasonable compromise that I have found useful, and I've had to do my share of restores, so I know it is workable.

All these backup programs have undergone some changes over the years, and many are now available in publicly available versions. In particular, a program called pax (for portable archive exchange, but also peace in Latin) by Mark Colburn was sponsored by The Usenix Association; it reads and writes both `cpio` and `tar` files in a portable way. There have also been programs posted to Usenet (i.e., `tar_aids` and `fixcpio`)

Systems fail, and without a good backup, your data will too. Protect both.

ILLUSTRATION: TIM CLARK © 1991

Listing 1: *A shell script for daily backups of all recently changed files.*

```
days=$1
echo "running backup for last ${days:=1} day(s) -- kill if wrong"
sleep 1
cd /
find . -type f -depth -mtime -$days -print |\
#
#       uncomment next line to stop backup of Usenet news
#       grep -v "usr/spool/news" |\
#
        cpio -moveaC 10240 -K 60000 > /dev/rct0
```

that attempt to recover damaged `tar` or `cpio` tape files.

Some commercial backup programs are available. Skipping the more extensive (and expensive) software intended for large and/or networked installations, I've worked briefly with two: BRU from Enhanced Software Technologies and Lone-Tar from Lone Star Computer Services. Both programs can do compression of files being backed up, both can recover from media errors, and both have far too many possible options to use without careful study of the manual. If you're interested in this type of program, I suggest contacting the vendors and seeing which set of capabilities you prefer, as they differ slightly.

Of course, the best defense is not to need backups at all. Many frustrating file restoration sessions seem to be preceded by improper use of the `rm` command, which is why I recommend that you replace it with its equivalent, `del` (see "The Free Software Hit Parade," August 1990 BYTE). This will let you undelete files without having to spend time on a file restore or money in an attempt to recover something that's otherwise really gone.

Another good thing to do is use the `fsck` program on a regular basis. Although many of today's Unix versions check a flag bit to decide whether to actually run `fsck` on a file system, running it manually occasionally may catch errors that have crept in unknowingly.

When the Bits Hit the Fan

Sometimes things really go wrong. If it's "just" a simple disk failure, an emergency boot floppy disk might save the day...if you've made one in advance. Such a precaution can let you avoid reloading the entire root file system from floppy disks (see "Tricks of the Unix Gurus," March BYTE).

But if it's more serious, you may wish you had an extra copy of those full `volcopy` monthly backups somewhere. That's why you should keep them somewhere else: anywhere but in the same building as your computer. That way, you won't be totally out of business in case of earthquake, mudslide, fire,

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flood, robbery, or a UFO landing on your house. Here in California, we have to worry about all this stuff.

Another smart idea might be to get computer insurance. For years, I've had a reasonably priced Safeware policy from The Insurance Agency. This covers my computer, its peripherals, the software I've paid for, and even backup tapes. The insurance paid for itself when a power surge permanently snarfed a daisy-wheel printer (remember those?). And it covers the equipment no matter what it's used for. This is an important point for people who work at home, since most homeowners' insurance will not cover computers used for business.

Speaking of surges, I'm going to assume that you have, at the very least, a surge-protective power strip on your computer. It's also a good idea to get some protection for your modem from the noise and spikes that can be found on telephone lines.

For the ultimate in protection, you can also get devices that protect each of your serial ports (try B&B Electronics for these and other serial-port specialties). The most inexpensive protection of all is a ground-checking device, from your local hardware store, with three LEDs that indicate that your electrical ground is indeed grounded. Then you can sleep safely through thunderstorms.

Need Help? Call the Equalizer

Lone Star also sells a program called Buttsaver. This is supposed to be able to restore files that have been erased, by scanning the free list. Obviously, on busy systems, you may have little chance of restoring the file completely intact, but it is a good start. Unfortunately, Buttsaver isn't yet available for an SCO Unix system, so I couldn't test it.

If all else fails, you can always call Jim Joyce at The Gawain Group. He has restored erased files and file systems that have lost their superblock, and he has other horror stories. He uses a combination of proprietary software, imagination, and many years of experience to get Unix people out of tight spots. ■

David Fiedler has been a consultant and writer on Unix topics for over a decade and has started several Unix publications. His company, InfoPro Systems, produces corporate image and marketing videos for high-tech firms. You can reach him on BIX as "fiedler."

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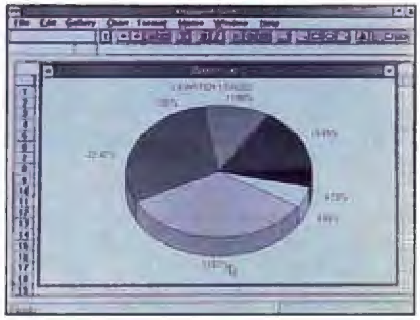

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WILLIAM SPROULE
AND
JON EDWARDS

APPLETALK OVER THE INTERNET

A recent experiment at Princeton and Penn State Universities demonstrates that you can use the Internet to connect AppleTalk networks and AppleShare file servers. Using products such as Shiva's FastPath and Cayman Systems' GatorBox to encapsulate AppleTalk traffic in Internet Protocol packets, Princeton and Penn State have created an experimental AppleTalk wide-area network between the two campuses over a T1 (1.544-megabit-per-second) connection. In so doing, we have found that it's possible to connect campus AppleTalk networks in ways that make collaboration and sharing of data far easier than ever before.

The wide-area AppleTalk network (WAAN) allows universities and other users of the Internet to share existing AppleTalk resources quickly and inexpensively over existing network links. All the software required to become a WAAN participant (K-Star, GatorShare, and/or Kinetics Internet Protocol [KIP]) is either in the public domain or ships with the Shiva FastPath or the Cayman GatorBox AppleTalk gateways. Most research universities are already using the Internet for machine-to-machine communications, so no additional networking links are required.

The experiment has demonstrated how AppleShare simplifies access to remote files. Usually, Macintosh users who want to access a file on the Internet must go through a mainframe or minicomputer, download the file, and then edit and convert it. Instructions for doing this are often cumbersome and difficult for those who aren't regular users of large computer systems. Even users with direct Mac-to-Internet connections must have some knowledge of Internet file transfer protocols, and they often have to edit, concatenate, and convert the files in order to use them.

AppleShare presents even the beginning user with a simple paradigm for file transfer. Users need only select the desired file servers from the Chooser; the file server then becomes an extended part of the user's Desktop. With the WAAN, users on one campus can use the Chooser to select file servers and public folders at other institutions. Resources at other sites appear as additional AppleTalk zones; users simply select their choices from a far larger sample.

The WAAN Advantage

WAAN users can transfer files in an intuitive, easy way. University researchers and faculty can share and disseminate text and data files with far more ease than would otherwise be possible. In addition, a multicampus file server can provide almost any type of information to any Mac on any connected campus. A single university or repository can provide public-domain or other specialized files on a server for easy access. A freely shareable file server might include applications, documents, sound, and graphics. Retrieval of software becomes something that all users—not just those in the know—can do with a click and a drag. Adding to the public domain would become easier.

Users at universities and other institutions on the Internet gain the ability to share, review, and discuss papers, work, diagrams, scanned images, and the like. The WAAN can also provide connections to resources such as networked CD-ROMs. Finally, the WAAN shows how far we currently can push AppleTalk. Today's resources are already sufficient to allow impressive results.

AppleTalk Extended

The WAAN uses AppleTalk encapsulated in UDP/IP to link AppleTalk LANs by way of the Internet. Once an institution has connected to the WAAN, users can access all AppleTalk resources published by other AppleTalk sites, including AppleShare file servers and LaserWriter printers.

The AppleTalk protocol is designed for small, linear networks. For example, you can connect two AppleTalk networks over an Ethernet using AppleTalk gateways. Every 10 seconds, the gateway sends out a Routing Table Management

Two universities put their networks together to come up with an innovative wide-area-network scheme

ILLUSTRATION: TIM CLARK © 1991

Protocol (RTMP) packet containing information about the networks connected to that gateway.

AppleTalk requires broadcast packets to exchange routing information, but an IP route will not forward such packets back to a different network. Therefore, the information must be encapsulated inside a UDP/IP packet.

Interconnection Options

There are two ways to interconnect AppleTalk networks over a UDP/IP link. The first works with both the Shiva FastPath and the Cayman GatorBox. The second method uses built-in features of the Cayman GatorBox.

With the first option, all sites need the administrator software, KIP, and a Unix host on which to run the software. KIP was developed at Stanford University to allow the original Kinetics FastPath to route AppleTalk between subnetworks. The software originally came in two pieces: `gw.srec`, the code that ran on the FastPath, and `atalkad`, the administrative daemon that runs on the Unix host; `gw.srec` has since been replaced by K-Star on the FastPath, and GatorShare on the GatorBox. The `atalkad` daemon is still required and is available via anonymous `ftp` from "Rutgers.EDU."

The WAAN makes it difficult to limit access to licensed software.

The `atalkad` daemon passes routing information to allow gateways to learn about each other. Since routers don't forward broadcast packets, AppleTalk gateways must download static routing information to communicate. The `atalkad` daemon provides this information.

The GatorBox and FastPath manuals describe configuration details, including setting the gateway's IP address, the broadcast address, and the IP address of the Unix host running the `atalkad` daemon. Next you create the `atalkatab` file, which contains information about all the gateways on the networks, as well as the AppleTalk network numbers.

You configure a gateway with the information needed to talk to the `atalkad` daemon and then boot it up. The gateway queries the daemon to send the information. The daemon builds a table of AppleTalk addresses that are related to the IP address and sends the table to the gateway. Then the gateway queries for the zone names associated with the AppleTalk address and stores this information in a table.

