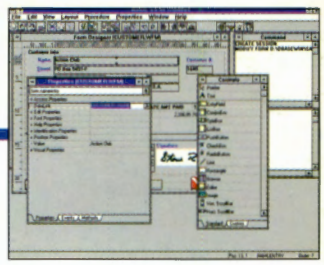
THE INDEPENDENT GUIDE TO PERSONAL COMPUTING OCTOBER 11, 1994 VOL. 13 NO. 17 U.S. $3.95 / CAN. $4.95 / U.K. £2.95

PC MAGAZINE

dBASE for Windows:
More Than You'd Expect



Tools for Rightsizing:
PC Labs Tests File Servers, SQL Databases, and Ethernet Switches

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- Everything You Need to Know to Get Connected
- How to Find the Data You Need
- Internet Tools And Providers

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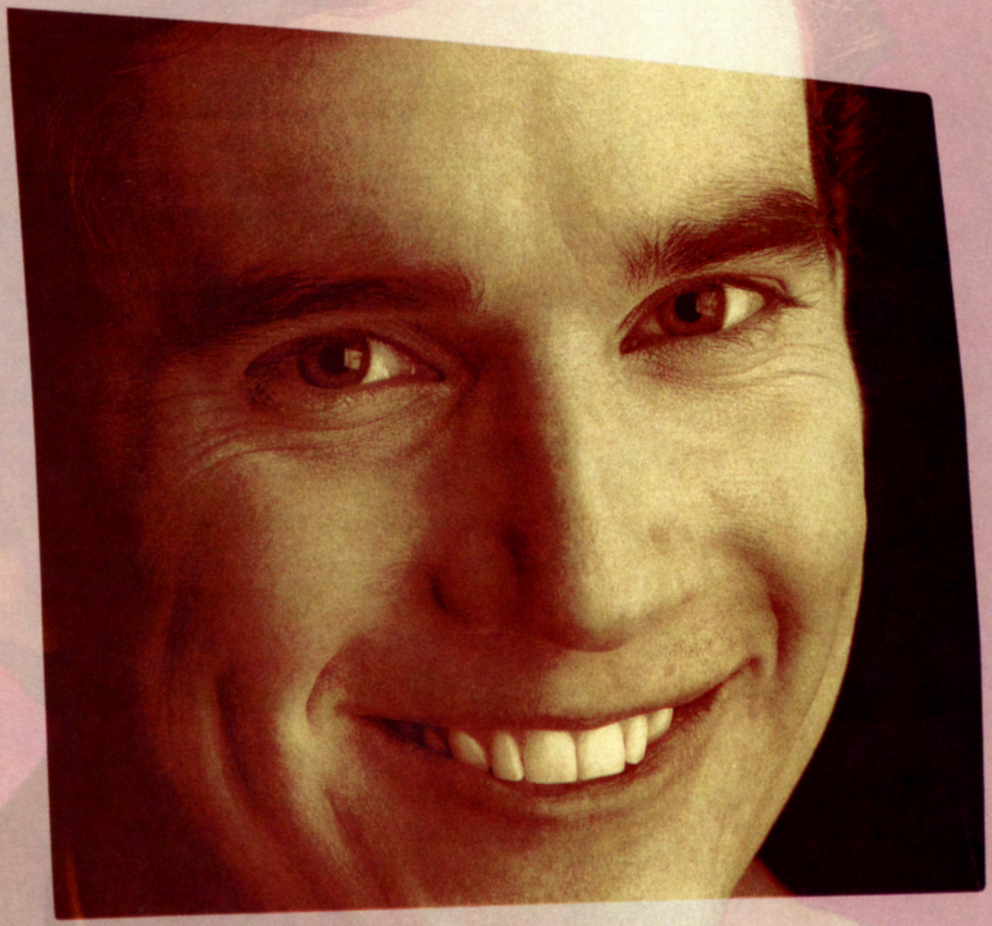

Fifteen hours today.
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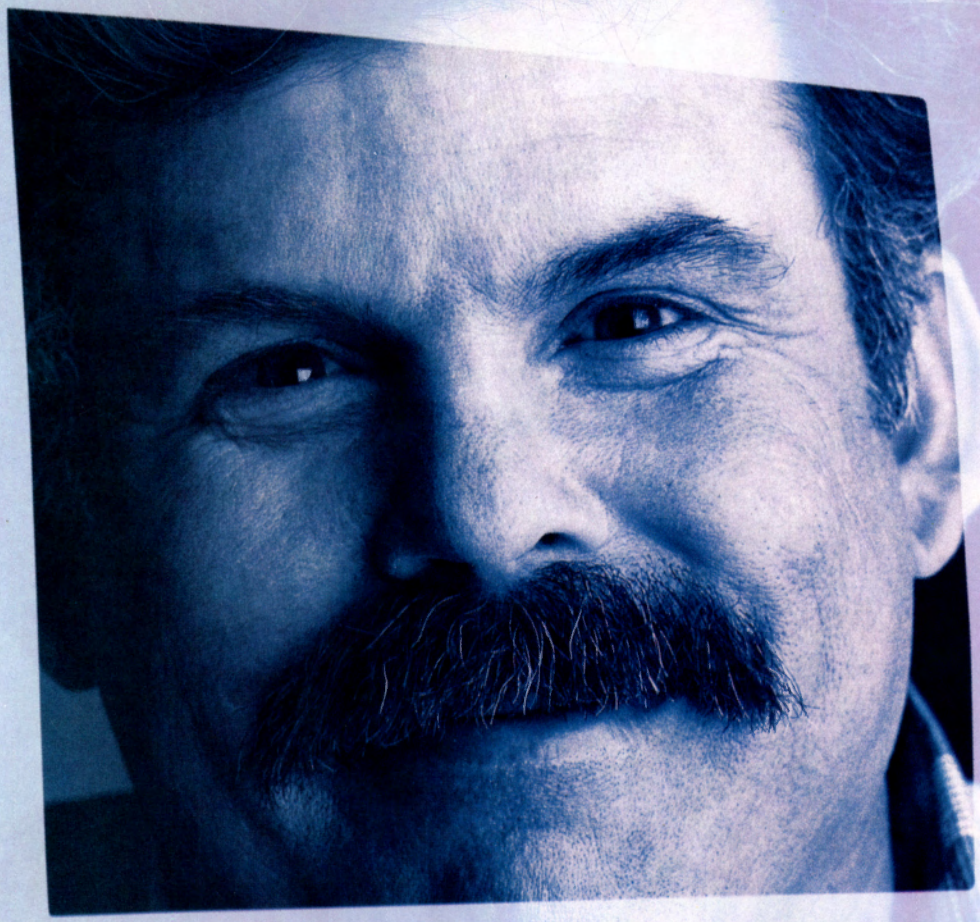
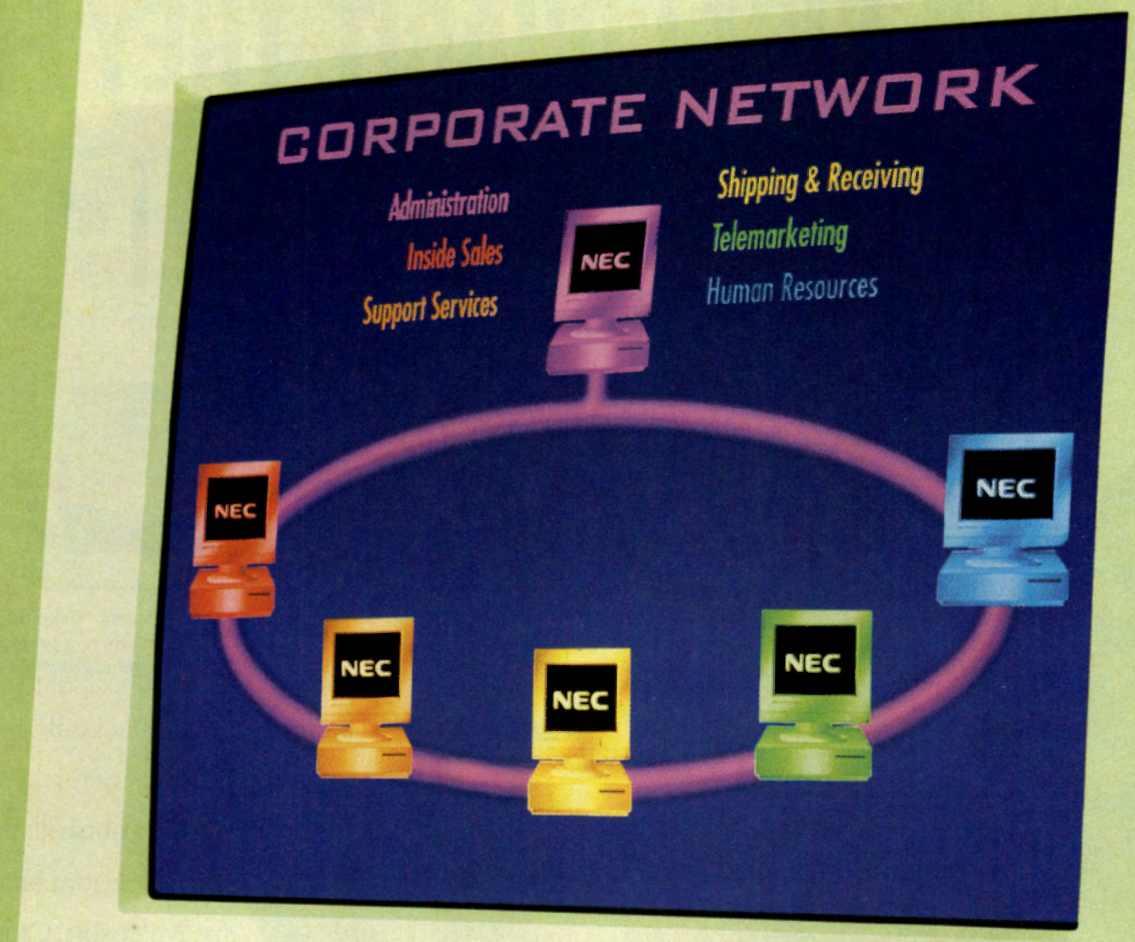


Ten hours per day.
One hundred and thirty words per minute.





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IN THE MICROSOFT OFFI
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You might say we simply borrowed the idea from nature. Programs that live in the same place should work together.

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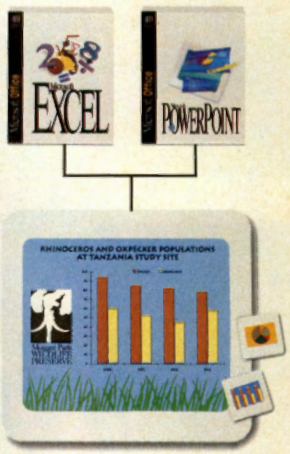

Create powerful presentations easily with information from different programs. Suddenly, you're a whiz presenter.

In a nutshell, that's the whole idea behind the Microsoft® Office. Now all your programs can work together like one.

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Then you click to open your Microsoft Access® database and call up your sales data. By client. By vendor. By salesperson. By region. By month.

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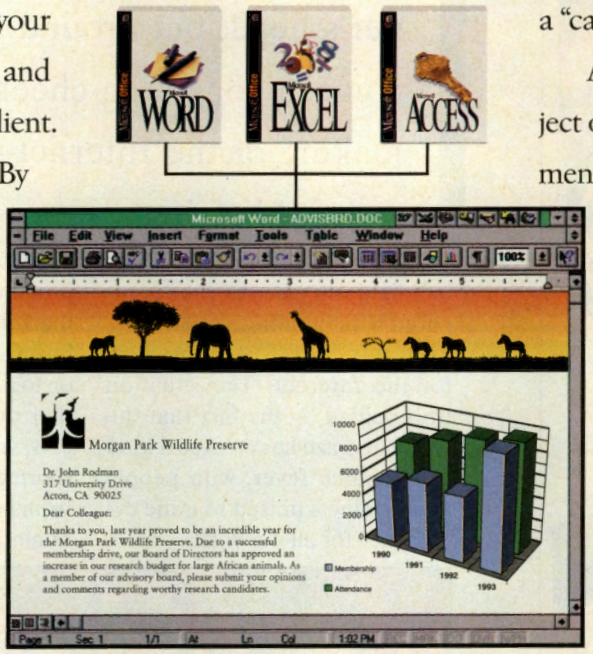
And while we're on the subject of relationships, we should mention the Microsoft Office is the only product of its kind that offers you unlimited product support with no service charge.*

Clearly, the Microsoft Office with OfficeLinks marks a quantum shift in what software enables you to achieve. And it's a clear indication of where the future is heading.

To find out the rest of the story (a small sample of which we've covered here), visit your retailer or call (800) 894-6642, Department VAC, for your Office Information Kit.

With the Microsoft Office, you'll not only improve the relationship between your programs, the same will go for you and your computer.



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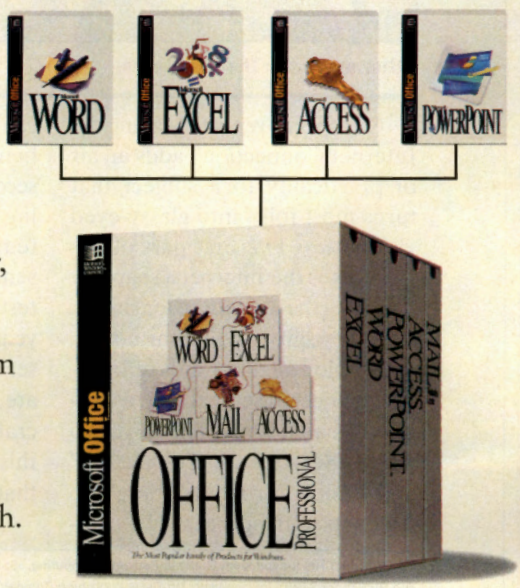

Microsoft Office

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Inside

If you build it, they will come" may have started life as a voice inside Kevin Costner's head, but around our halls it's become a tongue-in-cheek slogan for the making of the Internet—the PC world's own field of dreams.

Undoubtedly, building a baseball field is a piece of cake compared with building a secure, fiscally responsible infrastructure for the Internet. The situation isn't helped by the fact that the Internet craze has created a kind of Klondike fever, with people and products poised to mine cyberspace for all it's worth.



Butler and Mace: The Rightsizers.

Our special report "Making the Internet Connection" adds an air of practicality to a subject that turns most folks into glassy-eyed visionaries. The first part of the story gives the Internet a shape by depicting the how-tos of logging in, using newsgroups, sending e-mail, and exploring thousands of Internet-connected servers with a variety of search tools. The next two parts, "Services for Connecting" and "Tools for Connecting," tie products to the process. We compare 12 products, each of which promises instant and easy access to the Internet. You can choose to buy a set of tools, or you can sign on to a commercial on-line service that provides some Internet access. In this story, you'll find no shortage of opinions on how to get from here to there. Hmm, kind of reminds me of the Internet itself.

Another area still zoned "Under Construction" is the client/server arena. This issue marks our third annual look at PC-based SQL server software, and testing is more rigorous then ever. Not only do we pit Microsoft, Oracle, and Sybase against one another, we also pose two basic questions that only testing can resolve. First, do these servers benefit from multiple CPUs, and second, if you're going to be shooting the budget on a big server system, what platform makes most sense? With ZD Labs' exhaustive testing, contributor Brian Butler's years of expertise in getting the big servers up and running, and associate editor Thomas Mace's way of crafting a story, we're prouder of this year's coverage than of any that has come before.