For example, a Princeton user in the zone named `PUcit87` pulls up the Chooser and selects a LaserWriter in the zone `PSU.cac.mpw` at Penn State. The Mac sends the request to the gateway, which looks up the network number associated with that zone and finds the IP address of the gateway to which it should send this packet. The gateway then stuffs the original AppleTalk packet inside a UDP packet, which it sends along to the IP address 128.118.3.128. The Penn State gateway then unstuffs the packet and forwards the

original packet to the LocalTalk network. The LaserWriter replies to the gateway at Penn State, which reverses the process.

The second method uses the GatorBox and is much simpler. The GatorShare software lets network administrators at different sites exchange IP addresses of GatorBoxes and download the configurations to them. GatorShare then forms the tunnel. The principle is the same: AppleTalk packets are encapsulated in IP packets and sent to the proper IP address. However, you don't need an `atalkad`, a Unix host, or an `atalkatab` file, and you can include and exclude networks based on network number. We used KIP when we first established the link between Penn State and Princeton. The link is now up with the GatorBox.

Current Difficulties

One problem with our WAAN is that it doesn't scale to very large networks. The original KIP code was limited to 64 routes and 32 zones. Princeton has over 75 routes and 64 zones, and several sites are much larger. The limits are due to the size of the tables in the KIP code, as well as the packet size that AppleTalk can handle. Another annoyance is that, for the moment, Internet resources appear alongside local resources.

Because of the 64-route limitation, each Internet site must limit the number of zones it exports. Of course, no site has to import all zones available to it.

We have worked out a naming convention that eases the problem somewhat. Export zones begin with capital letters (e.g., `PU-zonename` is a Princeton zone; `UR-zonename` is a zone at the University of Rochester). Nonetheless, the numbers of resources will grow, and member institutions will be forced to limit exported and imported resources.

The Future of AppleTalk over IP

We expect to make efforts to ease these difficulties. The Internet Engineering Task Force now has a MacIP group (which includes members of the Internet Community, as well as engineers from Apple, Cayman, and Shiva) to standardize and support WAANs and AppleTalk tunneling through foreign networks.

The task force is addressing several key WAAN issues. The first concerns *network hiding*. A site with several dozen zones might not want to add several dozen additional zones from another site. Indeed, it's possible that, in connecting to a WAAN, an organization might inherit hundreds or even thousands of new zones. Scrolling through a multitude of zones in the Chooser would be time-consuming, as well as process- and memory-intensive.

Another important reason for limiting zone information is the level of traffic. Most connections at a local site are high-speed, short-distance networks such as Ethernet. Most off-site connections today are no faster than T1 links, and even as slow as 9600 bps. Sending routing information for 70 zones would overwhelm such links.

Security is another issue. We need to limit the number of zones available in the WAAN. Princeton makes several public clusters available to students, faculty, and staff. The WAAN makes it more difficult to limit access to licensed software or to track what these users are doing.

The GatorBox software filters packets based on network number in order to limit the zones that are shared across the WAAN. Each site constructs a list of the networks to include or exclude. When a

packet is sent across the tunnel, the GatorBox at the receiving end looks at the source network. If the network number isn't in the list of networks to include (or if it is in the list of excluded networks) the GatorBox discards the packet. If the source network is authorized, the packet goes through.

There's just one problem with this scheme. Users on a network that isn't allowed to go through other sites will still see the foreign WAANs. However, the users will see only empty zones, since the lookup packets are dropped before they can be answered. The GatorBox scheme also does not prevent a link between two GatorBoxes from becoming bogged down by excess traffic. If many users at one end start doing lookups, the packets still get passed and dropped at the other end of the link. It would be better if the local box did the processing.

The MacIP task force is also working on network number conflicts. It might seem unlikely that two or more large sites that want to connect would have one or more identical network numbers, but many institutions have numbered their networks starting from 1.

The current plan allows gateways to remap network numbers at remote sites to a local range of numbers. For example, when a local gateway receives a packet from another network, it looks in a table to find which network numbers are free on the local side. If the remote source number is in use locally, the gateway changes it. The local gateway simply reverses the operation when replying. The scheme requires a bit of coordination on the part of the routers, and it requires processing time.

Finally, the task force is exploring the exchange of routing information. An AppleTalk router sends an RTMP packet every 10 seconds. The bandwidth required for these routing packets makes it impractical for slow network links. It may be possible to link the routes between sites statically, thereby reducing the need for routing information. Then you'd only have to send routing information when shutting down or bringing up a link, or when link information (e.g., the zone name) changes. Gateways might then send each other an occasional "tickle" to make sure that connectivity is still being maintained. ■

Editor's note: *Several working papers on WAANs are available from the MacIP Task Force via anonymous* `ftp` *to "apple .com" in the pub/macip directory.*

To participate in the WAAN, an institution must have at least one Unix-based computer that's connected to the Internet. It must run the `atalkad` *administrative daemon (a part of the KIP software), and it must be connected to a Cayman GatorBox or a Shiva FastPath running either KIP, K-Star, or GatorShare. If you are interested in becoming a member, send Internet mail to the WAAN administrator at "waan-request@nisc.nyser .net."*

William Sproule is a network programmer for systems and technical support at Princeton University. Jon Edwards is assistant to the vice president for computing and information technology. They can be reached over the Internet at "sproule-@princeton.edu" and at "jedwards-@princeton.edu," respectively, or on BIX c/o "editors."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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ASK BYTE

Who Moved My Key Caps?

I have been trying to find information on the origins and development of the key layout on keyboards for personal computers. Obviously, computer keyboards evolved from teletype machines, which in turn were engendered by typewriters. Additionally, I'm interested in the differences between the QWERTY version and the Dvorak and foreign-language versions—why and how they came to differ from ours.

H. S. Rodgers
San Diego, CA

I checked the local library and dug through a pile of encyclopedias. Armed with a bit of background material, I then checked the U.S. Patent depository and looked up the original typewriter patents. With that and some other tidbits I found here and there, this is what I got:

As you point out, the computer keyboard layout is clearly rooted in the standard typewriter QWERTY layout. When Christopher Sholes patented the typewriter in 1868, it had an alphabetic layout. A few years later, the Remington company bought the rights and produced the first commercial typewriter in 1873. By then, the key layout had been changed to the QWERTY that we all know and love. Why? No one seems to know.

One popular theory is that it slowed typists down so they couldn't type faster than the mechanism could keep up. Unfortunately, there's no factual evidence to back this up. According to Grolier's, *the key layout was changed to make it easier for Remington to sell machines to its customers. It's hard to imagine why anyone would prefer the QWERTY layout, but it certainly would make it hard for a Remington user to switch to a competitor's typewriter.*

August Dvorak studied the English language and realized that it was silly to put so many common letters in such dumb places on the keyboard. He rearranged the key caps to move the most-often-used letters to the home row, distribute the typing effort evenly between the left and right hands, and put the most-often-used letters under the strongest fingers.

That gets us past typewriters, and as you point out, computer keyboards obviously evolved from typewriters. All I can tell you about computer keyboard layouts is what I learned when designing Multimate's Business Advantage keyboard a few years back. I ran into an interesting study, attributed to IBM, that talked a bit about the function keys on the PC, XT, and 84-key AT keyboards.

Prior to the IBM PC, many terminal manufacturers placed function keys anywhere they wanted. The study suggests that most people who used computer terminals in the late 1970s were primarily doing data entry. The numeric keypad on the original PC made it easy to enter numeric data with the right hand. With the function keys together on the left, the left hand could easily control all the program functions without the right hand moving from the numeric keypad.

Word processing had become a primary PC application by the time the AT was shipped in 1985. The new keyboard had a bigger Return key, and the Escape key was moved out of harm's way. The study goes on to talk about key heights, angles, click, and so forth. Of course, the new standard is the 101-key keyboard. Escape is more or less back where it belongs, and the dedicated cursor pad is in a good spot. I have to assume that the function keys were moved to the top of the keyboard just to be annoying.

I wasn't able to dig up anything on the foreign-language keyboards. Big computer companies like IBM, DEC, and Wang do research on this stuff all the time. Perhaps someone would care to shed some light on this?

—H. E.

Going Back in Time

We have a DOS date problem that consistently causes confusion on our network. During log-in, the PC's DOS clock synchronizes to the server's clock. Following log-in, the PC's clock runs independently of the server's.

In general, most PC clocks remain fairly well coordinated with the server's clock. The problem is that PCs that remain logged in for several days will sometimes slip a day. That is, the time will be correct, but the date will not have advanced. This has become an annoying problem, since several of our mission-critical applications automatically insert the date from the local PC's DOS clock.

I remember reading somewhere that slipping dates in DOS can be caused by TSR programs (e.g., network drivers) interfering with the date change that should occur at midnight. The time is not affected because it is continuously updated.

Am I interpreting the problem and its cause correctly? Is there any fix, and will the problem continue under DOS 5.0? We have been able to find very little information on this subject. Any help would be greatly appreciated.

James F. Remillard
Woods Hole, MA

DOS handles date and time functions in a software-maintained clock. A continuous hardware timer triggers an interrupt, which in turn updates a 4-byte counter in low memory. Another location stores the overflow flag, which indicates that the time has run over midnight.

For DOS to realize the date has changed, it must see the overflow flag. A number of DOS versions have confirmed bugs in the code that handles this flag. One source on BIX suggests that the date and time management happens every time your application requests keyboard input from DOS. If your application is busy running at midnight without checking the keyboard, there's a chance that the date software simply isn't getting a chance to update itself.

There are several fixes. The obvious one is to rely on the CMOS hardware clock for your date functions. If you're on an AT, use INT 1Ah, functions 2 and 4, to read the time and date, respectively. The CMOS clock is a real clock, not subject to any DOS errors. Another *possibility is a replacement for the standard DOS clock software. BIX and other BBSes often carry device drivers that fix the DOS clock bugs.*

I can't speak for DOS 5.0. I haven't tried it myself, and bugs like that often take a while to surface anyway. There's a good chance that the existing software patches won't work under DOS 5.0. If you can, modify your applications to use the CMOS clock. That should fix you right up.—H. E.

I, Database

I am hoping to develop a CD-based library of the writing of various authors, primarily works of fantasy and science fiction. Each CD would cover the works of a single author, including short stories, articles and essays related to the genre, novellas, novels, and biographical or autobiographical works.

For these reasons, I would like to solicit your suggestions on the selection of hardware and software needed.

I realize that this project will require a significant investment of both time and money on my part, but it has developed a grip on me that I can't deny. This is a chance for me to repay this medium for all the years of pleasure it has given me, and at the same time give something to future generations of readers in the form of books, stories, and artwork that might otherwise be lost to them. Any suggestions that you can make to aid my preparation would be greatly appreciated.

Earl Baker
Jefferson City, MO

I admire your devotion to this labor of love, but I urge caution before making a substantial investment in hardware and software.

It would be very interesting to have a single source for the works of such authors as Isaac Asimov, Arthur C. Clarke, or BYTE's own Jerry Pournelle. However, I would first investigate whether there is a market that will pay back such an investment in time and effort. CD-ROMs such as you suggest would appeal to a limited number of readers, libraries, or universities.

I suggest you do a little more research and see if you can start a new career in the CD-ROM publishing industry, rather than going the do-it-yourself route. For an introduction to CD-ROMs, see The CD-ROM Chronicles Audio CD, available for $18.95 from Meridian Data, Inc. (5615 Scotts Valley Dr., Scotts Valley, CA 95066, (408) 438-3100; fax (408) 438-6816).

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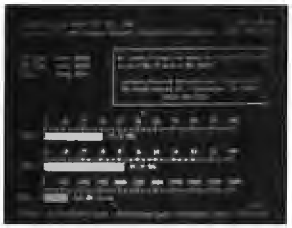

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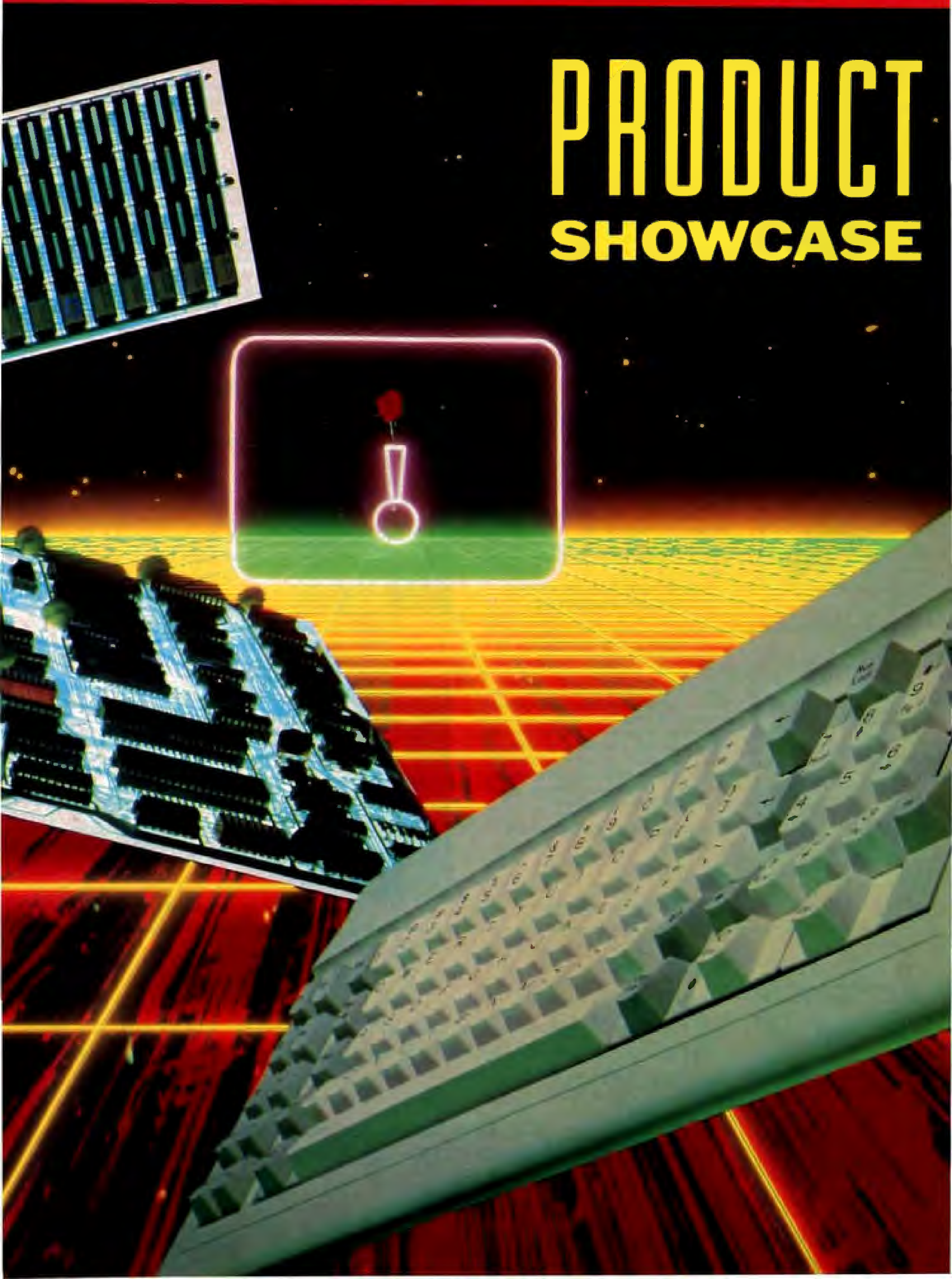

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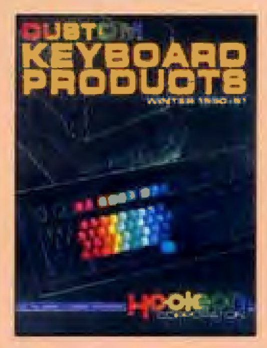

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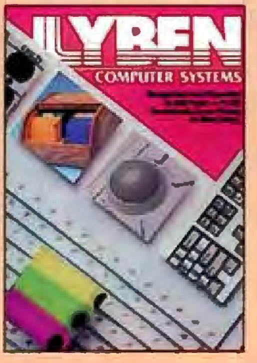

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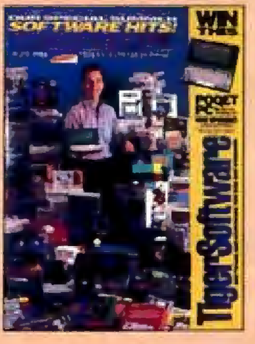

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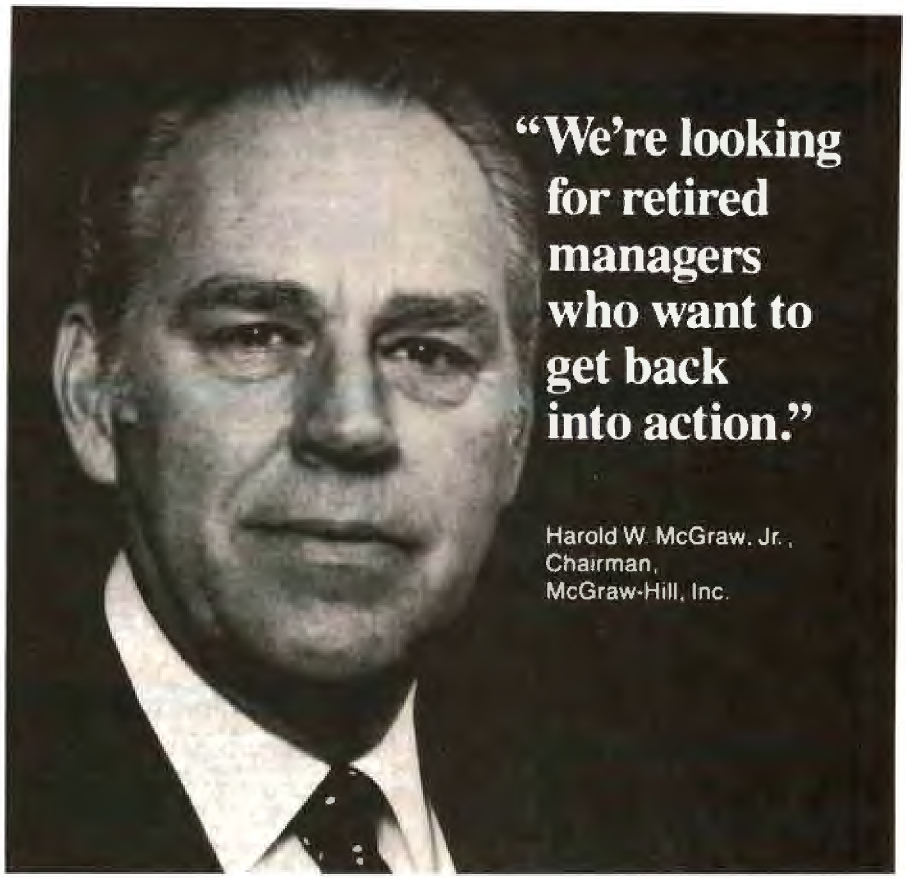