—Robin Raskin

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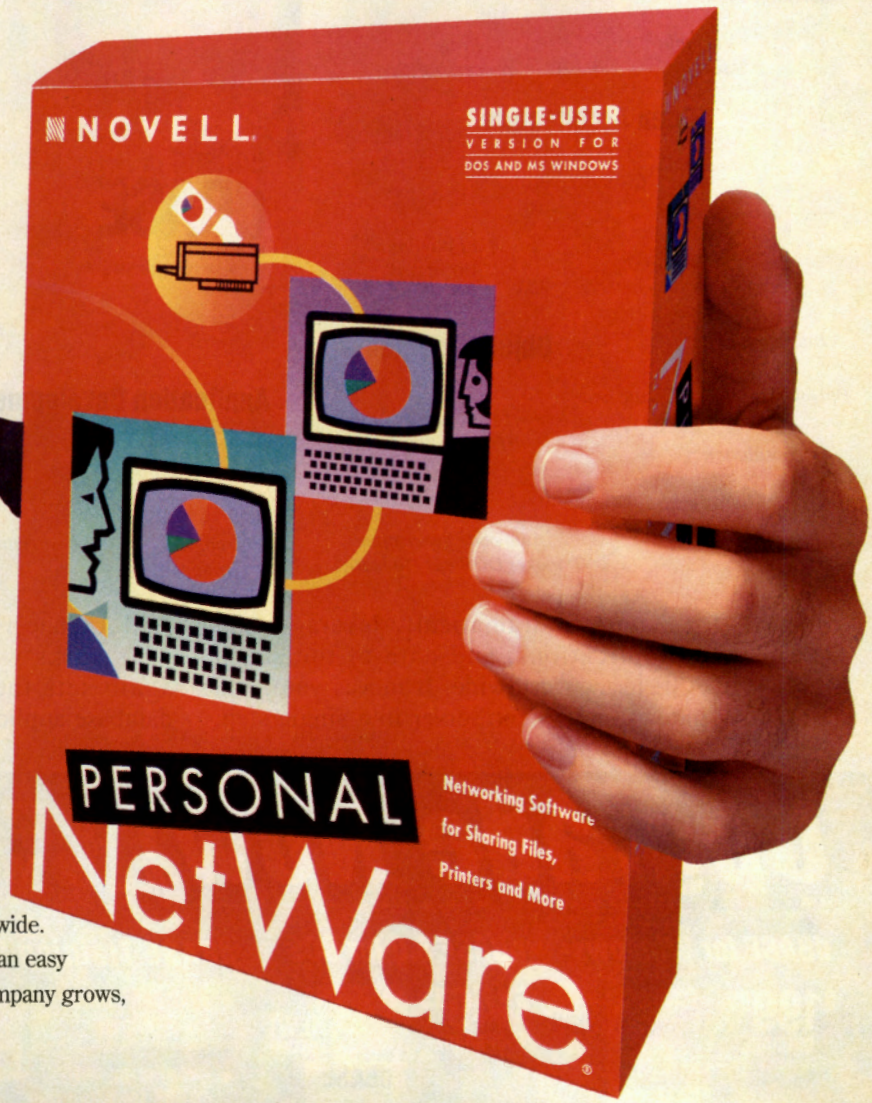

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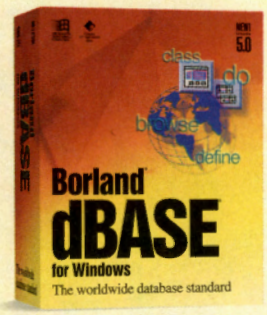

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COVER STORY

Internet Access



Making the Internet Connection

BY RICK AYRE With more than 20 million high-tech members, the Internet may be the world's largest exclusive club: Everyone's talking about it, everyone wants to be there. But information on how to get connected is scarce. *PC Magazine* tackles the tough questions: What problems, what decisions do I face in connecting to the Internet? What services are available? What tools can I use? We review eight software products and four on-line services—and show you how it all fits together **118**

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File Servers: Data on Demand



BY JIM SEYMOUR Today's networks demand that file servers be more than just upended desktop PCs. They must be scalable, expandable systems that incorporate security and fault-tolerance features and have room to grow with your network. We test 15 file servers to determine which ones meet these needs.....**187**

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Switching Hubs: Switching to the Fast Track

BY GARY GUNNERSON Thanks to faster desktop processors and larger applications that create bigger files for your users to send to each other, your Ethernet network is struggling to keep up with the heavier traffic. Before you spend a fortune to replace a lot of hardware in moving toward a high-speed solution, take a look at switching hubs. Basically, you plug in a switch and immediately gain bandwidth; you don't have to replace any of your current hardware or software. We examine ten switches, both with and without high-speed ports.....**297**

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SQL Databases: The Great Leap Forward

BY BRIAN BUTLER AND THOMAS MACE This year was different. Where products in the past have crashed and burned, *PC Magazine*'s third annual marathon test of SQL database servers reveals a new level of stability and robustness. Performance is also up, and prices are falling. Our exhaustive tests put the leading SQL databases through their paces to reveal the hardiest.....**241**

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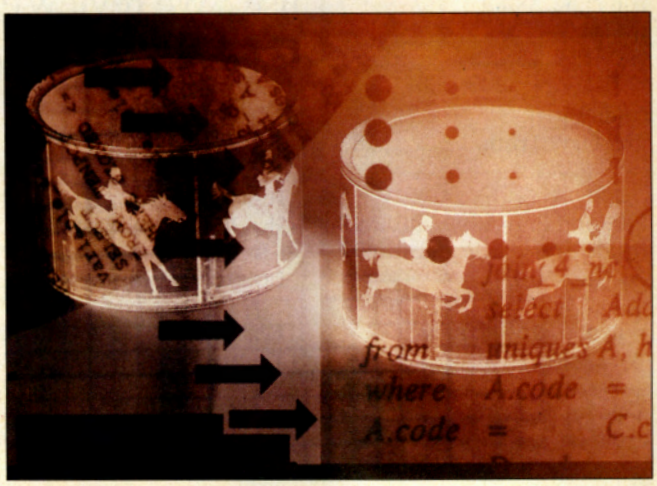

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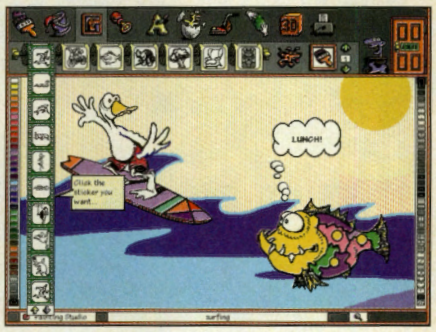

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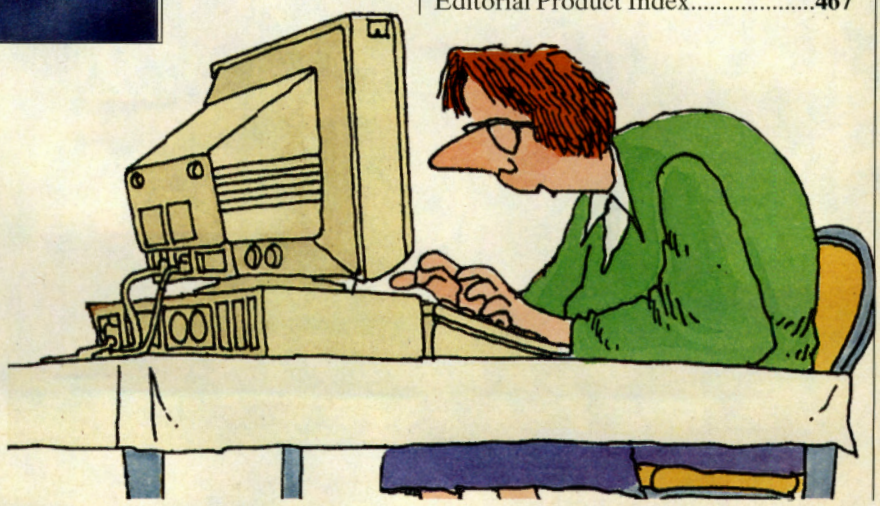

Mom loses her cool in cyberspace (page 478).

The detail of EPSON's 2400 dpi,
scanner really stands



Actual 30-bit scan

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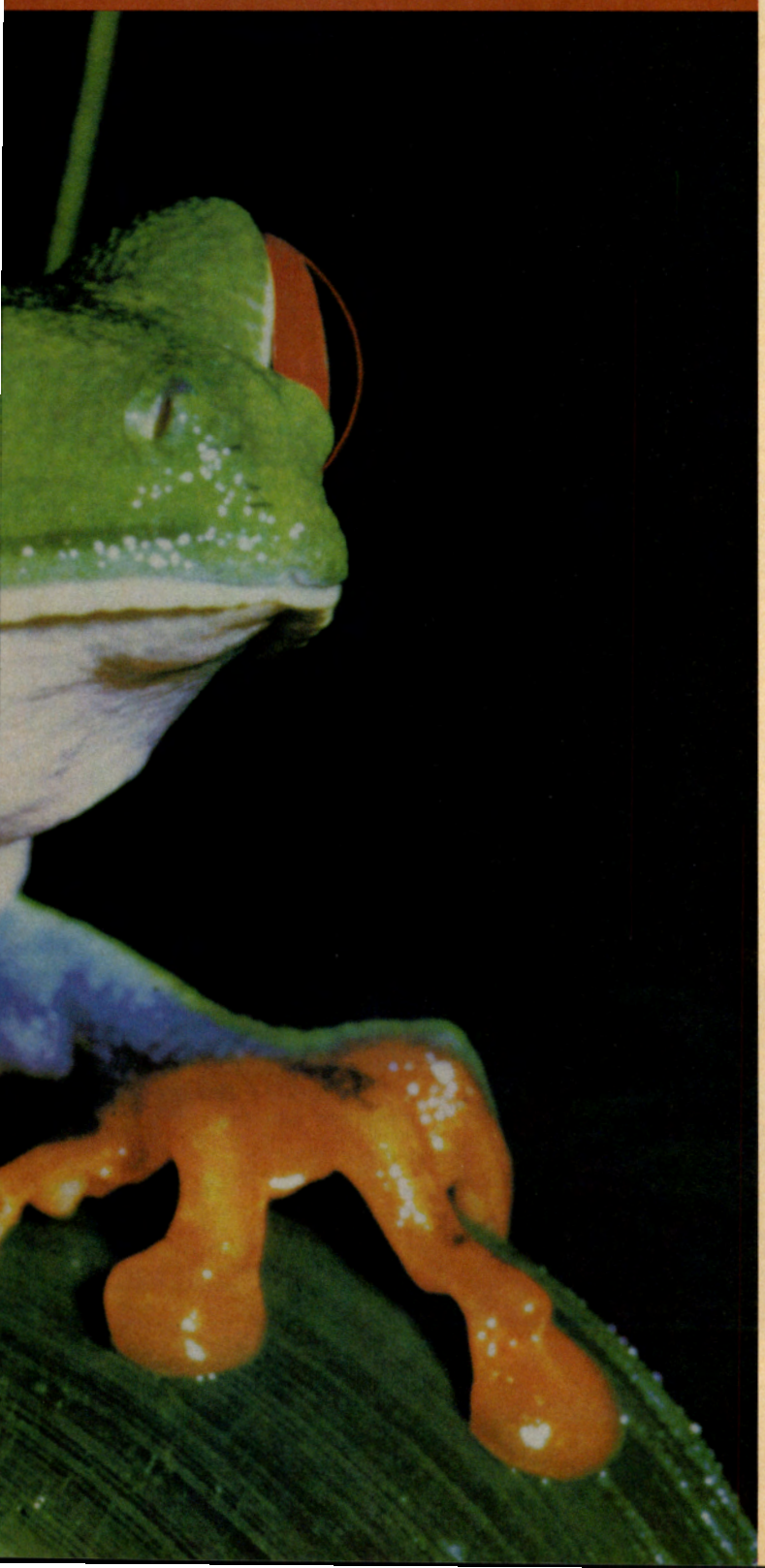
30-bit color out.



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Dual Connectivity	yes	no	no	no

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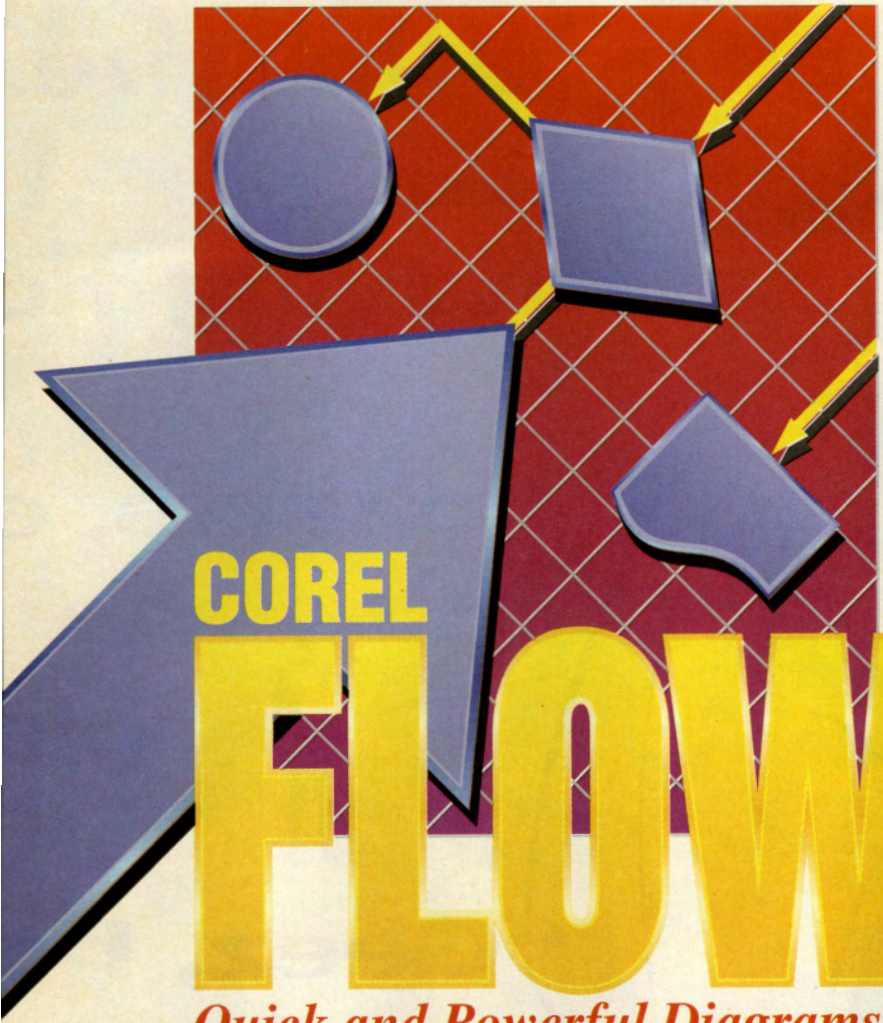

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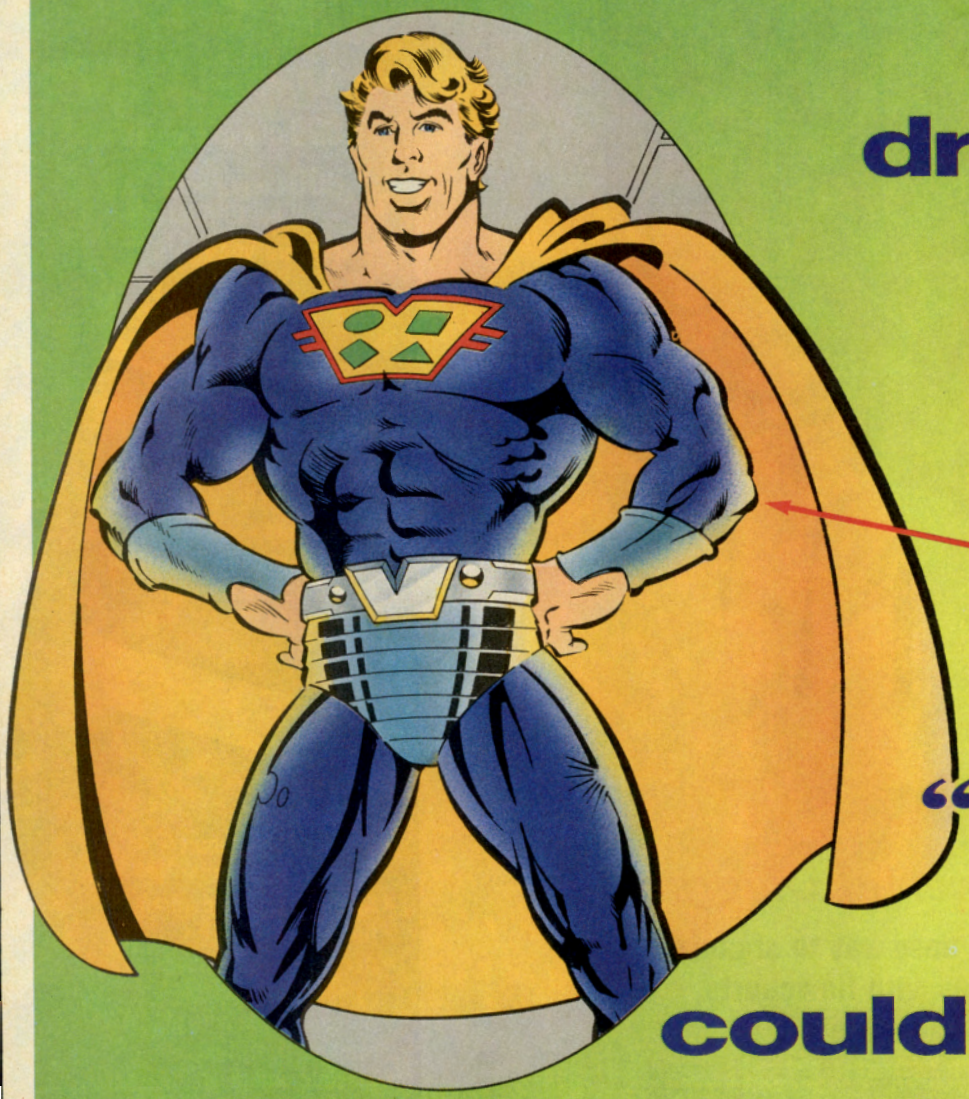

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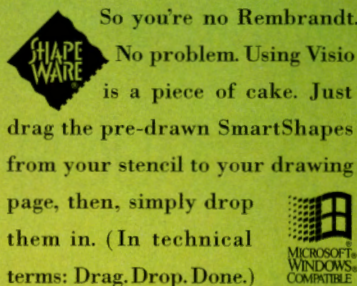

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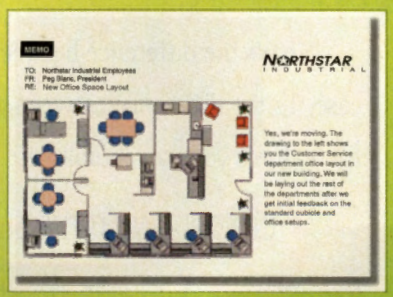

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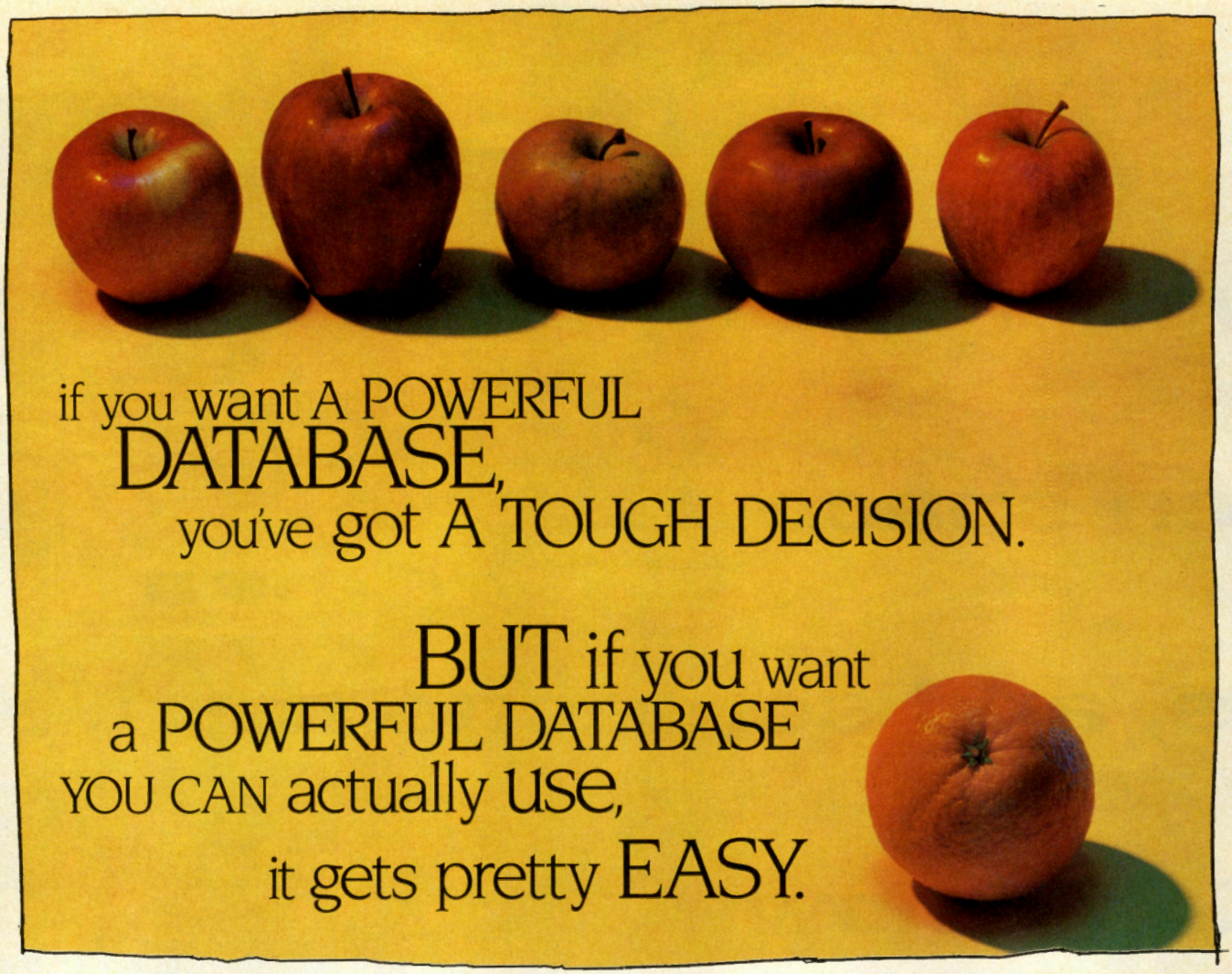

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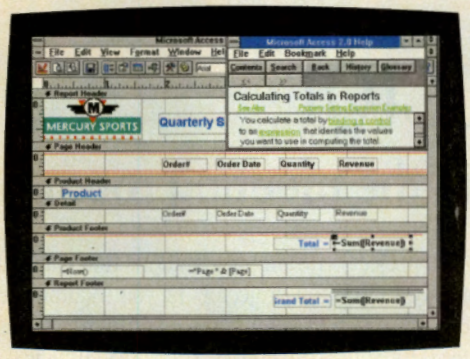

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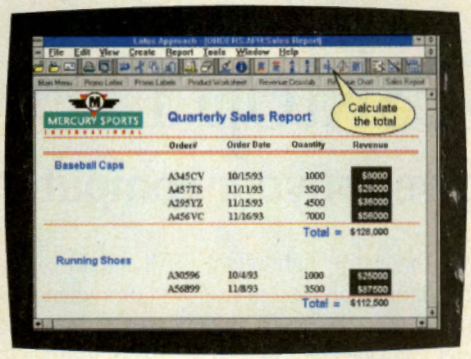

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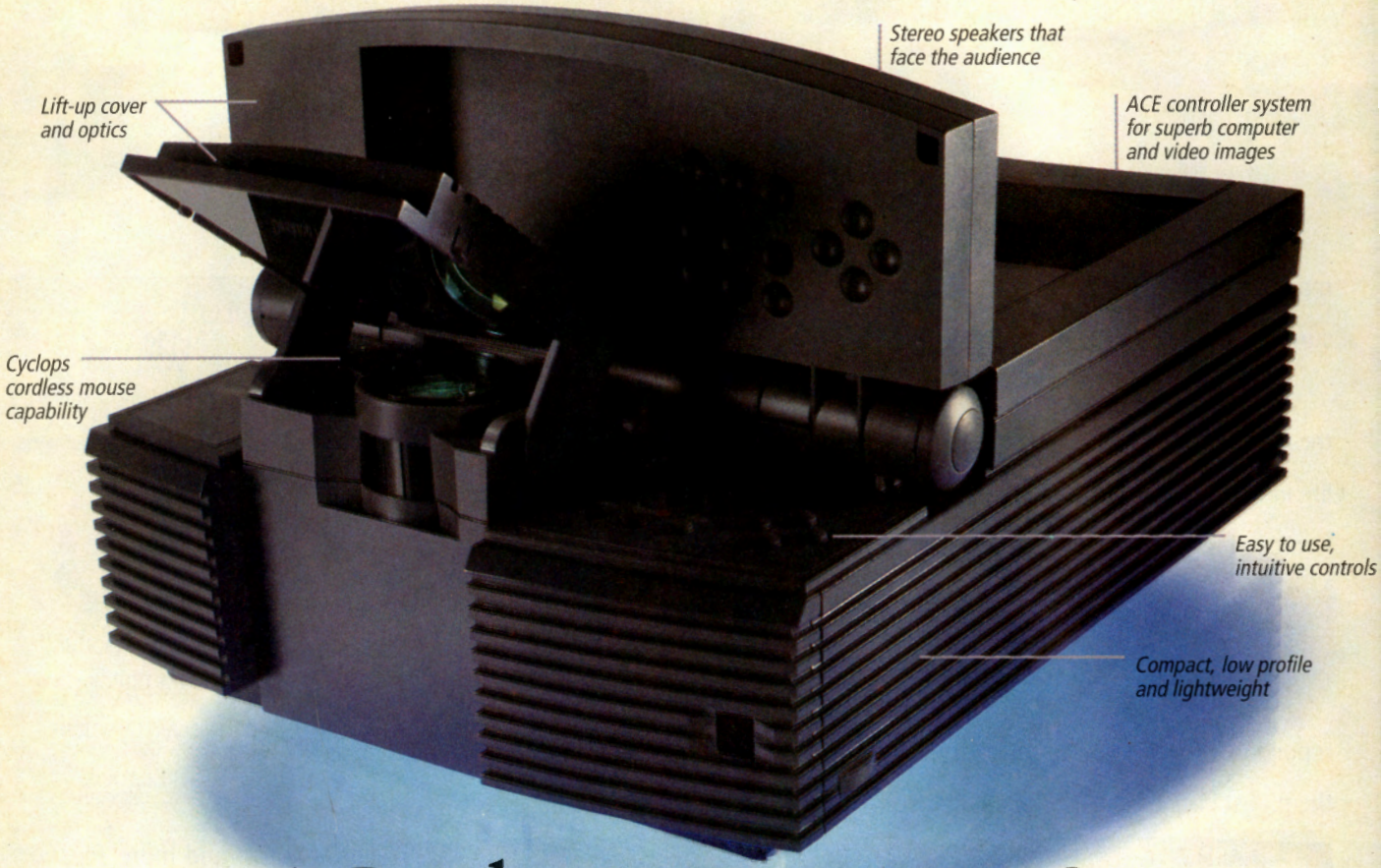

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Letters

FINDING THE PRIZE

Bill Machrone's column about the laudable efforts of the group Voice for Joanie ("Eyes on the Prize," June 28, 1994) has brought to light an important issue. Computers can be adapted to help children and adults overcome disabilities. My five-year-old daughter has a connective tissue disorder and vision impairment; her ability to write legibly is significantly limited. When she enters school this fall, she'll most likely require an adapted computer to perform many traditional pencil-and-paper assignments. My daughter is one of many individuals who will go through school or employment with a disability.

There is a tremendous need to get information out to the general public regarding computer software and hardware accessories for people with disabilities. Teachers and employers in particular must be properly informed about the latest innovations so that they can best help their students or employees.

Bob Talis
via the Internet

• For additional information on the group Voice for Joanie, contact Shirley Fredlund at 203-355-2611, ext. 4517. —Ed.

Machrone has provided an interesting perspective. It is great to hear of efforts to help those who are not so fortunate. A friend of mine who's a former chief scientist for the U.S. Navy is stricken with multiple sclerosis; he has no control of his body below the neck, but he's still very intelligent and strives to find ways both to communicate more fully and to enrich his mind. I've wanted to help him in the area of speech signal processing and was glad to learn of the group Voice for Joanie.

Troy Giles
via the Internet

Kudos to Machrone. Computers can be a valuable tool for the disabled, and this is something that needs to be highlighted more often. I administer an Internet mailing list designed to allow persons with disabilities—and nondisabled professionals working with the disabled—to


Bill Machrone
Eyes on the Prize

Computers can be adapted to help people overcome disabilities.

discuss various aspects of disability and the use of the Internet to aid the disabled. You may subscribe by sending the message "sub mobility [your name]" to "listserv@sjuvm.stjohns.edu."

Robert Mauro
via the Internet

DEFINING ACCESS

In the article "Remote-Control Software: How to Be in Two Places at Once" (August 1994), *PC Magazine* outlined certain criteria for defining *remote access.* However, it is important to clarify what the term *remote access* means to the professionals who develop remote communications software. We at Ocean Isle spend a lot of time distinguishing between *remote control* and *remote access.*

In a *remote-control* situation, you connect to a host PC, run applications that reside on the host, and input data to the host system; any resulting on-screen changes are reflected back to the viewing PC. With *remote access,* you still connect to another PC, but instead you use data residing on that PC, typically while running applications locally. Our software ReachOut was the first program to offer both *remote control* and *remote access* (via drive mapping) when we introduced it about a year ago, and this feature has quickly become standard.

Doug Fowler
Vice President, Ocean Isle Software
Vero Beach, Florida

PENTIUM TO THE MAXIMUM

Step into the nineties. The relative importance given DOS scores in your roundup of 90-MHz Pentium machines ("The Pinnacle of Power," June 28, 1994) leaves me wondering what applications you guys are running. We're not working with 286s any more: What's important is how well these Pentium machines handle GUI environments (including IBM's OS/2 and Microsoft Windows NT) and what they can do with up-and-coming technologies (such as Microsoft Video for Windows).

E. Christenson
via the Internet

The Pentium has been available for well over a year, and yet we still haven't seen any software optimized for use on the Pentium. Stop worrying about the availability of native applications for the Power PC, and start wondering when software will be available to take full advantage of the powerful computers that are ready now.

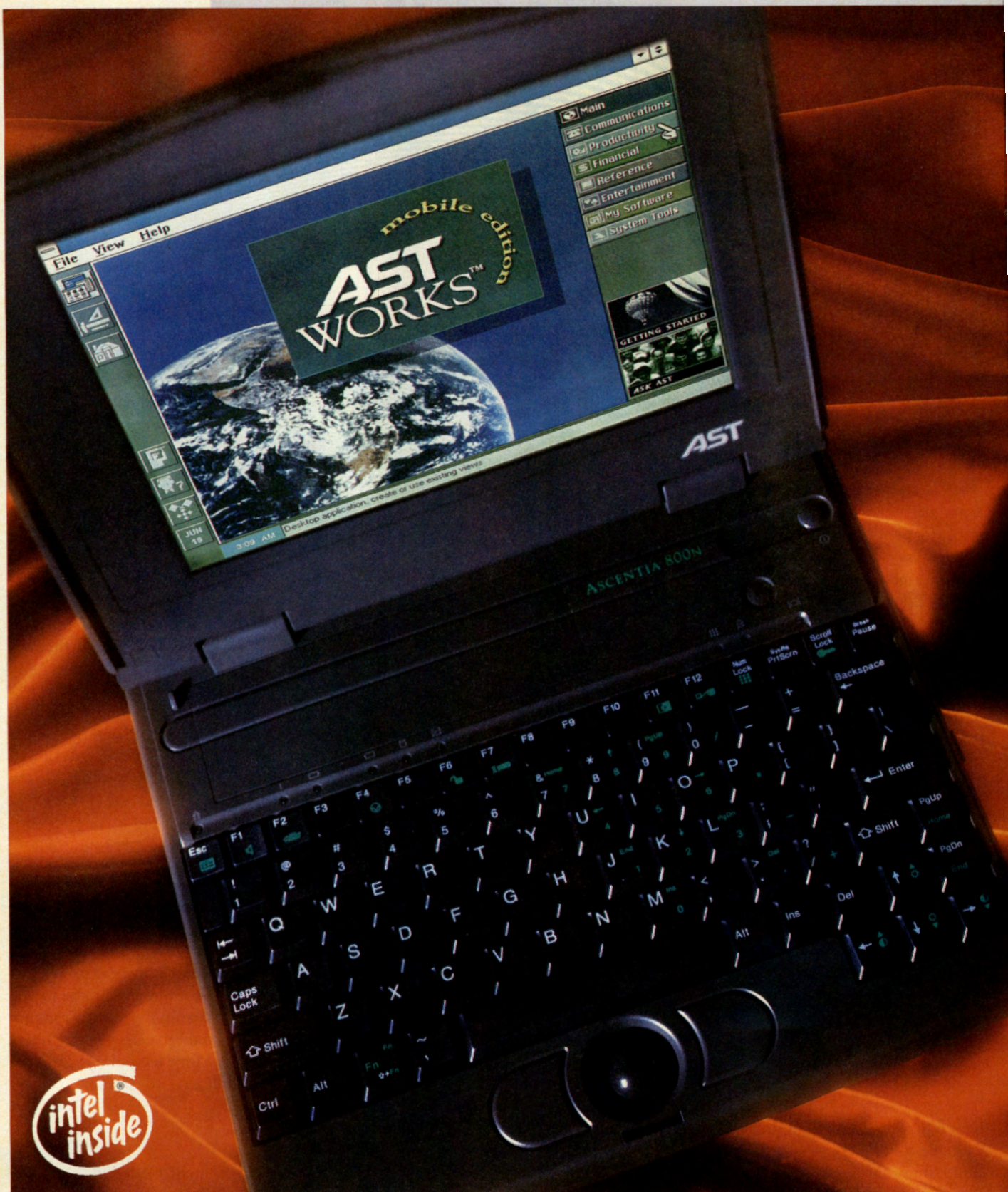
Tom Nielsen
via the Internet

ORWELL ON MY MIND

In Bill Machrone's excellent column "Privacy in the Digital Age" (June 14, 1994), he mentions the position of FBI director Louis J. Freeh that "the American people must be willing to give up a degree of personal privacy in exchange for safety and security." I have only one response to Mr. Freeh—a quote from Benjamin Franklin: "Those who would give up essential liberty to purchase a little temporary safety deserve neither liberty nor safety."