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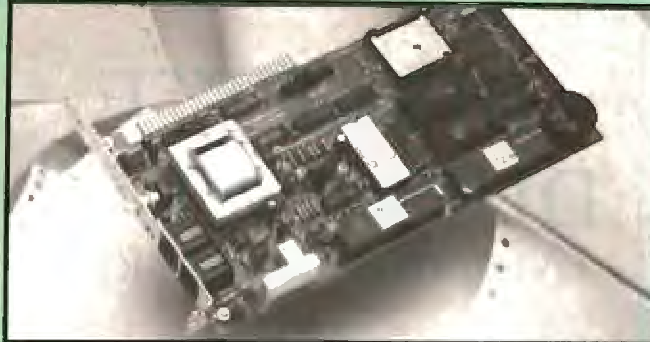

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IBM

Part # EQ	Works With	PRICE
78X8955 (128K)	PS/2 25	$ 19.00
1057035 (512K)	PS/1	$ 75.00
1057036 (2MB)	PS/1	$ 215.00
30F5348 (512K)	30/286	$ 39.00
30F5360 (2MB)	30/286	$ 125.00
6450603 (1MB)	50Z, 55SX, 70-EG1, 70-121, P-70	$ 79.00
6450604 (2MB)	50Z, 55SX, 70-EG1, 70-121, P-70	$ 135.00
6450608 (2MB)	70-A21, A61 B21, B61	$ 139.00
34F2933 (4MB)	55SX, 65SX, 55LS, 65LS, 34F3077	$ 329.00
6450375 (1MB)	80-041	$ 97.00
6450379 (2MB)	80-111, 311	$ 167.00
6451060 (4MB)	80-A21 A31 A61	$ 379.00
6450902 (2MB)	90, 95	$ 229.00
6450128 (4MB)	90, 95	$ 425.00
6450605 (2-8MB)	70, 80	$ 415.00
34F3077 (2-16MB)	70, 80	$ 406.00
6450609 (2-16MB)	50, 50Z, 55SX, 60, 65SX	$ 425.00

COMPAQ

Model	Memory Added	Part # EQ	PRICE
DP 386/33, 486/25, 33 & Systempro	2MB MODULE	115144-001	$ 149.00
	8MB MODULE	116561-001	$ 950.00
DP 386/20e, 20, & 25e, 25	1MB BOARD	113644-001	$ 159.00
	4MB BOARD	113645-001	$ 409.00
	1MB MODULE	113131-001	$ 105.00
	4MB MODULE	113132-001	$ 285.00
DP 386s/16	1MB BOARD	113633-001	$ 155.00
	4MB BOARD	113634-001	$ 409.00
	1MB MODULE	113646-001	$ 109.00
	4MB MODULE	112534-001	$ 315.00
DP 286N, 386N & 386SX/20	1MB MODULE	118689-001	$ 99.00
	2MB MODULE	118689-001	$ 149.00
	4MB MODULE	118690-001	$ 459.00
	0K BOARD	118700-001	$ 99.00
DP 386/16	1MB BOARD	108069-001	$ 279.00
	2MB BOARD	108069-W/71	$ 380.00
	4MB BOARD	108070-001	$ 599.00
	8MB BOARD	108070-W/72	$ 899.00

NEC

Model	Memory Added	Part # EQ	PRICE
Powermate SX Plus	1MB BOARD	APC-H850E	$ 279.00
	2MB BOARD	& APC-H851E	$ 479.00
	4MB BOARD	APC-H852E	$ 759.00
	8MB BOARD	& APC-H853E	$1,299.00
Powermate SX/20			Call
Powermate 386/20	2MB BOARD	APC-H655E	$ 499.00
Powermate 386/25	2MB BOARD	APC-H655X	$ 499.00
	8MB BOARD	APC H656X	$1,399.00
	8MB BASEBOARD	APC-H657X	$1,449.00
Powermate 386/25S	2MB KIT	OP-410-8103	$ 249.00
	8MB KIT	OP-410-5202	$ 699.00
Powermate 386/33E 486/25E	2MB MODULE	OP-410-5101	$ 379.00

Apple

Model	Memory Added	Part # EQ	PRICE
MAC Classic	1-3MB BD	M6361LL/A	$ 119.00
	2MB KIT	M0514LL-A	$ 109.00
MACIIci, IIsi	1MB KIT	M0291LL-A	$ 79.00
MACIIsi	2MB KIT	M0514LL-A	$ 199.00
MACIIci, IIsi	4MB KIT	M0292LL-A	$ 229.00
MACIIsi	8MB KIT	M0513LL-A	$ 799.00
MACIIci, IIsi	16MB KIT	No # Available	$1 099.00
MACIIfx	4MB KIT	M0376LL-A	$ 249.00
	16MB KIT	No # Available	$1 199.00
MAC SE, SE30, Plus, II, IIcx, IIx	4MB KIT	M02707	$ 229.00

AST

Model	Memory Added	Part # EQ	PRICE
BRAVO 486/25	2MB SIMM	500718-004	$ 205.00
PREMIUM 386SX/16, SX20 & 386/25, 33	1MB MODULE	500780-003	$ 89.00
	4MB MODULE	500780-004	$ 499.00
	8MB KIT		
PREMIUM 386C, WKST & BRAVO	1MB KIT	500510-007	$ 79.00
	4MB KIT	500510-008	$ 270.00
PREMIUM 286			
Fastram	512-2MB BD	500394-001	$ 289.00
Fastram Kit	512 UPGRADE	500510-001	$ 55.00
Adv Fastram	2-8MB BD	500565-001	$ 629.00
Adv Fastram Kit	2MB UPGRADE	500510-002	$ 130.00
PREMIUM 386	1MB KIT	500610-003	$ 89.00
	4MB KIT	500510-004	$ 269.00

CHIPS

STANDARD SIMMS

Part#	PRICE
256 X 8-10	$ 17.00
256 X 9-10	$ 18.00
256 X 9-80	$ 19.00
256 X 9-70	$ 21.00
1 X 8-10	$ 50.00
1 X 8-80	$ 50.00
1 X 9-10	$ 55.00
1 X 9-80	$ 54.00
1 X 9-70	$ 58.00
4 X 9-80	$ 239.00
4 X 8-80	$ 219.00

DRAM

Part#	PRICE
1 X 1-10	$ 5.50
1 X 1-80	$ 5.75
1 X 1-70	$ 6.00
256-10	$ 1.85
256-80	$ 1.95
256-70	$ 2.20
256 X 4-10	$ 5.50
256 X 4-80	$ 6.00
4464-10	$ 2.20
4464-80	$ 2.50
4164-10	$ 2.00

LASER PRINTER MEMORY

Model	Memory Added	Part # EQ	PRICE
H P LASERJET IIP, III, IIID	1MB MODULE	H33474B	$ 85.00
	2MB MODULE	H33475B	$ 140.00
	3MB MODULE	H33476B	$ 198.00
	4MB MODULE	H33477B	$ 248.00
H P LASERJET II IID	1MB MODULE	H33443B	$ 85.00
	2MB MODULE	H33444B	$ 148.00
	4MB MODULE	H33445B	$ 248.00
H P DESKJET	256K MODULE		$ 115.00
IBM 4019, 4019e	1MB MODULE	1039136	$ 149.00
	2MB MODULE	1039137	$ 189.00
	3.5MB MODULE	1038675	$ 275.00
OKI LASER 400	1MB MODULE	70014701	$ 179.00
	2MB MODULE	70015801	$ 249.00
OKI LASER 800, 820	1MB MODULE	70016501	$ 189.00
	2MB MODULE	No # Available	$ 249.00
	4MB MODULE	No # Available	$ 359.00
PANASONIC 4450	1MB MODULE	KXP440	$ 180.00
PANASONIC 4420 4450i	1MB MODULE	KX443	$ 150.00
	2MB MODULE	KX441	$ 169.00
	4MB MODULE	No # Available	$ 269.00
CANON LBP-4	1MB MODULE	S63-2240	$ 189.00
	1MB EXP	S63-2230	$ 189.00
CANON LBP-8II	1MB BOARD	S63-1300	$ 99.00
	2MB BOARD	S63-1880	$ 149.00
	4MB BOARD	No # Available	$ 289.00
APPLE LASERWRITER	1MB KIT	M6005	$ 89.00
	4MB KIT	M6006	$ 299.00
EPSON EPL6000	2MB MODULE	IBS401	$ 199.00
	4MB MODULE	IB401/4	$ 329.00
TI MICROLASER	1MB MODULE	2559810-8001	$ 89.00
TOSHIBA PAGELASER 6	2MB MODULE		$ 219.00
	4MB MODULE		$ 349.00
QMS PS410	1MB UPGRADE	2600090-903	$ 169.00
	2MB UPGRADE	2600090-902	$ 229.00
	4MB UPGRADE	2600090-901	$ 349.00

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83D87-33	$ 459.00

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Part#	PRICE
2C87-8	$ 149.00
2C87-10	$ 159.00
2C87-12	$ 179.00
2C87-20	$ 229.00
3C87SX-16	$ 249.00
3C87SX-20	$ 269.00
3C87-20	$ 289.00
3C87-25	$ 359.00
3C87-33	$ 449.00