Paul Card
via PC MagNet

First Amendment, Second Amendment—it really doesn't matter to all those nice people with the best of intentions in Washington. The Second Amendment will be the first to go, but the freedoms of



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LETTERS

speech, privacy, and unreasonable search and seizure will shortly follow. All of these rights have already begun to erode. The ongoing war on drugs and crime has given the elitist federal government the justification to "do something even if it's wrong," and this attitude is only going to carry over into the digital world.

Jim Reid
via PC MagNet

Machrone is on the right track with his attack of the federal government and the Clipper chip. It seems as though, in spite of running a little behind schedule, George Orwell's 1984 predictions will come true—at the least by the year 2000. The nation's security, or lack thereof, is at stake if the Clipper chip is adopted. Encryption itself is a good idea, but if we allow the government to decode the information we send, we, the users, lose all semblance of confidentiality.

Aaron Stanley
via the Internet

THE ENDGAME IS NEAR

In his column "The Endgame" (June 14, 1994), Michael J. Miller makes a point that most financial and technology journalists fail to appreciate. There is a distinct difference between a consolidation during a growth phase and one that occurs in a mature phase. In the software business, consolidation is taking place in some—not all—of the mature niches. Although the rapid pace of technology is a key element in providing new opportunities, it is just as important that the software business still has relatively low barriers to entry compared with other consumer products.

Rob Kugel
via the Internet

INCREASING WIZARDRY

Jim Seymour's column "Not How, But What" (June 14, 1994) provided some interesting insight into the concept of Wizards, and it's good to see that the Wizard concept has been applied successfully at even higher levels by Microsoft. When a computer requires so much detailed knowledge of the system supporting it that only technoids can find their way through the maze, the environment is ripe for change. There is little doubt that Wizards represent a powerful new ingredient in future applications.

Robert L. Kellogg
San Diego, California

IT'S ALL IN THE NAME

John C. Dvorak discusses how IBM's OS/2 has a large installed base and yet developers still seem to ignore it (Inside Track, June 14, 1994). A key to the perception Dvorak mentions is name recognition. OS/2 has fallen into the same trap that's plagued many a product ahead of its time. If OS/2 were constantly mentioned as the latest and greatest available, users and developers would flock to it.

Nyle F. Landas
Rochester, New York

CORRECTIONS AND AMPLIFICATIONS

In "The PC Magazine 150" (July 1994), the table "Vendor Support & Financial Information: Software" incorrectly cites SBT Accounting Systems' technical support policy. SBT provides free technical support for any bugs found in the program for five years from the date of purchase.

Contrary to what we stated in the roundup "Portable Multimedia: Taking Your Show on the Road" (August 1994), the NEC MultiSpin 3Xp—a CD-ROM drive—does have a $99 battery option.

HOW TO WRITE TO PC MAGAZINE

We welcome your comments and suggestions. Please send correspondence to Letters, *PC Magazine*, One Park Ave., New York, NY 10016-5802. You can send electronic mail via the Internet at 157.9301@mcimail.com, or you can upload it to PC MagNet (see page 12 for access information). You can also send e-mail to individual editors. Type GO PCMSTAFF on ZiffNet for a list of addresses. All letters become the property of *PC Magazine* and are subject to editing.

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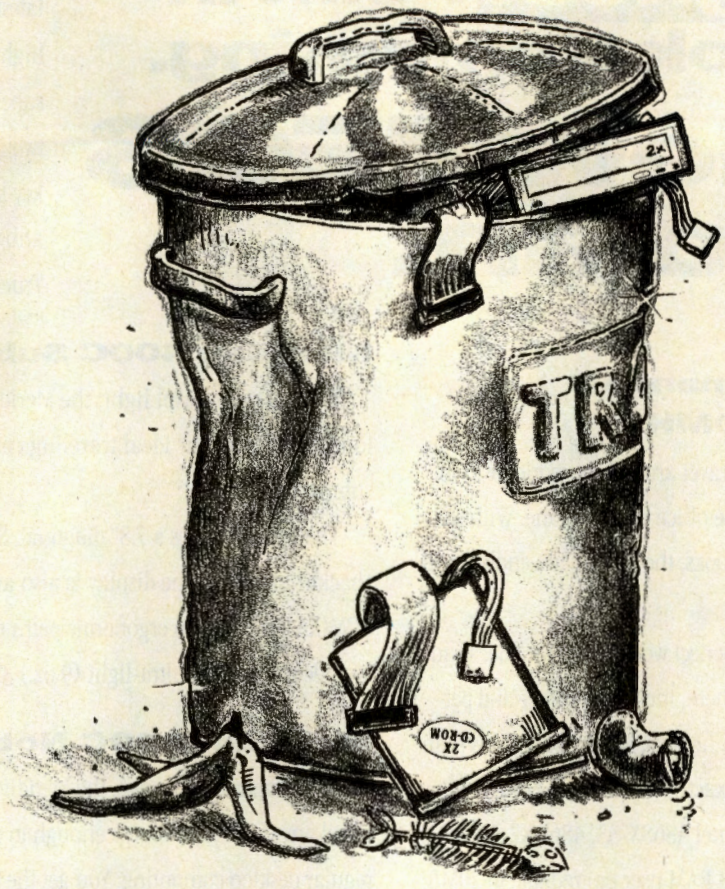

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486DX2-50	$2195 Lease $80/mo.	$2495 Lease $91/mo.	$2495 Lease $91/mo.	$2695 Lease $99/mo.	$2795 Lease $102/mo.	$2995 Lease $110/mo.
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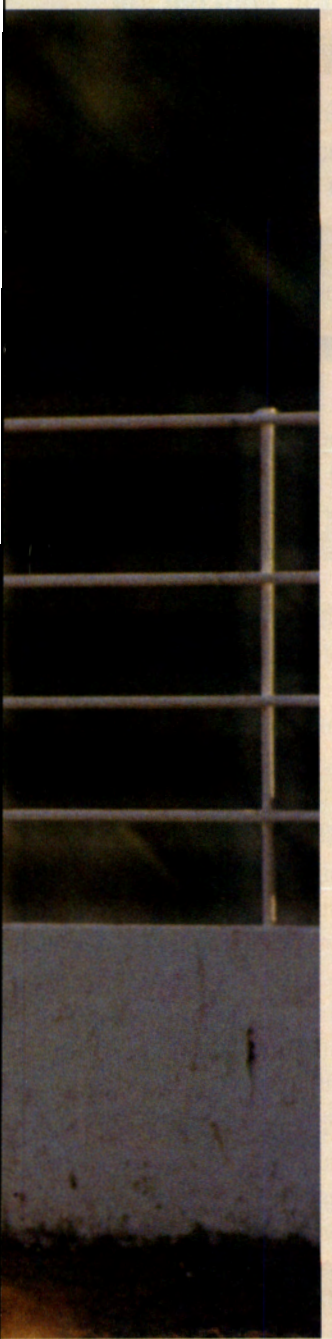



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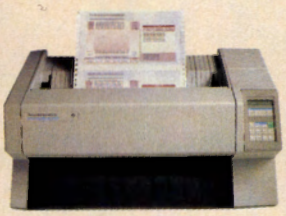

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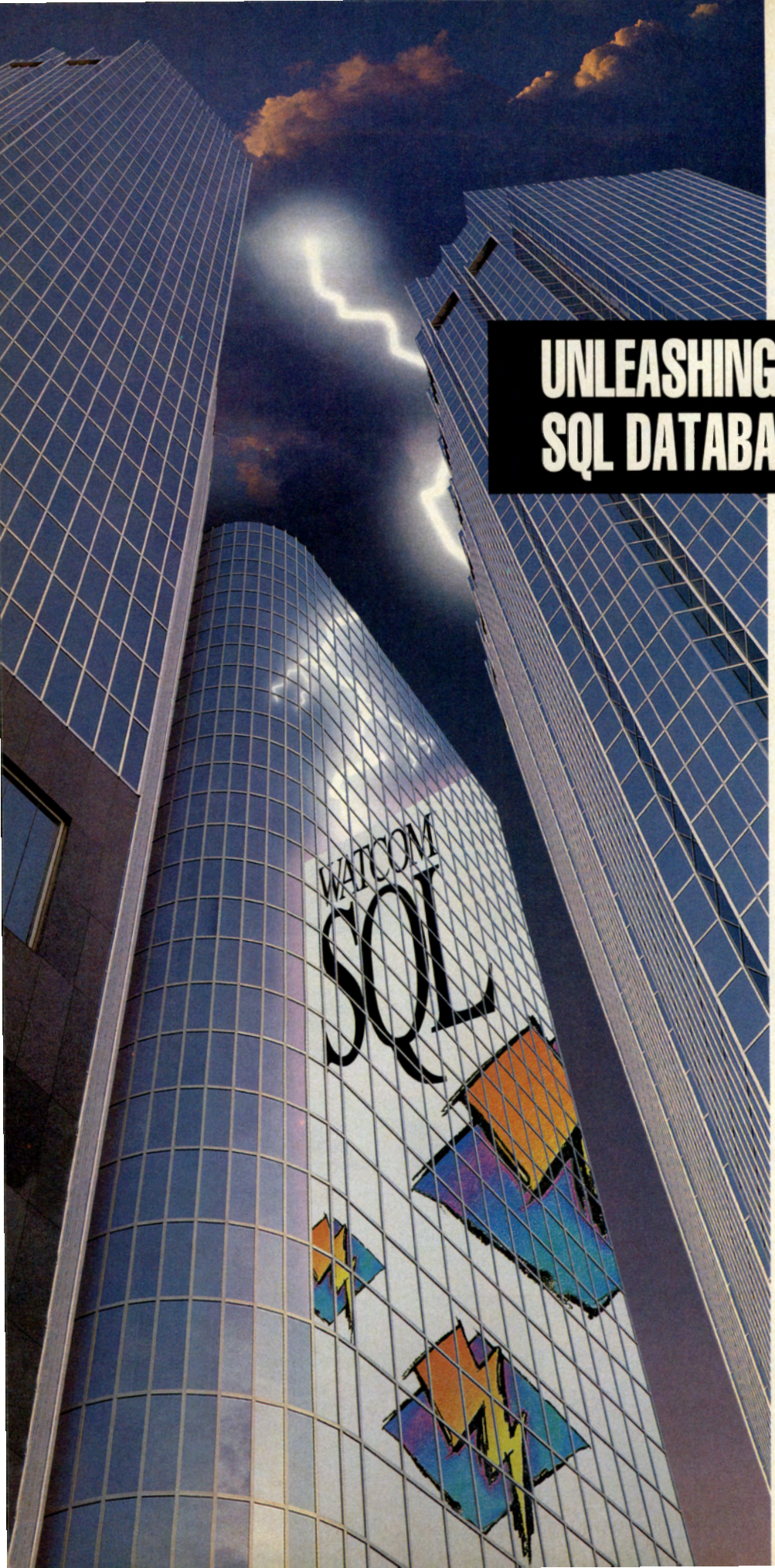

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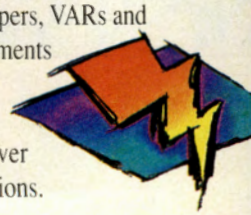

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The Power of Two

When are two processors better than one?

If a single processor isn't enough muscle for your applications, perhaps two are. With the growing number of desktop operating systems that can exploit the power of multiple processors, including NetWare MP, OS/2 for Symmetrical Multiprocessing, and Windows NT, a uniprocessor PC may be too puny. Multiprocessor PCs have long been available to run versions of Unix, but dual-processor PCs are just beginning to proliferate.

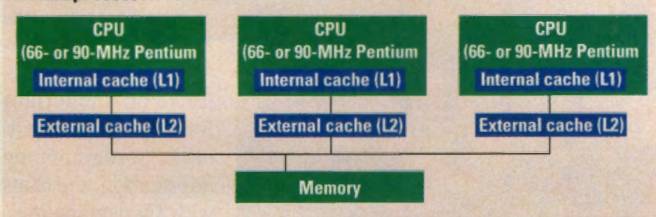
There's more to multiprocessor PCs than soldering another chip onto the motherboard. Most Pentium-based uniprocessor PCs have an external hardware cache (Level 2 cache) to break through processing bottlenecks, in addition to the Pentium's 16K of on-board cache. But a multiprocessing PC can have one of two basic designs. The major distinction between dual-processor and multiprocessor PCs is in the cache design. Dual-processor PCs have a shared cache, where the two CPUs use a single large L2 cache. Multiprocessor PCs have a cache dedicated to each processor.

Multiprocessor PCs will be used in high-end servers that run bus-intensive applications; each CPU has a dedicated L2 cache to provide a higher percentage of cache hits than a dual-processor PC with a single cache shared by two CPUs. Dual-processor PCs are more attuned to computation-intensive applications, such as those on desktop workstations. Intel estimates that a dual-processor PC can boost the performance by 50 to 60 percent over a uniprocessor system.

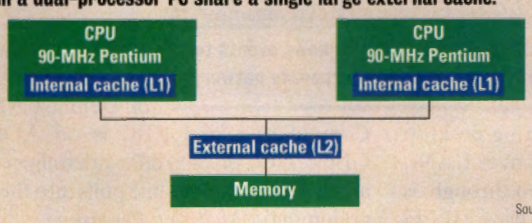
The complications and possible interrupt collisions created by the additional processor are addressed in a specification developed by Intel; the spec should run all uniprocessor and multiprocessor code with no modification. One of the first PCs to conform to the spec is Hewlett-Packard's Vectra XU. Intel built multiprocessor support into the 90- and 100-MHz Pentium chips with the Advanced Programmable Interrupt Controller, obviating the need for an external controller and makes designing dual- and multiprocessor systems with fast Pentium chips easier and less expensive.—*Christopher Barr*

Memory Working Overtime

A multiprocessor PC has an external cache dedicated to each CPU.



CPUs in a dual-processor PC share a single large external cache.



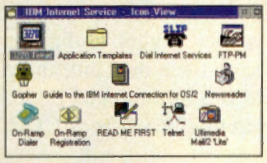
Source: Intel.

OS/2: Hardwired For the Internet

IN THIS ISSUE'S COVER STORY ON Internet tools and services, we found few products offered the perfect one-stop solution for connecting to and getting around the Internet. Don't worry, though, because the next version of your operating system may handle all your Internet needs.

IBM has built a complete set of Internet tools into the next release of OS/2 (code-named Warp), which it expects to ship well before the next version of Microsoft Windows debuts in 1995. OS/2 will come with the plumbing to connect your PC to the Internet, a graphical World Wide Web browser (similar to Mosaic) all the tools you need to explore it, and 10 hours to cruise the net for free.

Since installing the TCP/IP Internet communications protocol (the lingua franca of the millions of connected computers) is typically a painful experience, IBM has preconfigured the software and designed a one-button install that signs you up with IBM's very own global Internet access provider. The new OS will also include the SLIP protocol for connecting over a modem. At the sign-up screen, you'll type in your credit card number, billing address, and name and receive an Internet address ("yourname"@ibm.net).



Quick Internet access.

The new OS will also provide the graphical software you'll need to mine the Internet—FTP for downloading files; a graphical Gopher for searching; and telnet for logging onto other computers. You'll be able to download a beta version of WEBExplorer, IBM's own World Wide Web browser for accessing documents with sound and video.

Meanwhile, Microsoft is wiring Chicago, the upcoming release of Windows, with less ambitious Internet support. You'll get TCP/IP, SLIP, PPP, FTP, and telnet, but you won't get a gopher front end, a World Wide Web browser, or a one-button connection to an Internet service provider.—*Carol Levin*

Pipeline *By Robin Raskin*

Waiting for Chicago

Call me naive, but I lost all bets when Microsoft decided that Chicago wouldn't ship until it was ready. (Latest ETA is sometime in early 1995.) And when an early beta wouldn't install properly on my hard disk compressed with Stacker (yes, I really am naive), I decided that Chicago would have to wait for me, too. Some software vendors tell me they've gone into a revenue-halting holding pattern, having decided not to ship another 16-bit, non-OLE app.

Apologies to Beckett, but you get the distinct feeling that the whole PC world is "Waiting for Chicago." Not me, though. I'm keeping plenty busy. For those of you wondering about how to fill the pre-Chicago void, here are my personal recommendations:



1. Call your local phone company and order ISDN service today; then wait to see which comes first.

2. Upgrade aging PCs. If you've been sitting on the fence deciding whether "to go Pentium or not," a processor upgrade is like a face-lift that buys you some time. Intel's OverDrive series can work wonders, provided you've got the right socket on your machine. Or try Cyrix's upgrade chips, which we used here in the office to upgrade our 386 PCs.

3. Get your family on e-mail. ConnectSoft's Kid Mail Connection is a first-of-breed product designed to make messaging a hoot for the whole family. It has personalized stickers, a Flinstone-like screen design, and a simple-to-follow interface. Just keep an eye on the e-mail bill, and you'll have a blast.

4. Celebrate the Summer of Love. Take a nostalgic spin through Paramount's Woodstock CD. The disk might not wow you, but it will remind you just how much you miss analog vinyl records and large-screen movie theaters, never mind the free time to attend a summer music festival.

5. Start a DOOM collection. There are hundreds of variations of this game, each with its own twist on graphics, sound, and animation. Imagine Barney the Dinosaur singing, "I love you; you love me..." as he chews your arm off. A *PC Magazine* favorite faithfully recreates the warren of our offices at One Park Avenue in New York. We battle mutants who've taken over the joint, attempting to restore journalistic integrity as we go. PARKDO.ZIP is on ZiffNet in Library 3 of the Speakeasy forum.

6. Become an airwave auction watcher. As we speak, the government continues to auction bandwidth. There's been much talk about making sure that there'll be opportunity for the "small players," but in July's auction, licenses went for as much as $80 million. You may be better off investing in coffee futures.

7. Converge your PC and telephone. Your heart tells you that these two office appliances should be speaking to each other,yet making that first move is so tough. Try the Bocamodem ($245) from Boca Research. It's a voice-mail system (each family member can have a separate mailbox and greeting), a faxback system, and a great 14.4-Kbps data/fax modem, too.

8. Practice your OS/2. Hey, with a new release that'll probably ship before Chicago, and one that includes some excellent new technology and the basic technological features touted by Chicago (including 32-bit, multithreaded, real multitasking), it can't hurt to keep all your bases covered. The only reason to stay clear of OS/2 is that IBM has no plans for running the new Chicago apps you're waiting for in the first place.

9. Play some of the great new titles from Microsoft Home. With 34 new products being launched before the holiday season, obviously Microsoft is not waiting for Chicago, either.

Robin Raskin is the editor of PC Magazine.

NBC on LAN TV

FOLLOWING IN THE FOOTSTEPS OF newspapers and magazines, television and cable networks are now experimenting with electronic distribution. NBC and CNN are going a step further by delivering live video news feeds and customized, on-demand news directly to desktop PCs via office LANs.

NBC is the first broadcast network out the door with a business-focused video-on-demand product. NBC Desktop Video provides real-time news targeted at financial and corporate executives for whom instant access to market-moving events is crucial.

Rather than reading about a major decision on an international trade agreement 30 minutes after it's announced on the newswires, you get an alert that something important is about to happen and then you see the live, full-screen announcement on your PC at 30 frames per second.

Content is provided by CNBC, NBC News, and NBC international sources. If you don't want to see the event live, you can go back later and search through a menu of the day's major events. The service costs $1,795 per month for five users.

This technology could serve as a basis for future consumer-oriented video-on-demand products. "It's all going to start in the office," says Tom Rogers, the executive vice president of NBC. NBC and the other networks are also involved in video-on-demand tests for consumers, while CNN is testing a service for corporate servers using Intel's Indeo compression for delivering desktop video of CNN Headline News over LANs.



NBC Desktop Video brings live news events to desktop PCs over existing corporate networks.

No one technological breakthrough is enabling the NBC project: It uses MPEG compression from Xing Technology, MFS Datanet's T1 ATM network for high-speed video transmission, and Windows-based communications software. "It was a case of marrying all of the existing technology," says Michael Wheeler, senior vice president of multimedia at NBC.

Meanwhile, all the commercial networks and some cable networks have established on-line forums for audience feedback, programming information, and chats with TV personalities. ABC, MTV, and the Sci-Fi Channel are on America Online, CBS is on Prodigy, Fox is on Delphi, CNN is on CompuServe, and NBC is on AOL and GEnie. ABC plans to offer video clips on-line, and will integrate on-line polls into their programming.—*Melissa J. Perenson*

The Euro Desktop Crosses the Atlantic

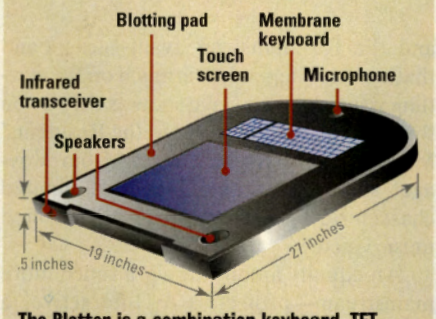
EUROPEAN DESIGNERS ARE WELL known for successfully reworking mundane appliances into practical works of art. The spider-shaped Alessi juicer and the Bauhaus-influenced Braun electric shaver are not only useful but beautiful, as well. Source Développement, a French company based near Paris, is looking to continue that tradition by giving your desktop computer the same aesthetic appeal. They've designed a stylish and sleek peripheral that puts an active-matrix touch-screen LCD panel and membrane keyboard at your fingertips.

Called the Blotter, the leather-covered device has a brushed aluminum frame with a single cable that connects to a PC or Macintosh. To use the Blotter as a regular desk blotter, there's a switch that disables both the LCD panel and the membrane keyboard. The Blotter weighs about 12 pounds and measures .5-inches high, 19-inches wide, and 27-inches deep.

Flat speakers will be elegantly concealed in the corners; a microphone will be embedded as well. Still in the design phase, Source Développement is considering a lineup of possible Blotter options, including handwriting recognition, voice recognition, a smart card slot, PCMCIA sockets, and a CD-ROM drive, as well as an infrared interface you can use for a mouse or for file transfers.

Just as you pay a premium for European luxury cars, the Blotter will not come cheap. While the first prototype is being sculpted and refined for a 1995 delivery date, Source Développement expects the Blotter to cost between about $2,500 and $3,000. If you're interested, you'll have to contact the company directly (fax, 64-11-41-42), as it does not yet have a distributor in the United States.—*Christopher Barr*

Form and Function



The Blotter is a combination keyboard, TFT screen, speaker, and microphone that you place flat on your desk.

Source: Source Développement.

Top Retail Software

Current ranking	Last issue	Product/ company
1	3	**Procomm Plus for Windows 2.0** *Datastorm*
2	1	**MS-DOS 6.22 Upgrade** *Microsoft Corp.*
3	10	**Delrina WinFax PRO 4.0** *Delrina Corp.*
4	—	**MS Office 4.2 for Windows Upgrade** *Microsoft Corp.*
5	—	**Internet Membership Kit 1.0** *Ventana Media*
6	—	**MS Access 2.0 for Windows Upgrade** *Microsoft Corp.*
7	6	**MS Windows 3.11** *Microsoft Corp.*
8	—	**QEMM 7.0** *Quarterdeck Office Systems*
9	—	**Corel Ventura 4.2** *Corel Corp.*
10	10	**Procomm Plus 2.01** *Datastorm*

This list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending August 6, 1994. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and cannot be interpreted as a picture of the entire software market. Sales information adapted from a compilation by Ingram Micro.

VoiceView: No Ordinary Phone Call

WRITTEN OFF FOUR YEARS AGO AS far too simple an approach for transmitting voice and data over a *single* phone line, Radish Communications' VoiceView is now positioned to be deployed on millions of modems in 1995. It could be a new way to move voice and data over PCs.

VoiceView uses existing data-modulation and error-correction standards so modem makers can implement the firmware in modem chips at little or no additional cost to the customer.

Designed for transmitting 1-page to 3-page documents and files, VoiceView *alternates* voice with bursts of data. It takes about 2.5 seconds for a 9,600-bps modem to send text and graphics on your screen to another PC, during which there's an interruption in voice contact.

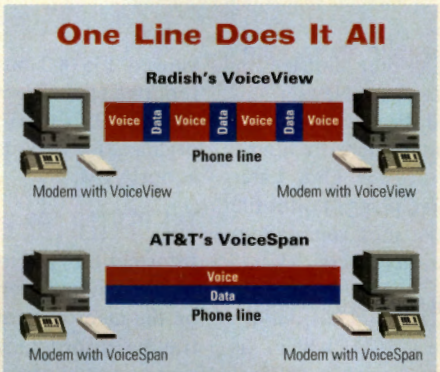
AT&T's VoiceSpan takes a far more sophisticated, costly approach by splitting the line into separate voice and data channels and transmitting both voice and data *simultaneously,* a better approach for application sharing and whiteboarding. "We'd either go out of business and the technology would die or we'd share the protocol," says Cyndi Kemper of Radish, which recently made the protocol public. Since then, Intel, U.S. Robotics, and Hayes Microcomputer Products have pledged to build VoiceView into modems to ship early next year. Microsoft is supporting VoiceView in Chicago, the next generation of Windows expected later this year. And AT&T Paradyne has licensed the VoiceView protocol to use along with its own VoiceSpan.

"We sat down and looked at the infrastructure of the telephone, the PC, and the modem, and made the best use of what's there today," says Mike Winseck, director of systems engineering at Radish. "VoiceView's main capability is to switch from normal voice to one of several data modes. There's a full-duplex modem mode, and a fax/data mode, as well as a VoiceView data mode" explains Winseck.

Radish expects the technology to fuel a new category of software in 1995. Future applications could let you talk on the phone while simultaneously transmitting a file to a colleague, a business card to a customer, or your CONFIG. SYS file to a support technician. It also opens a whole new dimension for PC games, such a the ability to talk with an opponent while playing the game across the phone line.

—*Carol Levin*

One Line Does It All



VoiceView alternates between sending data and voice over a single phone line; VoiceSpan splits the line into two bands. Both let you send text, graphics, and files while you talk on the phone.

Designing Next Year's Chatterbox

WILL YOU EVER USE YOUR VOICE to interact *fully* with your PC? Not unless the speech-recognition tools you use are seamlessly integrated into your applications and work across all of them. How do you set a standard for such complex controls? You form a committee, of course.

If a common Application Programming Interface (API) for speech recognition is to emerge, it will come from the recently announced Speech Recognition API Committee, which includes industry leaders Dragon Systems, IBM, Kolvox Communications, Kurzweil Applied Intelligence, Lernout & Hauspie Speech Products, Novell (which now includes WordPerfect Corp.), and Philips Dictation Systems.

By providing the API to software developers, the committee hopes to inspire the development of speech-driven applications, the likes of which we haven't yet seen. Until now, affordable speech recognition on the PC has been clunky and of limited usefulness.

The API will support both *discrete* and *continuous* speech recognition. With discrete recognition, you give the PC commands such as "File...Print," pausing briefly between each word so the command can be processed. Continuous recognition handles entire phrases, such as "Buy ten shares of Acme Corp. at 25," without making you pause between words.

So far, software developers are being vague about specific plans and dates for new products that incorporate this next generation of speech recognition. A real boom in speech-recognition apps probably can't happen until users find an affordable way to dictate error-free text to their favorite apps faster than the 40 to 60 words per minute at which they can type it.

It's possible that Novell/WordPerfect will emerge as a leader in speech-recognition tools, not only because it's adding tools into its own apps, but also because the company will provide the API in its PerfectFit Software Developers Kit, perhaps by the end of this year. Before mainstream apps start to emerge, you can expect to see specialized tools for the health care and legal fields.—*Don Willmott*

It's Only Rock & Roll...on CD-ROM

VIDEO MAY HAVE KILLED THE radio star, but digital video is breathing new life into the careers of many an aging rocker. These days everyone from the Wilson sisters of Heart to ☥, the artist formerly known as Prince, has a CD-ROM playing on a PC near you. And those rockers who don't have their own titles are busy recording the soundtrack to someone else's game or educational product.

Among the first to discover the potential of the desktop computer as performance medium were Peter Gabriel, who pioneered the use of CD-ROM among rock musicians, and the Residents, an avant-garde band that's always depended as much on the startling visuals of their stage show as they do on their amplifiers. Freak Show, the Residents' Macintosh CD-ROM offering from Voyager, serves up a surreal blend of animated characters, interactive story telling, and music videos.

An equally ambitious—if a touch more mainstream—project is ☥ Interactive, a hybrid CD-ROM from The Graphix Zone. This paean to His Purpleness allows you to explore the artist's work and his psyche through the use of video, puzzle solving, animation, and of course, his music. ☥ has even composed an original song especially for the disk.

Next in line to receive the interactive treatment are John Lennon, whose work and life will be chronicled in the Yoko Ono–narrated John Lennon: Imagine; and The Who's *Tommy,* which will appear in all its many incarnations on a "rockumentary" Tommy Interactive CD-ROM. Both of these CD-ROMs are forthcoming from Compton's NewMedia. The Graphix Zone will soon add yet another aging rocker, Bob Dylan, to its interactive music collection.



☥ Interactive: A whole new genre of music-video adventure.

While Bob Dylan may seem like a rather unlikely candidate for the multimedia treatment, for artists such as ☥, the jump from traditional music video to interactive CD-ROM seems like a logical step. "The time is ripe for this project," said Gilbert Davison, president of Paisley Park Enterprises (☥'s production company). "CD-ROM is a natural medium for extending the impact of recorded music and music videos."

This is only the beginning in the merger between Motown and Silicon Valley. Be on the lookout for future CD-ROM releases from Todd Rundgren and Thomas "She Blinded Me With Science" Dolby to bring even more interactivity and a touch of virtual reality to music on the PC. —*Gayle C. Ehrenman*

Briefs

QUANTUM PHYSICS, MUSIC, GARDENING, and myriad other Internet Newsgroups can now be reached directly from your CompuServe account for an extra hourly fee of $9.60 for access at 14.4 kbps. Later this year, CompuServe plans to offer file transfer from Internet sites, remote logon, and later, full Internet access.

THE FIRST MAJOR SPLASH FOR ASYNCHRO-nousTransfer Mode (ATM) will be as corporate backbone, though it will not come at the expense of other high-bandwidth technologies, predicts market research firm Computer Intelligence /InfoCorp (800-244-4495), which interviewed 135,000 businesses for its new report "The CII 500: ATM Edition." The $2,495 report names the top 500 organizations thatt are most likely to adopt ATM.