LAPTOP MEMORY

Model	Memory Added	Part # EQ	PRICE
TOSHIBA			
T1000SE, XE & 2000SX	1MB KIT	PC14-PA8311U	$ 187.00
	2MB KIT	PC14-PA8312U	$ 277.00
	4MB KIT		$ 689.00
	8MB KIT		$1,189.00
T1200XE	2MB KIT	PC-PA8306U	$ 169.00
T1600	2MB KIT	PC8-PA8302U	$ 169.00
T3100SX	2MB KIT	PC15-PA8308U	$ 169.00
	4MB KIT	PC15-PA8310U	$ 395.00
T3100E	2MB KIT	PC9-PA8341U	$ 169.00
T3200SX	2MB KIT	PC12-PA8307U	$ 169.00
	4MB KIT	PC12-PA8309U	$ 395.00
T3200	3MB KIT	PC6-PA7137U	$ 275.00
T5100	2MB KIT	PC7-PA8301U	$ 169.00
T5200, 5200C 8500	2MB KIT	PC10-PA8313U	$ 169.00
	8MB KIT	PC10-PA8313U	$ 989.00
COMPAQ			
Portable III	Modem/Interface	107808-001	$ 89.00
	0-6MB BD	107811-001	$ 189.00
	512 KIT	107331-001	$ 39.00
	2MB KIT	107332-001	$ 129.00
Portable 386/20	Modem/Interface	107707-001	$ 89.00
	1MB KIT	107651-001	$ 239.00
	4MB EXP	107653-001	$ 699.00
Portable LTE286	1MB BOARD	117081-001	$ 129.00
	2MB BOARD	117081-002	$ 179.00
	4MB BOARD	117081-003	$ 595.00
Portable LTE386S/20	1MB BOARD	121125-001	$ 349.00
	4MB BOARD	121125-002	$ 999.00
SLT/286	1MB BOARD	110236-001	$ 159.00
	4MB BOARD	110237-001	$ 625.00
SLT/386	1MB BOARD	118303-001	$ 169.00
	2MB BOARD	118304-001	$ 275.00
	4MB BOARD	118305-001	$ 675.00
NEC			
Prospeed SX/20	1MB BOARD	PC-43-21	$ 220.00
	4MB BOARD	PC-43-22	$ 625.00
Prospeed 286, 386SX/16	1MB BOARD	PC-21-21	$ 220.00
	2MB BOARD	PC-21-26	$ 325.00
	4MB BOARD	PC-21-22	$ 889.00
Prospeed 386	2MB CARD	PC-31-21	$ 309.00
	8MB CARD	PC-31-22	$1,240.00
Supersport Sx	2MB ALPHA	ZA-180-86	$ 225.00
	2MB BETA	ZA-180-87	$ 225.00
	2MB EXP	ZA-180-64	$ 225.00
Slimport, 286e	2MB CARD	ZA-180-64	$ 225.00
	4MB CARD	ZA-180-71	$ 675.00
Turbosport 386e	1MB BOARD	ZA-3034-ME	$ 199.00
	4MB BOARD	ZA-3034-ME/4	$ 599.00
OTHER LAPTOPS			
MAC Portable	1MB BOARD	M0248	$ 235.00
	2MB BOARD	M0248/2	$ 735.00
	3MB BOARD	M0248/3	$ 899.00
	4MB BOARD	M0248/4	$ 1,199.00
AST Executive Notebook	1MB SIMM	500814-001	$ 109.00
	4MB SIMM	500814-003	$ 599.00
SHARP PC-6220 Notebook	1MB BOARD	CE-6218	$ 169.00
Ti Travelmate 2000	1MB BOARD	2568034-0001	$ 189.00
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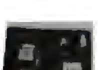

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2716	3.29	3.13	2.82	27C64	3.29	3.13	3.28
2716-1	3.79	3.60	3.24	27128-20	4.99	4.74	4.27
TMS2716	5.79	5.50	4.95	27128	4.79	4.55	4.09
27C16	3.99	3.79	3.41	27128A	4.79	4.55	4.09
2732	4.19	3.98	3.58	27C128	4.79	4.55	4.09
2732A-2	3.79	3.60	3.24	27256-20	5.29	5.03	4.53
2732A	3.69	3.51	3.16	27256	4.79	4.55	4.09
2732A-4	3.19	3.03	2.73	27C256	4.29	4.08	3.67
TMS2532	5.79	5.50	4.95	27512-20	6.49	6.17	5.55
TMS2532P	1.99	1.89	1.70	27512	5.99	5.69	5.12
27C32	3.79	3.60	3.24	27C512	5.99	5.69	5.12
2764-20	4.29	4.08	3.67	27C1024	12.99	12.34	11.11
2764	3.99	3.79	3.41	68764	13.99	13.29	11.96
2764A-20	3.99	3.79	3.41	68766	12.99	12.34	11.11

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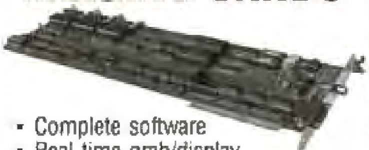

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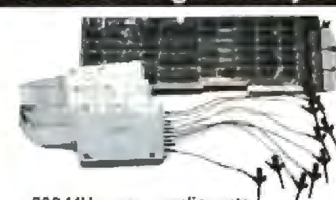

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A. What is your primary job function/principal area of responsibility? (Check one.)
1 ☐ MIS/DP
2 ☐ Programmer/Systems Analyst
3 ☐ Administration/Management
4 ☐ Sales/Marketing
5 ☐ Engineer/Scientist
6 ☐ Other

B. What is your level of management responsibility?
7 ☐ Senior-level
8 ☐ Middle-level
9 ☐ Professional

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?
10 ☐ Yes   11 ☐ No

D. What operating systems are you currently using? (Check all that apply.)
12 ☐ PC/MS-DOS
13 ☐ DOS + Windows
14 ☐ OS/2
15 ☐ UNIX
16 ☐ MacOS
17 ☐ VAX/VMS

E. For how many people do you *influence* the purchase of hardware or software?
18 ☐ 1-25
19 ☐ 26-50
20 ☐ 51-99
21 ☐ 100 or more

JULY 1991

Inquiry Numbers 1-495

1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33
34	35	36	37	38	39	40	41	42	43	44
45	46	47	48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63	64	65	66
67	68	69	70	71	72	73	74	75	76	77
78	79	80	81	82	83	84	85	86	87	88
89	90	91	92	93	94	95	96	97	98	99
100	101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120	121
122	123	124	125	126	127	128	129	130	131	132
133	134	135	136	137	138	139	140	141	142	143
144	145	146	147	148	149	150	151	152	153	154
155	156	157	158	159	160	161	162	163	164	165
166	167	168	169	170	171	172	173	174	175	176
177	178	179	180	181	182	183	184	185	186	187
188	189	190	191	192	193	194	195	196	197	198
199	200	201	202	203	204	205	206	207	208	209
210	211	212	213	214	215	216	217	218	219	220
221	222	223	224	225	226	227	228	229	230	231
232	233	234	235	236	237	238	239	240	241	242
243	244	245	246	247	248	249	250	251	252	253
254	255	256	257	258	259	260	261	262	263	264
265	266	267	268	269	270	271	272	273	274	275
276	277	278	279	280	281	282	283	284	285	286
287	288	289	290	291	292	293	294	295	296	297
298	299	300	301	302	303	304	305	306	307	308
309	310	311	312	313	314	315	316	317	318	319
320	321	322	323	324	325	326	327	328	329	330
331	332	333	334	335	336	337	338	339	340	341
342	343	344	345	346	347	348	349	350	351	352
353	354	355	356	357	358	359	360	361	362	363
364	365	366	367	368	369	370	371	372	373	374
375	376	377	378	379	380	381	382	383	384	385
386	387	388	389	390	391	392	393	394	395	396
397	398	399	400	401	402	403	404	405	406	407
408	409	410	411	412	413	414	415	416	417	418
419	420	421	422	423	424	425	426	427	428	429
430	431	432	433	434	435	436	437	438	439	440
441	442	443	444	445	446	447	448	449	450	451
452	453	454	455	456	457	458	459	460	461	462
463	464	465	466	467	468	469	470	471	472	473
474	475	476	477	478	479	480	481	482	483	484
485	486	487	488	489	490	491	492	493	494	495

Inquiry Numbers 496-990

496	497	498	499	500	501	502	503	504	505	506
507	508	509	510	511	512	513	514	515	516	517
518	519	520	521	522	523	524	525	526	527	528
529	530	531	532	533	534	535	536	537	538	539
540	541	542	543	544	545	546	547	548	549	550
551	552	553	554	555	556	557	558	559	560	561
562	563	564	565	566	567	568	569	570	571	572
573	574	575	576	577	578	579	580	581	582	583
584	585	586	587	588	589	590	591	592	593	594
595	596	597	598	599	600	601	602	603	604	605
606	607	608	609	610	611	612	613	614	615	616
617	618	619	620	621	622	623	624	625	626	627
628	629	630	631	632	633	634	635	636	637	638
639	640	641	642	643	644	645	646	647	648	649
650	651	652	653	654	655	656	657	658	659	660
661	662	663	664	665	666	667	668	669	670	671
672	673	674	675	676	677	678	679	680	681	682
683	684	685	686	687	688	689	690	691	692	693
694	695	696	697	698	699	700	701	702	703	704
705	706	707	708	709	710	711	712	713	714	715
716	717	718	719	720	721	722	723	724	725	726
727	728	729	730	731	732	733	734	735	736	737
738	739	740	741	742	743	744	745	746	747	748
749	750	751	752	753	754	755	756	757	758	759
760	761	762	763	764	765	766	767	768	769	770
771	772	773	774	775	776	777	778	779	780	781
782	783	784	785	786	787	788	789	790	791	792
793	794	795	796	797	798	799	800	801	802	803
804	805	806	807	808	809	810	811	812	813	814
815	816	817	818	819	820	821	822	823	824	825
826	827	828	829	830	831	832	833	834	835	836
837	838	839	840	841	842	843	844	845	846	847
848	849	850	851	852	853	854	855	856	857	858
859	860	861	862	863	864	865	866	867	868	869
870	871	872	873	874	875	876	877	878	879	880
881	882	883	884	885	886	887	888	889	890	891
892	893	894	895	896	897	898	899	900	901	902
903	904	905	906	907	908	909	910	911	912	913
914	915	916	917	918	919	920	921	922	923	924
925	926	927	928	929	930	931	932	933	934	935
936	937	938	939	940	941	942	943	944	945	946
947	948	949	950	951	952	953	954	955	956	957
958	959	960	961	962	963	964	965	966	967	968
969	970	971	972	973	974	975	976	977	978	979
980	981	982	983	984	985	986	987	988	989	990

Inquiry Numbers 991-1479

991	992	993	994	995	996	997	998	999	1000	1001
1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012
1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023
1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034
1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045
1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056
1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067
1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078
1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089
1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100
1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111
1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122
1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133
1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144
1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155
1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166
1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177
1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188
1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199
1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210
1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221
1222	1223	1224	1225	1226	1227	1228	1229	1230	1231	1232
1233	1234	1235	1236	1237	1238	1239	1240	1241	1242	1243
1244	1245	1246	1247	1248	1249	1250	1251	1252	1253	1254
1255	1256	1257	1258	1259	1260	1261	1262	1263	1264	1265
1266	1267	1268	1269	1270	1271	1272	1273	1274	1275	1276
1277	1278	1279	1280	1281	1282	1283	1284	1285	1286	1287
1288	1289	1290	1291	1292	1293	1294	1295	1296	1297	1298
1299	1300	1301	1302	1303	1304	1305	1306	1307	1308	1309
1310	1311	1312	1313	1314	1315	1316	1317	1318	1319	1320
1321	1322	1323	1324	1325	1326	1327	1328	1329	1330	1331
1332	1333	1334	1335	1336	1337	1338	1339	1340	1341	1342
1343	1344	1345	1346	1347	1348	1349	1350	1351	1352	1353
1354	1355	1356	1357	1358	1359	1360	1361	1362	1363	1364
1365	1366	1367	1368	1369	1370	1371	1372	1373	1374	1375
1376	1377	1378	1379	1380	1381	1382	1383	1384	1385	1386
1387	1388	1389	1390	1391	1392	1393	1394	1395	1396	1397
1398	1399	1400	1401	1402	1403	1404	1405	1406	1407	1408
1409	1410	1411	1412	1413	1414	1415	1416	1417	1418	1419
1420	1421	1422	1423	1424	1425	1426	1427	1428	1429	1430
1431	1432	1433	1434	1435	1436	1437	1438	1439	1440	1441
1442	1443	1444	1445	1446	1447	1448	1449	1450	1451	1452
1453	1454	1455	1456	1457	1458	1459	1460	1461	1462	1463
1464	1465	1466	1467	1468	1469	1470	1471	1472	1473	1474
1475	1476	1477	1478	1479						

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Nemesis Go Junior
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Select the file gomast.exe for MS DOS Go Master
Select the file gojr.bin for Macintosh Go Junior
Select the file gomast.bin for Macintosh Go Master

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41256-100	262144x1	100ns	16	1.99
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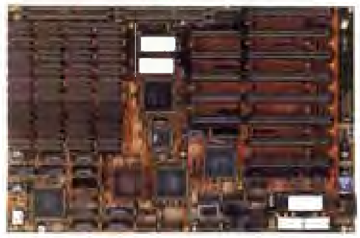

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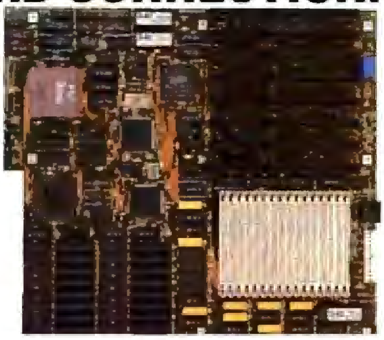

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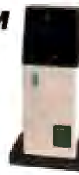

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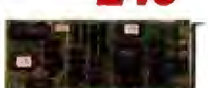

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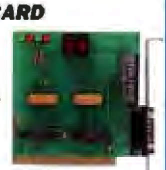

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Circle 6 on Inquiry Card (RESELLERS: 7).

 continued from page 248

Listing 4: *The device header has to be the first item in the driver's data segment. The start-up routine shown here handles that requirement.*

```
;      C startup routine,
       one device
          EXTRN    _main:near
          PUBLIC   _STRAT
          PUBLIC   _acrtused
_DATA       segment word public
            'DATA'
_DATA       ends
CONST       segment word public
            'CONST'
CONST       ends
_BSS        segment word public
            'BSS'
_BSS        ends
DGROUP      group CONST, _BSS,
            _DATA
_TEXT       segment word public
            'CODE'
            assume
               cs:_TEXT,
               ds:DGROUP,
               es:NOTHING,
               ss:NOTHING
            .286P
_STRAT proc      far
_acrtused:
         push     0
         jmp      start
start:
         push es
         push bx
         call _main
         pop  bx
         pop  es
         add  sp,2
         mov  word ptr es:[bx+3],ax
         ret
_STRAT      endp
_TEXT       ends
         end
```

Listing 5: *The driver's Strategy section is essentially a* `switch` *statement. The driver may implement or ignore requests passed to it from the kernel on behalf of applications.*

```
int main(PREQPACKET rp, int dev)
{
    switch(rp->RPcommand)
    {
    case RPINIT:
        return INIT(rp);
    case RPREAD:
        return (RPDONE);
    case RPWRITE:
        return (RPDONE);
    case RPINPUT_FLUSH:
        return (RPDONE);
    case RPOUTPUT_FLUSH:
        return (RPDONE);
    case RPOPEN:
        return (RPDONE);
    case RPCLOSE:
        return (RPDONE);
    case RPIOCTL:
        switch (rp->
        s.IOCtl.function)
        {
        case 0x00:               /
            return (RPDONE);
        case 0x01:               /
            return (RPDONE);
        }
    case RPDEINSTALL:
        return(RPDONE | RPERR |
                ERROR_BAD_
                COMMAND);
    default:
        return(RPDONE);
    }
}
```

address is valid. It must be saved, or it is lost forever. The address of the DevHlp entry point is passed in the INIT request packet (see listing 1). The initialization code performs two other functions. First, it issues the sign-on message to the screen that the driver is attempting to load. Second, it finds the segment address of the last data and last code item, and it sends them back to OS/2. OS/2 uses the code- and data-segment values to size memory. If a driver fails installation, it must send back zeroes for the CS and DS registers so that OS/2 can use the memory space it occupied.

One of the most common techniques in OS/2 driver design is for the Strategy section to request service from the device and wait for a device or timer interrupt to signal completion of the request. The fragment in listing 6 shows an implementation of this scheme for the Read function of my sample serial communications driver. In this case, the Strategy section starts the I/O and issues a `Block` DevHlp call, which blocks the calling thread. When the device interrupt signals that the operation is done, the interrupt section runs the blocked thread, completing the request. To protect against the request's never being completed (e.g., in the case of a down device), the `Block` call can contain a time-out parameter. If the time expires before the completion interrupt occurs, the Strategy section can send the proper error back to the kernel.

Another way to time-out a device is to use the `SetTimer` DevHlp routine. You can attach a timer handler to the OS/2 system clock and have the handler run the blocked thread after a specified number of ticks.

The commands allowed by the Strategy section are up to the device driver writer. You can process only the commands you wish to act on and let the others simply pass by sending a Done status back to the kernel. You may instead wish to trap the illegal function calls and return an ERROR_BAD_COMMAND message to the kernel. Keep in mind, however, that the kernel frequently issues its own commands to the driver without your knowledge. For example, when the user of the application that opened the driver types a Control-C, the kernel checks the application's list of open drivers and issues a Close request to each one. In general, I've found it easier to ignore all the requests I'm not waiting for and just flag them as done.

In the simplest of drivers, the Strategy section can only contain an Open, Close, and Read or Write request. In a complicated driver, such as a disk driver, the Strategy section may contain over two dozen standard driver functions and several additional `IOCtl` calls. `IOCtl` calls are actually Strategy functions, but they are broken down one step further to provide more detailed or device-specific operations. For instance, a driver might send a list of parameters to an I/O port to initialize it and return the input value of a status port with the status of the initialization.

A Sampler of Standard Driver Functions

INIT (code 0x00). This function is called by the kernel during driver installation at boot time. The INIT section should initialize your device, such as setting the baud rate, parity, stop bits, and so forth on a serial port or checking to see if the device is installed by issuing a status request to the device controller. This INIT function is called in a special mode in ring 3 with some ring 0 capabilities.

The driver may turn off interrupts, but they must be turned back on before returning to the kernel. The INIT code may perform direct port I/O without protection violations. Usually, the driver writer will allocate buffers and data storage during initialization, to be sure the driver will work when installed. Because the initialization is being performed in ring 3, the system can check to make sure the buffer and storage allocations are valid and the segments are owned by the driver. If not, the driver can remove itself from memory, freeing up any previously allocated space for other system components or another driver. Because initialization is done only once during system boot-up, it is not critical to optimize the section. Do all your initializations here, as it may be time-prohibitive or even impossible to do initialization during normal driver operation.