THE CENTER FOR WORKPLACE HEALTH Information publishes *CTDNews,* a monthly newsletter covering the latest on the medical treatment of cumulative trauma disorders, regulatory developments, and injury prevention. The $125 subscription includes the *North American Ergonomics Resources Guide.* For a free issue, call the center at 800-554-4283.—*Carol Levin*



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Package 2	
486SX-25	$1395
486DX-33	$1595
486DX2-50	$1595
486DX2-66	$1645

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Full Duplex Support	✔	No
Advanced Power Management	✔	No
HotSwap Support	✔	No
Suspend/Resume Support	✔	No
Windows Installation and User Utilities	✔	No
DOS, Windows, OS/2, NT & Unix Support	✔	?
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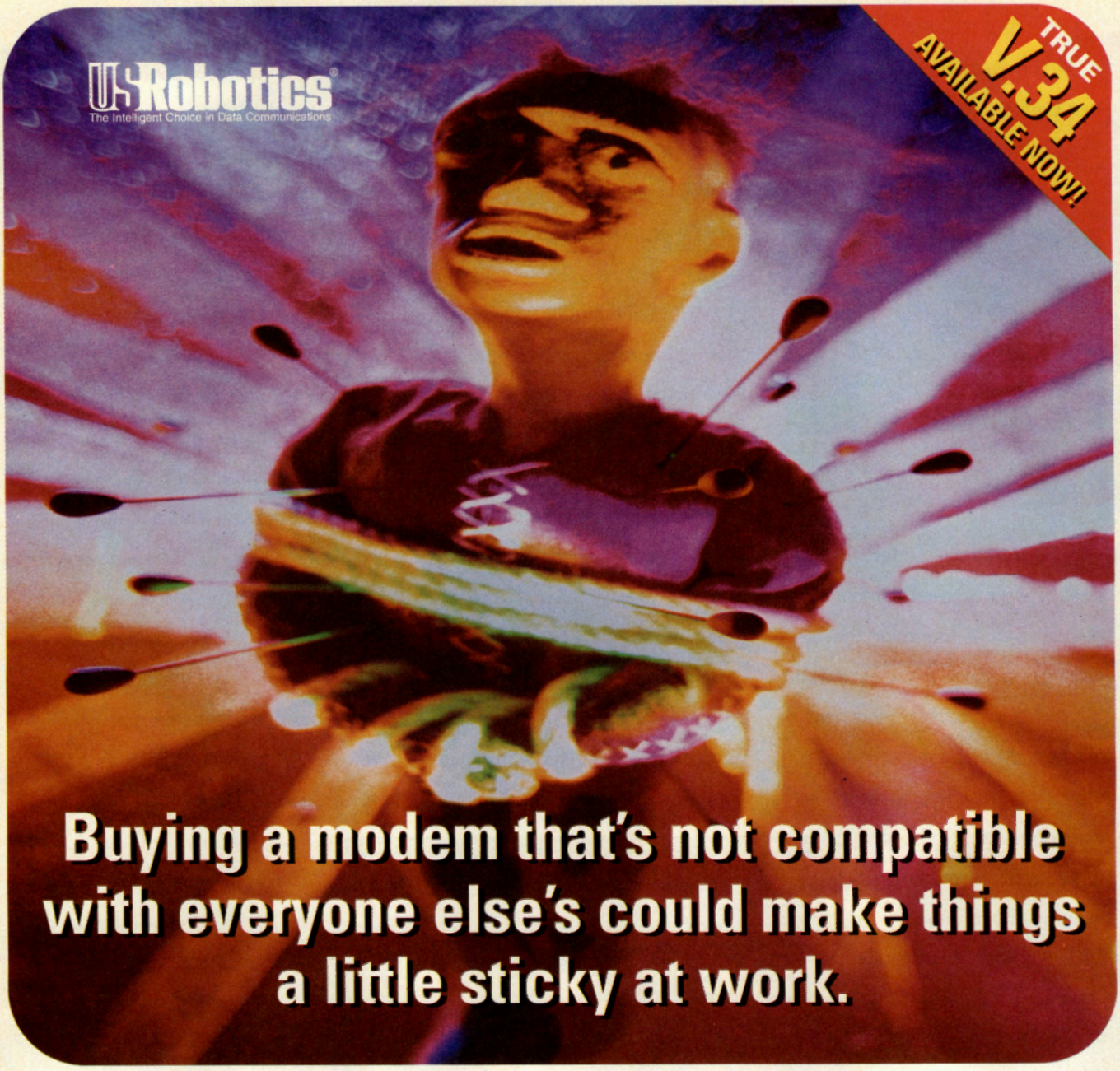

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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

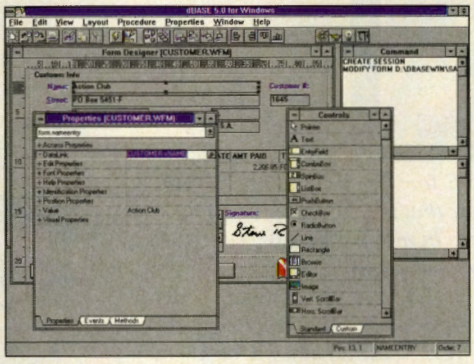
■ **Databases**

Borland Trio Puts Information In All the Right Places

BY STEPHEN W. PLAIN

Borland International recently shipped its trio of Version 5.0 databases, delivering on its promises of an easier-to-use Paradox for Windows, a faster dBASE for DOS, and the eagerly anticipated dBASE for Windows. The databases are a boost for developers who have patiently awaited the product's migration to a graphical environment.

There is something for everyone here: dBASE 5.0 for Windows ($495) is aimed at the many dBASE users and developers; Paradox 5.0 for Windows ($495) continues to serve double-duty as an end-user/development tool; and dBASE 5.0 for DOS ($795) is strictly for developers. Although they have distinct identities, these form-based tools use object properties and methods to establish event-driven behavior. Both dBASE for Windows and Paradox for Windows use the IDAPI database engine technology, which provides access to the Paradox and dBASE file formats.



OBJECTIVE DATABASE: *dBASE for Windows represents the future for dBASE, complete with objects, property inspectors, and visual tools.*

DBASE 5.0 FOR WINDOWS

After a gestation that seemed to last forever, dBASE for Windows is finally here. The program provides a solid foundation for the near-painless migration of existing dBASE code to Windows and of dBASE developers into an object-based coding style. dBASE for Windows is a redesigned product that allows you to exploit Windows to develop applications visually, without throwing away your general dBase knowledge.

Central to this product is the use of two-way tools that automatically translate any changes you make visually to a form or query to the underlying code and vice versa. The standard dBASE dot prompt is replaced in dBASE for Windows with the Command Window, allowing commands to be executed interactively.

Although dBASE for Windows provides a complete set of visual tools for creating forms, queries, and menus, you also can work visually or directly with code. You can translate design elements of dBASE IV applications, such as screen, report, and label formats, into dBASE for Windows using the supplied Component Builder. The Form Designer automatically generates the class definition in the form's definition file.

When designing forms in dBASE for Windows, you work extensively with the Object Inspector and Control Palette. The Object Inspector is a tabbed

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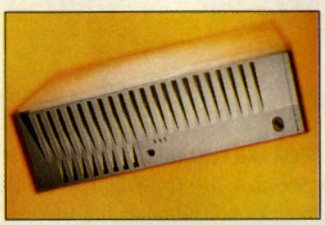
■ **Servers**

IBM Opens Up with the PC Server

BY MARK JONIKAS

The IBM PC Server represents a long-overdue turn in the evolutionary path of the company's line of PC-networking products. With this product, IBM—which has long been a stalwart of designing and manufacturing servers with standard IBM parts and its proprietary Micro Channel bus—marks several firsts. The PC Server, made by IBM Personal Computer Co., is not only the first IBM server based on the industry-standard EISA bus, it is also the first to use a motherboard designed and manufactured by outsiders.



STYLE: *The IBM PC Server moves away from the dull gray look; this is an attractive and functional server.*

Targeted at the rapidly growing small-business and departmental-level server markets, the system combines solid performance with an attractive price. Because the PC Server design includes PCI slots, it has the potential to raise throughput to a new level by taking advantage of the high-performance bus.

In essence, IBM has made this a solid reseller's machine that will be a strong and basic building block for mix-and-match systems. The flexibility ensures that performance,

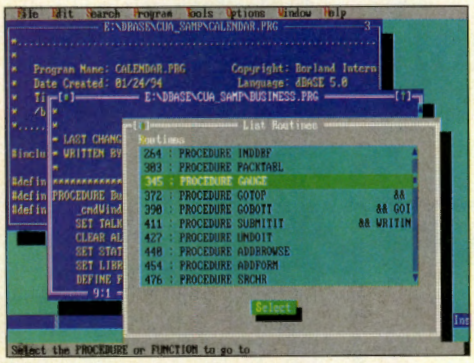
Continues on page 40

Photography by Thom O'Connor

Databases

CONTINUED FROM PAGE 37

dialog box that lets you inspect and modify an object's properties, and assign code procedures to various events associated with the object. The Control Palette offers various visual controls that you can place within your forms.



VISUAL APPEAL: *Version 5.0 of dBASE for DOS gains a multiwindowed editor that is designed with the developer's needs in mind.*

The Windows version of dBASE will accept traditional dBASE code as well. Even if you don't purposely immerse yourself in object-based programming, you'll be drawn into it by the code the visual tools generate, and will soon appreciate its power.

In its initial release, dBASE for Windows contains Crystal Reports from Crystal Services. Reports can be designed and executed from the dBASE Navigator, the centralized dialog box that serves as a front end for development. However, Borland's recent purchase of ReportSmith may mean that another reporting tool is in the offing.

This first release of dBASE for Windows proved to be a solid product, despite minor glitches. During testing, we discovered that it was not compatible with 2MB of SmartDrive software caching in some configurations; reducing the cache to 1MB on an 8MB machine solved the problem. The product definitely likes lots of memory. In testing, it turned in good middle-of-the-pack performance compared with the competition. Its strength was throughput on our random read test, with results approaching those of FoxPro.

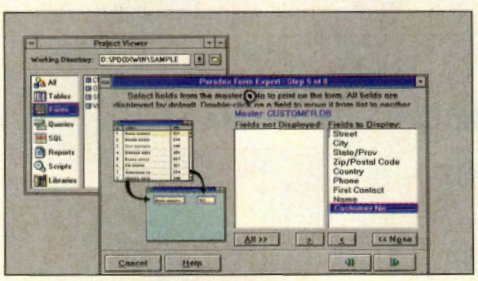
The major missing piece of the puzzle is the product's compiler, which is expected near the end of the year.

DBASE 5.0 FOR DOS

Though dBASE IV remains a mainstay for DOS database developers, it has become long in the tooth. Version 5.0 reinvigorates dBASE for DOS and will be a welcome upgrade for developers who expect to continue development and support of DOS-based dBASE applications.

This is a program that only works in 32-bit protected mode. This 32-bit version will be a shot in the arm for old dBASE apps, providing roughly a twofold improvement in performance. The compiler, shipped as a separate product for dBASE IV, Version 2.0, is built in. Although there is no support for real mode, Borland will continue to sell previous versions of the product to support this narrowing niche.

Because it is based on Borland's Turbo Vision interface, dBASE for DOS 5.0 provides a graphical view of the data with a mouse-driven, window-based approach. In addition, dBASE for DOS now has a new editor, which handles multiple windows, a quick pop-up list of all defined procedures, a clipboard, and menued hooks to its compiler.



FORM AND FUNCTION: *The new Form Expert in Paradox 5.0 for Windows makes it easier than ever to design forms.*

The two-way tools are similar to the Windows product, but dBASE 5.0 for DOS maintains two files for a form created in the Form Designer: the .DFM file that contains the dBASE code to define the various objects, and the .PRG that contains the procedural code to give life to the form. The .DFM file is inserted into the .PRG file when the application is compiled.

The new object extensions to dBASE 5.0 for DOS are thorough and complete, comprising 22 standard objects, 150 commands and functions, and 100 properties. Unfortunately, you cannot define your own custom objects yet, but Borland says this feature will be in the next version.

The new Form Designer offers an Object Palette that lets you place objects on a form and an Object Inspector that lets you interrogate and modify objects. The Menu Designer provides a quick way to define menu items, attach procedures, and define a status message, all in a single dialog box.

Some things are unchanged in dBASE for DOS: the debugger, reporting, and label modules remain the same.

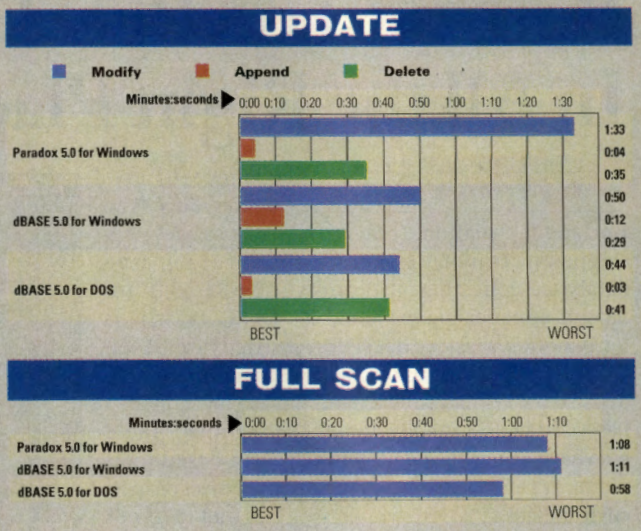
Like dBASE for Windows, this new DOS version loves memory and requires at least 6MB of system memory to work; the product will also look for disk space for its Virtual Memory Manager. The event-driven architecture of dBASE 5.0 for DOS makes it more competitive, both in features and performance, with Microsoft's FoxPro.

PARADOX 5.0 FOR WINDOWS

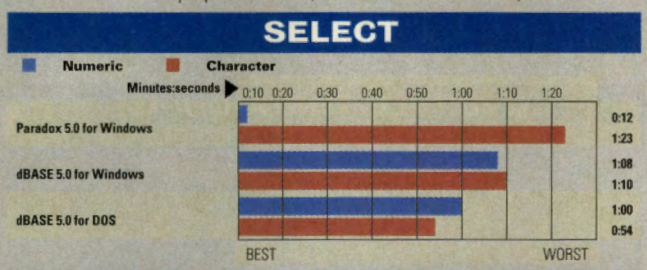
Paradox 5.0 for Windows extends the company's first object-based database development product in both the devel-

Benchmark Tests: Databases

PC Magazine Labs tested Borland's three newest databases using our standard suite of multiuser benchmark tests. For complete descriptions of our tests, refer to "Serious Solutions," Volume 13, No. 15. We tested each database on a network running NetWare 3.12 using a Compaq SystemPro with 32MB of RAM and two 2GB Seagate Barracuda hard drives. For single workstation tests, we used a Compaq DeskPro 486/33M with 8MB of RAM; for network loads, we used 36 Compaq 386/16N PCs with 8MB of RAM. Because of slight variations in our test bed, these results should not be compared directly to Volume 13, No. 15.

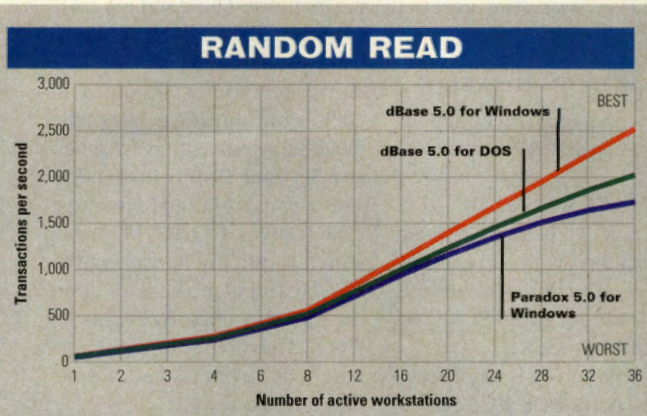


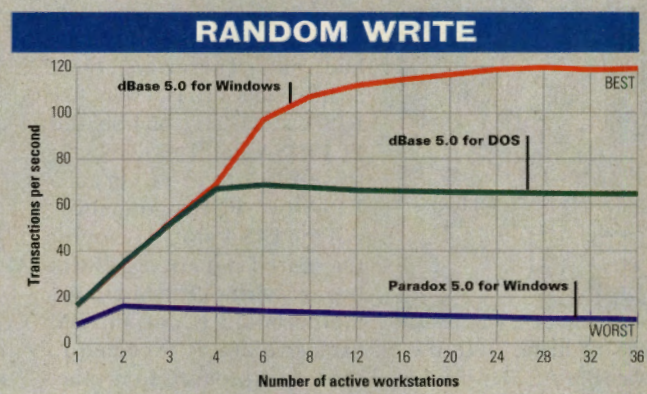
Paradox demonstrated improved importing capabilities, importing our four tables, each containing 100,000 records, and creating 13 indexes in 50 minutes, but dBASE for Windows proved fastest with a 24 minute time. On our Select tests, Paradox for Windows clearly surpassed the speed of both dBASE on our numeric select, due to its use of a clustered index. (Paradox 4.5's time in "Serious Solutions" for the numeric select was incorrectly reported as 1:14; the correct time was 0:14.)











oper and end-user directions, plugs some usability holes, improves performance, and broadens the product's connectivity.

Sharing the same IDAPI engine as dBASE for Windows, Paradox 5.0 for Windows provides compatibility with dBASE tables and structured query language (SQL) data. New SQL-links include: Interbase, Informix, and Oracle 7; ODBC drivers are still under development. This version also employs local SQL, allowing you to query data on local tables. By using aliases to identify directories and database names, you can move your LAN-based Paradox application up to a SQL database server by simply modifying the aliases' data source.

The new Project Viewer, which is similar to the Navigator in dBASE for Windows, gives you a quick launch interface to tables, queries, reports, scripts, and other Paradox elements, as well as a new directory browser for changing your working directory. New Form, Report, and Mailing Label experts help define their respective formats.

New features in Version 5.0 of Paradox for Windows are spread out but well chosen. New field types have been added to this version that provide the autoincrementing, logical, and time fields that were conspicuously absent in previous versions. Paradox 5.0 for Windows is an OLE 2.0-compliant client and server. This means you can both embed OLE 2.0 objects within forms and fields as well as embed Paradox tables within documents.

While being adapted to work with the IDAPI engine, Paradox for Windows also underwent a considerable amount of fine-tuning in order to improve performance and streamline the product's error-handling; performance has improved in most respects, with some areas, such as importing text files, dramatically faster. By tuning the IDAPI configuration and carefully planning data location, you can further improve performance.

Developers should be aware that good programming style is essential. During benchmark testing, we found it necessary to place a SLEEP() function after memory-intensive operations such as indexing that were contained in a FOR loop to prevent running out of memory. Apparently, this gave Windows enough breathing room to process its pending virtual memory messages in low-memory situations.

This Borland database trio represents the first manifestations of the company's cohesive database strategy, and are major steps forward. Although each seemed stable and was highly productive out of the box, they have their focal points: dBASE 5.0 for DOS will appeal to the DOS developer as much as dBASE for Windows will to the Windows developer, while Paradox 5.0 for Windows will cross over into the hands of end-users.

- **dBASE 5.0 for Windows.** List price: *$495; upgrade, $199.95.* Requires: *6MB RAM, 10MB hard disk space, Microsoft Windows 3.1 or later.*
- **dBASE 5.0 for DOS.** List price: *$795; upgrade, $149.95.* Requires: *4MB RAM, 9MB hard disk space, DOS 3.1 or later.*
- **Paradox 5.0 for Windows.** List price: *$495; upgrade, $199.95.* Requires: *6MB RAM, 15MB hard disk space, Microsoft Windows 3.1 or later.*

Borland International Inc., *100 Borland Way, Scotts Valley, CA 95066-3249; 800-682-9299, 408-431-1000; fax, 408-431-4123.*

Circle 433 on reader service card

FIRST LOOKS PLUS

From October 3 through 7, you can go on-line to discuss Borland's new databases with reviewer Stephen W. Plain and dBASE for Windows product manager Song Huang, along with other Borland executives. Type GO EXEC at any Compuserve ! prompt.

IBM PC Server

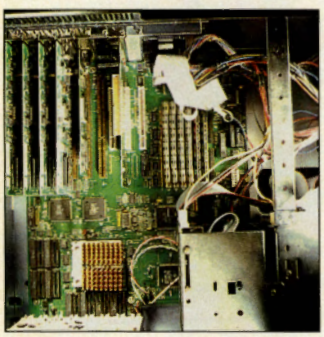
CONTINUED FROM PAGE 37

capacity, and price will be a function of a buyer's requirements.

TWIN-TRACK APPROACH

IBM offers two basic PC Server configurations, with and without hard disks. The PC Server can be configured with a 486DX2/66 or Pentium/60 processor.

The first set-up is a full server that includes a PCI-based hard disk controller and should be ready out of the box to function at the center of any small-to-midsize LAN. There is also a bare-bones system that is more appropriate for those interested in customizing their hardware. This alternative allows those who seek better performance or different RAID capabilities to go with a multitude of different adapter, disk, and interface-card combinations. Neither configuration includes NetWare.



NOT INVENTED HERE: *To IBM's credit, the IBM PC Server is based on a motherboard designed and manufactured by outsiders.*

In each of these configurations, the PC Server's standard equipment includes 16MB of parity-checking system memory. System memory is expandable to 192MB for the Pentium system (the 486DX2/66 server tops out at 128MB), but there is—unfortunately—no option for error-correcting memory. The standard 256K of external processor cache can be upgraded to 512K. An IDE controller comes standard in each configuration, but the included input medium is limited to a 3.5-inch floppy disk drive. This means additional expense if you want a CD-ROM drive, which is quickly becoming the standard input medium for operating system and software installation. The cabinet has eight half-height drive bays for additional data storage.

The PC Server's motherboard is neatly and efficiently laid out. There are eight adapter slots: two PCI slots, five EISA slots, and one shared PCI/EISA slot. This allows for a five-EISA/three-PCI or a six-EISA/two-PCI combination. All the EISA slots except for the shared slot are capable of bus-mastering. The Micronics motherboard is not an IBM exclusive and is expected to show up in products from other vendors.

READY TO ROLL

The configuration that includes a hard disk comes with IBM's own SCSI-2 fast PCI drive controller, which is a single-chip controller card. Though it offers the capability of PCI throughput, IBM's controller does not support RAID data storage. It also does not yet support several network operating systems, including Banyan's VINES, Novell's NetWare 2.2, and SCO Unix. To support any of these features, look to other PCI controllers currently available from Adaptec, BusLogic, Future Domain, and NextStor.

FIRST LOOKS PLUS

From September 26 through 30, you can go on-line to discuss IBM's PC Server with reviewer Mark Jonikas and Linda Lynes, product manager, IBM PC Server. Type GO EXEC at any Compuserve ! prompt.

Our test system came with a Pentium/60 processor, 64MB of RAM, and 256K of second-level cache. One PCI slot had IBM's SCSI-2 fast PCI adapter connected to four IBM 1GB hard disks. The system also included four 3Com 3C579 Ethernet network adapter cards.

This basic configuration yielded solid—though not exceptional—NetBench 3.0 results using Novell's Netware 3.12. For an in-depth analysis of our testing procedures and results, refer to the story "Data on Demand" in this issue. Out of a group of 15 servers tested, the PC Server landed in the middle of the pack, with an overall maximum throughput of 1.8MB per second at a load of 60 workstations.

It would be unfair to compare the PC Server with the highest performers in this group—the HP NetServer, which had a maximum throughput of 2.8MB per second, and IBM's Micro Channel PS/2 offering, the Model 95, which managed a maximum throughput of 2.7MB per second. Each of these systems has high-end disk controllers that include caching memory and high-performance network cards. These added significantly to their performance—and cost. At $10,893, the PC Server is an excellent value for a small- to medium-size network.

A NEW LOOK

With the PC Server, IBM has gone beyond the traditional gray appearance of servers. Though it is not expected to win any fashion awards, the PC Server has an elegant and practical louvered facade that conceals its air vents. Air flow is controlled by a temperature-sensitive fan in the power supply and a second fan that cools the motherboard and adapter cards.

IBM PC Co. backs the new PC Server with its traditional three-year warranty, which includes on-site service.

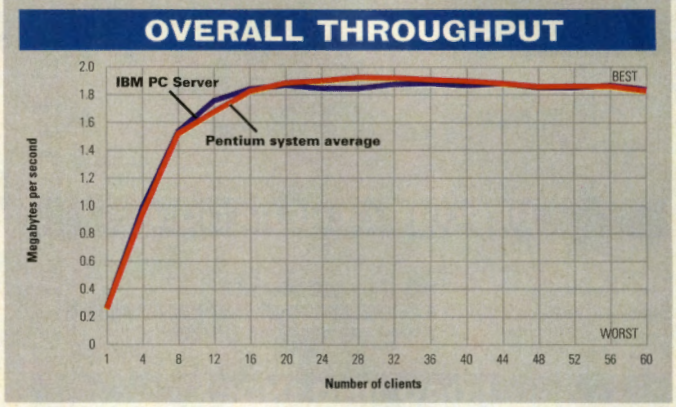
With this server, IBM can at last satisfy its clients with its first server system that is open and based on industry-accepted standards. Aided by the presence of PCI slots, the PC Server offers good performance, and its baseline configuration can be enhanced by more powerful adapter cards and disks. This is a promising start for IBM's venture into the PCI/EISA world, and we hope it is followed up with larger-capacity servers.

► **IBM PC Server.** List price: *$10,893.* Configuration: *Pentium/60, 64MB RAM, four 1GB fast SCSI-2 hard disks, fast SCSI-2 PCI bus adapter, four 3Com 3C579 Ethernet network adapter cards.* IBM Personal Computer Co., *Route 100, Somers, N.Y. 10589; 800-772-2227; fax 800-426-4182.*

Circle 432 on reader service card

Benchmark Tests: IBM PC Server

The IBM PC Server, the company's first standard-architecture network system, proved to be a solid performer on NetBench 3.0 using Novell's NetWare 3.12. Overall, the server produced results that were in line with those garnered by the group of 15 systems we tested for this issue. The PC Server began with above-average throughput (compared with the average performance of the other Pentium servers tested), lagged slightly with 20 to 56 clients, and finished up on a par with the competition.





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CIRCLE 292 ON READER SERVICE CARD

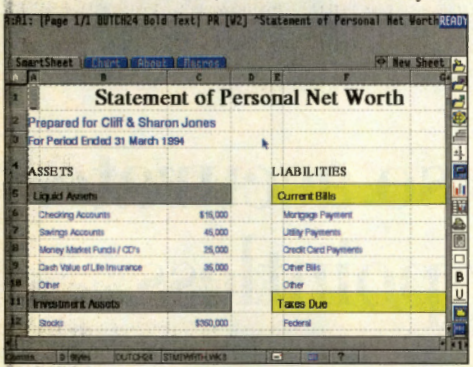
Spreadsheets

Lotus 1-2-3 Blurs the Line Between DOS and Windows

BY CRAIG STINSON

The latest—and possibly last—word in DOS spreadsheets comes from the company that uttered the first. Lotus Development Corp.'s Lotus 1-2-3 Release 4 for DOS, may well be the final offering for spreadsheet users who resist the tide toward Windows.

An upgrade for both Release 2.4 and Release 3.4, the $495 Release 4 for DOS represents a continuation of Lotus's effort to consolidate its spreadsheet line. Much of the work has gone toward merging the look of the DOS product as much as possible with Lotus's Windows applications. Release 4 of 1-2-3 for DOS goes beyond the SmartIcons introduced in Release 3.4, adding such essential tools as a spell-checker, Version Manager, and support for cc:Mail.



LOOKALIKE: *Lotus 1-2-3, Release 4 for DOS, does a good job of mimicking the look and feel of Windows applications.*

LOOKS LIKE WINDOWS

The appearance of the worksheet closely approximates that of many Windows spreadsheet programs. In both its default graphics and optional text display modes, Release 4 features the familiar black-characters-on-white-background worksheet with dotted gridlines to separate the cells, all bordered by a gray frame.

As in Lotus 1-2-3 Release 5 for Windows, page tabs appear along the top border, just below the classic Lotus "ring" menu. The tabs provide mouse travel between worksheet pages. A live status bar at the bottom of the screen provides quick access to fonts, numeric formats, the mail system, the help system, and some nifty designer styles that are new with this version. You can also add your own favorite formats or styles to the status bar.

All the graphical display elements, as well as the program's dialog boxes, may be turned off for the benefit of those who prefer the visual style of older DOS programs. Oddly enough, though, removing the SmartIcons does not provide more screen real estate. The program simply leaves a column of gray pixels at the right side of the display.

Longtime 1-2-3 users will be pleased that macros written in all earlier versions of 1-2-3 should work without modification in Release 4, and Release 4 macros should port easily to Windows with one exception. The /System command in Release 3.4 has been moved to a new Tools menu, so macros that move to DOS via the /s command (instead of {SYSTEM}) will need to be modified.

While macro and interface compatibility with Release 4 should simplify training and interoperability in multiplatform sites, Lotus's Windows and DOS spreadsheets unfortunately use different file formats. Release 4 for DOS uses .WK3 for data and .FM3 files for formatting information, while 1-2-3 Release 4 or 5 for Windows use a .WK4 file format. Those users who must straddle both file formats can use the built-in Magellan-based viewer to inspect the .WK4 files. In order to work on these files, they will need the Lotus standalone Translate application or an older version of 1-2-3.

SEND AND RECEIVE

Functionally, the most important advances in Release 4 are the inclusion of mail support and Version Manager. Release 4 users who have cc:Mail, Version 4.02 (or later), for DOS may send spreadsheet ranges or entire files without leaving 1-2-3. With a 482K TSR on board, users may also poll for incoming mail. A number next to the status bar's mail icon indicates the number of messages waiting to be read.

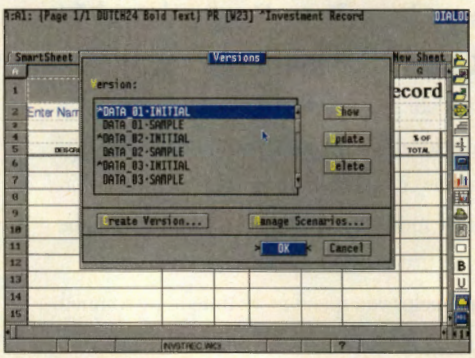
Version Manager is Lotus's system for managing a variety of inputs and incorporating them into a common range. Users can assign any number of alternative values to any named range, such as "Best case" or "If the river don't rise." Simple menu commands swap the alternatives in and out of display. Constellations of two or more versions—for example, "best case" for the Revenues range combined with "Last year +5%" for the Fixed Expenses range—can be assigned names and toggled in and out of display, as well. Release 4 for DOS refers to these version combinations as scenarios.

SEND AND RECEIVE

Those who create large numbers of similarly structured worksheets, for example, may find it more efficient to create sets of versions in a single file rather than sets of distinct files.

Unfortunately, the comment field attached to versions in 1-2-3 for Windows is not used in Release 4 for DOS, but there is a cell-annotation feature that can accommodate notes of up to 512 characters that are displayed in a yellow-framed rectangle.

The upgrade to Release 4 is certainly worth the cost if you want to remain a DOS user exclusively. But if you are headed toward Windows, it is difficult to justify stopping—however briefly—at Release 4 for DOS. If you like the graphical extensions that Release 4 provides, then you will like Lotus 1-2-3 for Windows even better.



MANAGE: *Version Manager helps incorporate input from many different sources of information.*

▶ **Lotus 1-2-3 Release 4 for DOS**. List price: *$495 (upgrade, $129).* Requires: *286 or better PC, 2MB RAM, 6MB hard disk space.* Lotus Development Corp., *55 Cambridge Pkwy., Cambridge, MA 02142; 800-343-5414, 617-577-8500.*

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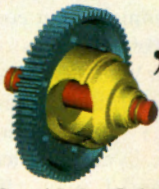
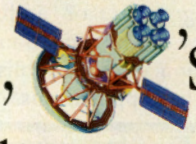
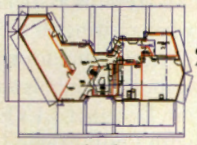
Yes,

you can do Windows™ and walls and doors and floors, ceilings, whole  's,  's, trains, boats,  's, chains,  's, diamond rings,  's and things,  's, power plants, topo maps,  's, helicopters, roads and bridges, circuit boards,  's power lines,  's, airports, furniture, digital terrain models,  's, skateboards, the  ,  's, chemical plants,  's, golf courses, anything you can think of ... even the kitchen 

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CIRCLE 048 ON READER SERVICE CARD

Voice Recognition

Listen 2.0: Vocal Command And Control for the PC

BY DAVID HASKIN

Verbex Voice Systems' $99 Listen for Windows, Version 2.0, is an impressive voice-recognition program that can handle continuous speech, so you won't have to alter your normal speech patterns to use it. Unlike the newest wave of voice recognition products, however, you can use Listen only for commands that control your Windows environment and applications, not for dictating.