Media Check (code 0x01). This function is called by the kernel prior to disk access, and it is therefore valid only for block devices. The kernel passes the driver the media ID byte corresponding to the type of disk it expects to find in the selected drive.

BuildBPB (code 0x02). When the block driver gets a `Build Bios Parameter Block` call, it must return a pointer to the BPB that describes the mass-storage device.

Read (code 0x04). The application calls the Read section by issuing a `DosRead` with the handle obtained during the `DosOpen`. The Read routine may return one character at a time, but more often it returns a buffer full of data. How the Read function works is up to the driver writer. The driver returns the count of characters read and stores the received data in the data segment of the application. Read returns a standard driver return code.

Nondestructive Read (code 0x05). In response to this request, the driver must get the first character in the driver buffer and return it to the caller. If no character is present, the driver must return immediately with the proper error bits and Done bit set.

Input Status (code 0x06). The driver must clear the Busy bit in the request packet if one or more characters are in the driver's buffer, or set it if no characters are present. This is a Peek function to determine the presence of data.

Flush Input Buffer(s) (code 0x07). This function should flush any receiver queues or buffers and return a Done status to the kernel.

Write (code 0x08). This is a standard driver request called by the application as a result of a `DosWrite` call. The application passes to the driver the address of data to write (usually in the application's data segment) and the count of characters to write. The driver writes the data and returns the status to the application along with the number of characters that were actually written. Write returns a standard driver return code.

Write with Verify (code 0x09). The driver writes data as in the Write function code above, but it verifies that the data was written correctly.

Output Status (code 0x0a). The driver must set the Busy bit in the request packet if an operation is in progress, or clear it if the transmitter is free.

Output Flush (code 0x0b). The driver must flush the output queues and buffers and return a Done status to the kernel.

Device Open (code 0x0d). This function is called as a result of the application issuing a `DosOpen` call. The kernel makes note of the DosOpen request, and if it is successful (done with no errors) the kernel sends back a handle to the application to use for subsequent driver service. The driver writer can use this section to initialize a device, flush any buffers, reset the buffer pointer, initialize the character queues, or anything necessary for a clean starting operation.

Device Close (code 0x0e). This function is called as a result of the application doing a `DosClose` with the correct driver handle. It's a good idea to make sure the application closing the driver is the same one that opened it, so save the process ID of the application that opened the driver and make sure the closing PID is the same. If not, reject it as a bogus request. You should make all your devices quiescent at this time.

Removable Media (code 0x0f). The driver receives this request when an application generates an `IOCtl` call to category 8, function 0x20. Instead of calling the `IOCtl`, the kernel issues this request. The driver must set the Busy bit of the request-packet status if the media is nonremovable, or clear it if it is removable.

Generic IOCtl (code 0x10). This is a special type of function call. It is very flexible, as the data passed to the driver is stored in two buffers owned by the caller. These buffers may contain any type of data; the format is up to the driver writer.

The first and second parameters of an `IOCtl` are the address of the application program's data buffer and parameter buffer, respectively. The parameter

Listing 6: *The implementation of the standard Read function initiates I/O and then calls the* `Block` DevHlp *routine to suspend the calling thread. When the device signals that I/O is complete (by way of an interrupt), the corresponding interrupt handler (not shown) uses the* `Run` DevHlp *to resume the calling thread and complete the request.*

```
case RPREAD:                     /* 0x04                  */
/*
Try to read a character out of the queue.  If none is
available, then Block until the interrupt routine can get a
chance to add a character to the queue, and Run this thread.
*/
ThisReadRP = rp;
com_error_word=0;              /* start off with no errors     */
ReadID = (ULONG) rp;
if (Block(ReadID, -1L, 0, &err))
  if (err == 2)            /* interrupted
*/
       return (RPDONE | RPERR | ERROR_CHAR_CALL_INTERRUPTED);
/*
We have a single character (in inchar) from the queue.
Move it to the user buffer, and while we are here, take
any other characters available, up to the number of characters
requested in the Read packet.  Return the final count to
the caller.  This will always be one or more.
*/
if (rx_queue.qcount == 0) {
        rp->s.ReadWrite.count=0;
        return (RPDONE | RPERR | ERROR_NOT_READY);
        }
i=0;
do {
            if (TransDD2App(&inchar, /*xfer characters to
                                               user buffer*/
            (FARPOINTER) (rp->s.ReadWrite.buffer+i),
            1))
                   return(RPDONE | RPERR | ERROR_GEN_FAILURE);
}
while (++i < rp->s.ReadWrite.count
            && !QueueRead(&rx_queue,&inchar));
rp->s.ReadWrite.count = i;
QueueINIT(&rx_queue);
return(rp->RPstatus);
```

buffer might contain a list of USHORTs, UCHARs, or pointers. The data buffer parameter might be a data buffer address in the application program, where the driver would store data from the device.

`IOCtls` can extend the range of status information that drivers can convey to applications. Suppose, for example, a driver needed to report to an application that the data was in ASCII or binary format, or that a parity error was detected while receiving it. Here an `IOCtl` would be the answer. The reason? The kernel massages return codes from standard function calls to fit within the standard error definitions. The `IOCtl`, however, will pass back codes to the application exactly as they were set in the driver. In several drivers that I have written, the `DosRead` and `DosWrite` sections of the Strategy routine are commented out and never used. I use `IOCtls` for the reads and writes to allow the driver to communicate directly with the application without interference from the kernel.

PrepareForSysShutdown. This function tells the device driver it should post any open buffers to their devices before the system powers down. This occurs when you select Shutdown from the Desktop window.

Listing 7: *The completion of an I/O request can be triggered by a device interrupt or by means of a timer. Here's a sample timer routine.*

```
void timer_handler()
{
  if (ThisReadRP == 0)
       return;
  tickcount--;
  if(tickcount == 0)  {
    ThisReadRP->RPstatus=
      (RPDONE |
      RPERR | ERROR_NOT_READY);
    Run ((ULONG) ThisReadRP);
    ThisReadRP=0L;
    tickcount=MIN_TIMEOUT;
    }
}
```

The Interrupt Section

When OS/2 calls your interrupt handler, it does so with interrupts disabled, so any extended time spent in the interrupt handler could cause performance problems. When activated in response to the receipt of data, the interrupt handler must store the data and exit quickly. In the case of character devices, the OS/2 `DevHlp` library supports fast reads and writes to circular character queues. For block devices, interrupt handling is fast because the interrupt is usually caused by a DMA completion or disk seek completion. For block devices, data is ordinarily transferred to the user buffer using DMA, eliminating the need to transfer data during the interrupt processing. On a DMA transfer, the driver can exit once the DMA controller starts so that other threads can run. When the DMA completes, it generates a DMA completion interrupt that activates the driver's interrupt handler.

The interrupt handler routine is not difficult to write or understand, but it can be very difficult to debug. Errors that occur in the interrupt handler frequently appear only in a real-time context, when the interrupt handler is active in response to a hardware interrupt. You can't do a `printf()` from the interrupt routine or inspect variables with an application debugger, such as CodeView. You must use the OS/2 KDB (Kernel Debugger) supplied with the DDK or a similar debugger. Even with the KDB, a breakpoint will halt the program, and further interrupts may pass undetected while you decide what to type next. Because of this pause in execution, you lose the real-time context of the program, which may be the root of the original problem. In the end, there's no substitute for the ability to visualize the correct operation of the interrupt handler.

The Timer Handler

In an OS/2 driver, you can hook the system timer interrupt with a call to the `DevHlp` library `SetTimer` function. You pass OS/2 a near pointer to your timer handler, and for each system timer tick, OS/2 calls your timer handler routine and any other timer handler that had been previously registered (see listing 7).

If no data appears within one or two 32-millisecond time ticks, the driver assumes that data input has stopped or at least paused. If a valid Read request is pending, it sends back the data to the blocked Strategy section by issuing a Run request with the same ID used to block the requesting thread. The Strategy section becomes unblocked, gets the data from the receiver queue, and sends the data to the application's data buffer.

Do You Really Need a Device Driver?

Maybe not. OS/2 1.x allows programs with I/O Privilege (IOPL) enabled to do direct register I/O to a device. If the device is a parallel card or digital switch, a driver may not be necessary. You can set or clear bits using IN and OUT instructions, and as long as the device is not time critical, such a method will be sufficient.

Yet devices that generate interrupts, require asynchronous service, or operate in a time-critical environment must use a device driver. Take a serial device, for example. It would be difficult or impossible to read data from the device using the IOPL method. By definition, asynchronous data may come in at any time. Because OS/2 may be running another thread at the time the data appears, your chances of missing data are excellent. But an interrupt driver could continue to read and buffer the incoming data until the OS/2 scheduler ran your thread.

Optionally, you can allow interrupts to preempt the current running thread and run your thread immediately. You need not wait for the scheduler to run it. This sort of preemptive multitasking sets OS/2 apart from other multitasking systems, like Unix. In Unix, the currently running program retains the CPU until it exhausts its time slice. It cannot be preempted based on an event, such as a device interrupt. That's why OS/2 is my choice for time-critical applications. ■

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HUGH KENNER

Noisy Narcissists, One Genius

What makes one genius into a criminal and another into a Nobel Prize winner?

Question: What intellectual quality is shared by Herbert A. Simon, Robert T. Morris Jr., Kevin Mitnick, Markus Hess, and Hans Huebner?

Answer: Remarkable native talent for attacking abstract problems plus the drive to make use of that talent.

Q: Why might Herbert A. Simon prefer to see his picture in a different gallery?

A: Because, while Simon is a Nobel laureate (1978, economics) and a father of AI, the others are chiefly remembered for run-ins with cops and courts. Morris got hit with $150,000 in fines and legal fees plus 400 hours' community service for unleashing the 1988 Internet worm. Mitnick served a year for fooling around with DEC's files. Hess paid 10,000 marks and was sentenced to 20 months (reduced to probation) for his traffic with the KGB; he was the hacker in the caper Cliff Stoll recounts in *The Cuckoo's Egg*. Huebner (aka Pengo, German nickname of a penguin in a video game) won nonprosecution by informing on accomplices in espionage, notably Hess.

Q: So what force pointed Simon toward glory, the rest toward, ah, embarrassment?

A: That is the question two books invite us to ponder. Simon has published *Models of My Life* (Basic Books, 1991, $26.95); Katie Hafner and John Markoff tell the story of the others in *Cyberpunk* (Simon & Schuster, 1991, $22.95).

Briefly: Cyberpunkery feasts on dreams of glory, nothing more. "I alone know that I am the world's greatest hacker!" And as Eve in a rush of guilty knowledge just had to tell Adam, so Pengo and Morris likewise had to tell friends, which was their undoing. For your fragile dream loses allure if the knowledge that *you* alone know about it cannot be shared.

Cyberpunk is worth a quick browse, quick enough to mute the cacophonies of its sledgehammer prose. Herbert Simon's *Models of My Life*, though, is a book to savor sentence by sentence. "On the cool days of late summer, whitecaps advanced across the deep blue lake, driven by a sharp wind that twanged the flagpole near the dock and rocked the moored rowboats in cadence with the twanging."

That's not an economist's boilerplate, nor yet just fancy writing. It's the voice of a man who treasures correlations, such as rowboats a-rock in cadence with a twanging. Narcissists aren't open to such outwardness; the domain they toy with is the enclosed system, Unix or Pacific Bell or VMS, imperfect like all human-made things and rife with the holes, trapdoors, forbidden portals, that no system operator has a suspicion of.

Simon lives, by his own account, in two worlds. One is the world in which we can all share observations. Systematize those, and we have the domain of science. The other is personal: a lifelong maze, in which he's repeatedly chosen some branching path that, in forgoing some unknown possibilities, opened others. He was diligent in pursuing the opened ones, and their sum is the track of his life.

Thus, about 1935 he took a fateful branch. Color blindness had steered him out of biology; distaste for an accounting course meant dropping economics for political science, although he never mislaid the economics. He found himself doing "my first piece of scientific work," a college assignment. "A standard topic in studies of organizations is the budget process, which in this case involved the division of funds between playground maintenance, administered by one organization, and playground activity leadership, administered by another."

It was soon obvious that the "global rationality" of classical economics wasn't in play. Global rationality says, consider the playground concept, an arena in which resources will be optimized. But reality says, consider the smaller horizons of two bodies, the maintenance folk and the activities folk. Each wants more money, and the ideal big picture vanishes. That led Simon to "bounded rationality," "a label for the computational constraints on human thinking."

"When people don't know how to optimize, they may very well be able to...find good enough solutions. And good enough solutions can often be found by heuristic search through the maze of possibilities." That, two decades later, became AI. "A research problem I found in 1935 has lasted me for a half century. I have never had to find another." That funded bodies guard their own funds he'd have found entirely natural, he remarks, save for the economic training with which it conflicted. And no merely press-trained cynic, deeming it obvious, would have broken through to bounded rationality and to AI.

That's a subtle theme, common sense impinging on a faulty orthodoxy. For the orthodoxy, after all, was not framed by idiots. Its framers, too, had obeyed the bounded rationality of their discipline as it was defined; they, too (notably Milton Friedman), have since merited Nobel prizes. Hence, for Simon, that large question, How do decisions (including academic decisions) get made? The ensuing "search through the maze of possibilities" was something a computer might accomplish. The first computer Simon got his hands on was John von Neumann's JOHNNIAC (1955), with a 4096-word memory. If it was more than intriguing gadgetry—no, a necessary aid—that was thanks to the playground assignment he'd confronted at 19. (And bless the Chicago teacher who assigned it!)

Now 75, he's written a book as subtly structured as any of his theorems. The two pages I've been paraphrasing come very late, resonating, thus, with 370 pages we've already read. I was tempted to say, whet your appetite with the last chapter, "The Scientist as Problem-Solver." I'm now convinced that *Models of My Life* needs to be experienced the way it's laid out: straight through. A sense of the maze, of large wholes achieved for the alert mind by serendipitous branching: That's something the *Cyberpunk* crew underlines by contrast. ■

STOP BIT

MARSHALL BRAIN

THE X ATTITUDE

I have a Unix workstation in my office, and I love it. It has a CPU that runs at 12 million instructions per second, 12 megabytes of RAM, a big swap disk, and 8 gigabytes of server space on the network. Of course, it runs the X Window System. But even with all this hardware, X Window is just "acceptable."

I have a Mac SE next to my workstation. Even though the workstation trounces the Mac at number crunching (it's 40 or 50 times faster), the two are neck and neck when it comes to windows and graphics. Ask both machines to draw 10,000 random line segments, and they finish about the same time.

A pig of a program can look pretty and sleek, given time and good hardware

What is going on here? Why would anyone design a system like X Window, such a pig when it comes to hardware resources? How did the designers get away with this? Why have people embraced the X Window environment?

X Window is successful for many reasons: It's free, it's portable, and it works. But more important, X Window is designed to offer some very nice capabilities, despite the fact that these capabilities require lots of hardware. I call this design philosophy "the X attitude," and its central tenet is, "The hardware will catch up shortly." This attitude has broad implications for software designers everywhere.

Everything about X Window is a pig. Its disk and RAM requirements are unbelievable. For example, if I want to build a little "hello world" program, I use the Motif widget set and write 10 lines of code. The executable file for this one little program consumes over a megabyte of disk space!

The network traffic generated by an X workstation is unbounded. X Window is *network transparent*, which means that I can run a simulation program on a supercomputer and get its graphical results displayed on my workstation. But X terminals can run a drawing program the same way. Every time I move the mouse 1 pixel while drawing a line, the terminal dumps a *button motion event* packet onto the network, and the computer at the other end has to send back commands to redraw the line—in real time.

You can see that X Window has tremendous hardware demands. What's interesting is that in 1984, when X Window was conceived, no normal person had hardware that could handle these loads. The 128-KB Mac came out in early 1984, and the IBM AT later in the year. But the designers of X Window were in a completely different world. It's as though they said to themselves, "Let's not clutter our minds with the constraints of today's hardware. The hardware will catch up with us in a few years." With the X attitude, you simply ignore hardware limitations and let the design proceed uninhibited. In a world where hardware is advancing by leaps and bounds every year, this is the smart thing to do.

The primary advantage of the X attitude is this: It is incredibly freeing from a creativity standpoint. No longer are designs constrained by today's realities.

It is educational to look for the X attitude (or its absence) in other products, like PostScript. It epitomizes the X attitude: It works, it is portable, and it is powerful. It is also a pig. It wants lots of MIPS and RAM, even though it was designed when these were expensive. It has been successful despite its prodigious appetite because of its amazing capabilities.

Then there's OS/2. Its designers ignored the X attitude. They initially stuck with the old 16-bit 286 architecture instead of looking ahead to the future. The design was constrained and limited by this decision, and OS/2 has paid dearly for it. There is a lesson here.

What do you do if you are a software designer and you want to make use of the X attitude? Buy the biggest, fastest machine you can find. Load it to the gills with memory, give it a few gigabytes of highly cached disk space, and connect the fastest graphics coprocessor you can find. Sure it costs $50,000 now, but in three years it will be a small-footprint entry-level machine.

Now use this monster for a month. Write some good code, and watch it scream. Let your mind wander. What kind of software would you design for a machine like this? What are the possibilities that open up? Which nagging limitations fall by the wayside? Now you have the right attitude! Program toward the future, not for the past. The hardware vendors will love you. ■

Marshall Brain is a faculty member at North Carolina State University and is the author of An Introduction to Motif Programming *(due from Digital Press in 1992). You can reach him on BIX c/o "editors."*

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35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68
69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85
86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102
103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119
120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136
137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170
171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187
188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204
205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221
222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238
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290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306
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443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459
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477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493

Inquiry Numbers 494-986

494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510
511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527
528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544
545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561
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970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986

Inquiry Numbers 987-1479

987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003
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1 ☐ MIS/DP
2 ☐ Programmer/Systems Analyst
3 ☐ Administration/Management
4 ☐ Sales/Marketing
5 ☐ Engineer/Scientist
6 ☐ Other

B. What is your level of management responsibility?
7 ☐ Senior-level
8 ☐ Middle-level
9 ☐ Professional

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?
10 ☐ Yes
11 ☐ No

D. What operating systems are you currently using? (Check all that apply.)
12 ☐ PC/MS-DOS
13 ☐ DOS + Windows
14 ☐ OS/2
15 ☐ UNIX
16 ☐ MacOS
17 ☐ VAX/VMS

E. For how many people do you *influence* the purchase of hardware or software?
18 ☐ 1–25
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Inquiry Numbers 494-986

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Inquiry Numbers 987-1479

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4. How many PCs does your company plan to purchase in the next twelve months?

Quantity	Timeframe	Quantity	Timeframe
______	Less than 1 month	______	6-12 months
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5. What do you plan to use computer products for?

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6. How many PCs do you have installed now at your company?

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7. Are you interested in leasing? ☐ Yes ☐ No

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