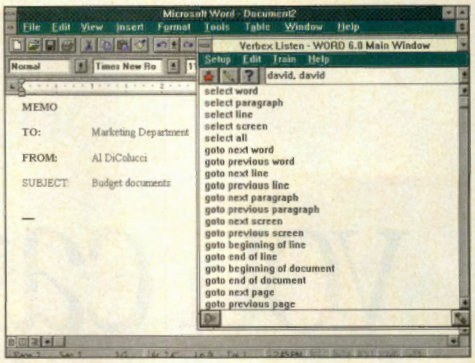
Adding to its convenience, Listen is speaker independent, so you don't have to train it to recognize your voice. The program comes with files, which Verbex calls grammars, that contain a robust set of commands for about 20 popular Windows applications. In operation, Listen is sensitive to context, switching grammars automatically as you switch applications, and displays a window showing available commands for the current application.

Listen's accuracy was impressive. In our tests, Listen made few mistakes and often recognized commands that were mumbled. When it fails to recognize a phrase, you can train it by selecting the phrase from a list and repeating it several times.

Listen does have some shortcomings, most of which involve the command editor for creating new commands and editing existing commands. The command editor is a necessary component because most users will want to add commands or adapt preexisting ones. In the command editor, you record keystrokes and then train Listen to recognize the spoken phrase that triggers it.

The command editor is poorly documented and is not always intuitive to use. For example, certain keys, such as the Delete and arrow keys, can't be incorporated simply by pressing them. Rather, you must learn the syntax for reserved keys and enter them into the editor manually. The correct syntax for these reserved keys is buried in the Help system and not in the printed documentation.

To some, Listen's limitations as a voice command and control system make it unnecessary, particularly since more powerful dictation-level voice products are available. However, those who repetitively perform typing intensive tasks—such as adding boilerplate text—will appreciate how Listen can save time and keystrokes.



SPEAK: *Listen's command editor enables you to add new phrases to the included vocabulary of commands.*

▶ **Listen for Windows, Version 2.0.** List price: *Without microphone, $99; with microphone, $139.* Requires: *5MB RAM, Sound Blaster–compatible sound card, Microsoft Windows 3.1 or later.* Verbex Voice Systems, *1090 King Georges Post Rd., Building 107, Edison, NJ 08837-3701. 800-275-8329, 908-225-5225; fax, 908-225-7764.*

Circle 423 on reader service card

Illustration

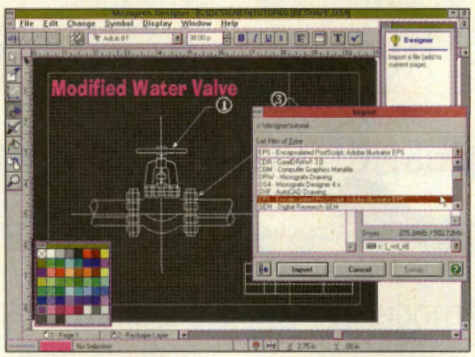
The Missing Link Between CAD and Business Software

BY J. W. OLSEN

In our most recent review of illustration programs ("A Picture in Time," January 25, 1994), Micrografx's Designer, Version 4.0, shared an Editors' Choice award with CorelDRAW. The $695 Micrografx Designer, Version 4.1 TE, reviewed here shows off a new interface and focuses on the needs of the technical illustrator—a path not taken by other software manufacturers.

Aimed at technical illustrators, Designer 4.1 TE can function as the needed bridge between CAD software and the rest of your enterprise. The program provides easy movement of multilayer illustrations among more than two dozen CAD and other file formats. In addition to .DXF and CGM filters, Designer 4.1 TE includes improved support for EPS, JPEG and Photo CD.

You might begin by sketching your ideas in Designer 4.1 TE, which is far faster than CAD programs, and then use the latter for adding details. At any time, drawings can flow easily back into Designer; then—after enhancing color, or adding text—they can be moved into presentation, desktop publishing, or other applications. No longer must you create illustrations for manuals and brochures separately or settle for dull CAD drawings.



EASY IN, EASY OUT: *Micrografx Designer 4.1 TE sports robust, multilayer importing and exporting for CAD documents and a variety of other applications.*

Designer 4.1 TE's file-format enhancement is the key improvement compared with other programs, but you're likely to appreciate the speed boost as well. Screen redraws affect only modified elements, and redraws continue during cursor movement. Speed also is improved by removing all the 3-D features from Designer 4.0.

Newly mixed colors can now be added to existing palettes, and creating text along curved paths is easier and faster. More significantly, a new dimensioning tool—horizontal, vertical, or diagonal—retains associations when resizing objects. The package includes 1,500 technical symbols and clip art. Designer 4.1 TE ships with PhotoMagic 1.0, an inviting if not feature-rich bitmap editor.

If you must sail the gulf between CAD and other illustration needs but don't require 3-D support, Designer 4.1 TE may be just your ticket.

▶ **Micrografx Designer 4.1 TE.** List Price: *$695.* Requires: *8MB RAM (16MB recommended), 20MB hard disk space, Microsoft Windows 3.1 or later, CD-ROM required to access most fonts, clip art, and on-line tutorial.* Micrografx Inc., *1303 E. Arapaho Rd., Richardson, TX 75081; 800-733-3729, 214-994-6475; fax, 214-234-2410.*

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Ergonomic Keyboards

They've Got the Look... Have They Got the Feel?

BY EDWARD MENDELSON

As recently as a few months ago, ergonomic keyboards with odd shapes—irregular slopes and curves instead of the more traditional straight-line design of standard keyboards—were expensive oddities. Now, Microsoft's $99 Natural Keyboard and Lexmark's $179 Select-Ease Keyboard put full-size keyboards designed to fit your hands firmly in the mainstream. While both are viable alternatives to standard fare, the more expensive Lexmark Select-Ease keyboard grows on you the more you use it, while the Microsoft Natural keyboard seems more idiosyncratic as time goes on.



DO THE TWIST: *New designs from Microsoft (top) and Lexmark (bottom) redefine keyboard design by separating letter keys into two groups.*

Microsoft's Natural Keyboard looks like a standard keyboard that melted in the back seat of your car. The left and right half of the main keyboard area are split into two regions for improved comfort. The beauty of the Natural keyboard is that you don't have to reach for the farthest keys.

It also adds something no other keyboard does—shortcut keys. The layout key, which is between the Control and Alternate keys, brings up a new Windows task manager. An additional menu shortcut key will tied to the next version of Windows.

The Windows driver adds mouse emulation and other convenience features, such as controls for fine-tuning the repeat rate and other mouse settings, and a unique "sonar" feature that pops up a circle around the cursor when you press the Ctrl key.

On the downside, the rubbery response of Microsoft's keys may disappoint some. In addition, the only physical adjustment available is one that raises or lowers the slope of the keyboard to improve wrist comfort. Microsoft's first attempt at a keyboard is quite a good effort at redefining what a keyboard is and does.

Lexmark's sturdy and responsive Select-Ease keyboard is a study in contrast compared with the Microsoft product. It also divides the main keyboard area in two halves, but with a twist. You can twist them, turn them, or even split them apart. The keyboard comes without software, but no other keyboard lets you adjust it so precisely for maximum comfort. Lexmark's layout is more compact, with smaller motions required to reach the arrow keys and keypad. The only major flaw is Ctrl and Alt keys that are the same size as letter keys, instead of the more generous size used on most other models.

Unlike Microsoft's one-size-fits-all model, Lexmark offers unmatched fine control over the hardware. By loosening a knob at the top center of the keyboard, you can rotate the two halves or detach them entirely from each other. Three adjustable legs on each half let you set the exact slope of the keyboard, with a screw adjustment for fine-tuning. The Select-Ease includes all the keys of the industry-standard IBM Enhanced Keyboard layout in a compact arrangement. The Spacebar is split into two keys, one for each half of the keyboard, and a dip switch maps either half as an additional Backspace key, to further reduce finger reaching.

For software enhancements and mouse emulation, consider Microsoft's keyboard. For the ultimate in responsiveness and comfort, choose Lexmark's. Both models make the standard keyboard seem as constraining as a corset.

▶ **Select-Ease Keyboard.** List price: *$179.* Lexmark International Inc., *740 New Circle Rd. NW, Lexington KY 40511. 800-438-2468; 606-232-3000; fax,* 606-232-7720.

Circle 424 on reader service card

▶ **Microsoft Natural Keyboard.** Estimated retail price: *$99.* Microsoft Corp., *One Microsoft Way, Redmond WA 98052. 800-426-9400; 206-882-8080; fax 206-936-7329.*

Circle 425 on reader service card

Peripherals

Tune In With Your PC

BY BRAD STILWELL

Although multimedia enthusiasts will likely welcome Novex Technologies' $49.95 RadioActive stereo FM-tuner board, the majority of mainstream users may dismiss it as little more than a plug-in toy.

The half-length 8-bit ISA board contains an FM receiver with a 1-watt-per-channel amplifier. The package comes with both a DOS and a Windows interface that enables you to store up to 100 radio stations, along with call names and frequencies.

There is also a clock, volume control, manual and autoscan tuning, a fine-tuning adjustment, and eight preset station buttons so that you can program the device to tune in for a radio show and then turn it off when it's over. Pressing the Escape key instantly mutes the radio. The software's current version only has three volume settings, only allowing crude adjustment; an expected year-end release will add better volume control as well as a cable to connect to a sound board.



CATCH THE WAVELENGTH: *Use your PC to tune in to stereo FM radio stations while you work with the Novex RadioActive card.*

Its price and its use of an expansion slot make the RadioActive an unlikely replacement for a common office radio or boom box, but for users who already have speakers, headphones, and a sound board, the RadioActive will add another dimension to multimedia presentations and playtime.

▶ **RadioActive.** Estimated price: *$49.95.* Requires: *One 8-bit ISA slot.* Novex Technologies Inc., *2738 E. 51st, #280, Tulsa, OK 74105; 800-725-8325, 918-744-8001; fax, 918-744-8077.*

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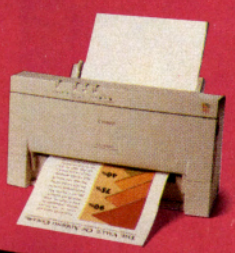

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■ **Mapping Software**

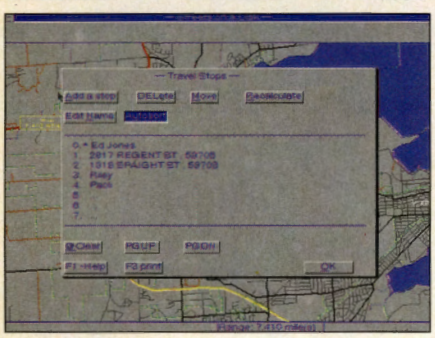
Two Mapping Programs Help You Get From Here to There

BY DAVID HASKIN

Streets On A Disk, Version 6.0, and Map 'n' Go, Version 1.0, are very different approaches to map-routing programs that complement each other. Either of the two will get you from here to there, but while Map 'n' Go is a flashy CD-ROM Windows routing program for long-distance travelers, Streets On A Disk provides a comprehensive set of tools for those whose business requires intimate knowledge of local roads.

With Map 'n' Go, you use a dialog box to establish the starting and ending cities for your journey and as many as 48 other cities to visit en route. You can search for specific cities on the basis of area code, ZIP code, or city name. Once your itinerary is established, Map 'n' Go will calculate either the shortest route, the fastest route, or the route that adheres to your preferences for roads, such as back roads. It then highlights the route on-screen and provides a travel plan.





PLAN: *Both mapping programs provide dialog boxes in which you establish your itinerary.*

WHERE ARE WE...

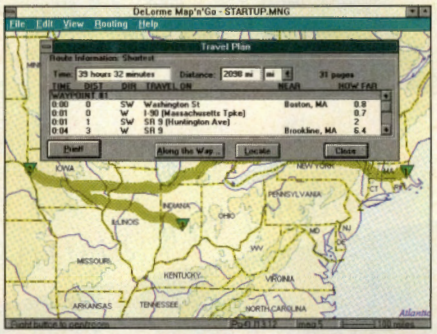
Because Map 'n' Go doesn't include lesser roads such as county highways, it probably won't please scenery buffs or those interested in traversing the roads less traveled. It does, however, include a sizable database of suggested stops, such as historical sites. While you can print descriptions of the sites, Map 'n' Go doesn't provide directions to them.

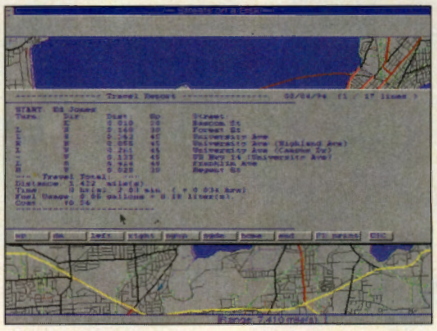
The product's Windows interface is generally straightforward, but sometimes appears off kilter. For example, in the dialog box in which you enter your itinerary, clicking on a button labeled Advanced displays a second dialog box with another set of options. However, you can't change your beginning and end points in this second dialog box easily. Map 'n' Go's strength is providing unerringly accurate and detailed routes, including highlighting when a ferry is required.

... WHERE ARE WE GOING

While Map 'n' Go is excellent for inter-city travelers, Streets On A Disk is a powerful tool for those who use regional roads. Streets requires that you buy extra-cost county maps that include every road. The interface is straightforward but is less intuitive than Map 'n' Go.

Streets offers an exceptional level of detail and flexibility. For example, you can search for itinerary points on a number of criteria, including street addresses and even latitude and longitude.





ROUTE: *After the programs calculate the route, they display the itinerary both in dialog boxes and on-screen.*

Itineraries can have as many stops as you want, making Streets ideal for the planning and dispatching of truck or car routes. One impressive feature is AutoSort, which analyzes the points on your itinerary and suggests a logical route order—a feature that less professionally oriented routing programs like Map 'n' Go should include.

AutoSort worked well at creating precise, compact itineraries. Distances for each leg are measured to a thousandth of a mile (compared with a tenth of a mile for Map 'n' Go). The itinerary can also optionally include items such as the speed limit on each stretch of road.

There are powerful mapping tools, as well. You can use comma-delimited database files to add points such as customer information to a map, although the interface for doing so is circuitous. Streets has extensive map-editing capabilities, so you can add landmarks and mark traffic patterns; maps can also be annotated with information (such as sales territories). Macro-recording capabilities help speed repetitive tasks. Streets even supports the satellite-based Global Positioning System (GPS). If you buy third-party GPS modules for each vehicle in your fleet and link them to Streets, you can view the location of the vehicles on-screen as they move.

Even with its dated DOS interface, Streets On A Disk is a powerful tool for those who must master the roads in their region. However, if you need a tool for planning long-distance road trips, Map 'n' Go is fast, simple, and thorough.

▶ **Map 'n' Go.** Estimated Price: *$50.* Requires: *4MB RAM, 3MB hard disk space, CD-ROM drive, Microsoft Windows 3.1 or later.* DeLorme Mapping, Lower Main St. *Freeport, ME 04032. 207-865-9291; fax, 800-452-5931.*

Circle 417 on reader service card

▶ **Streets On A Disk.** List Price: *$225 plus $95 per county.* Requires: *500kb lower memory; 2MB extended memory, 3MB hard disk space,* Klynas Engineering, DOS 5.0 or later, Microsoft Windows 3.1 or later. *Simi Valley, CA., P.O. Box 499, 93062805-583-1133 805-583-1133; fax, 805-583-1457.*

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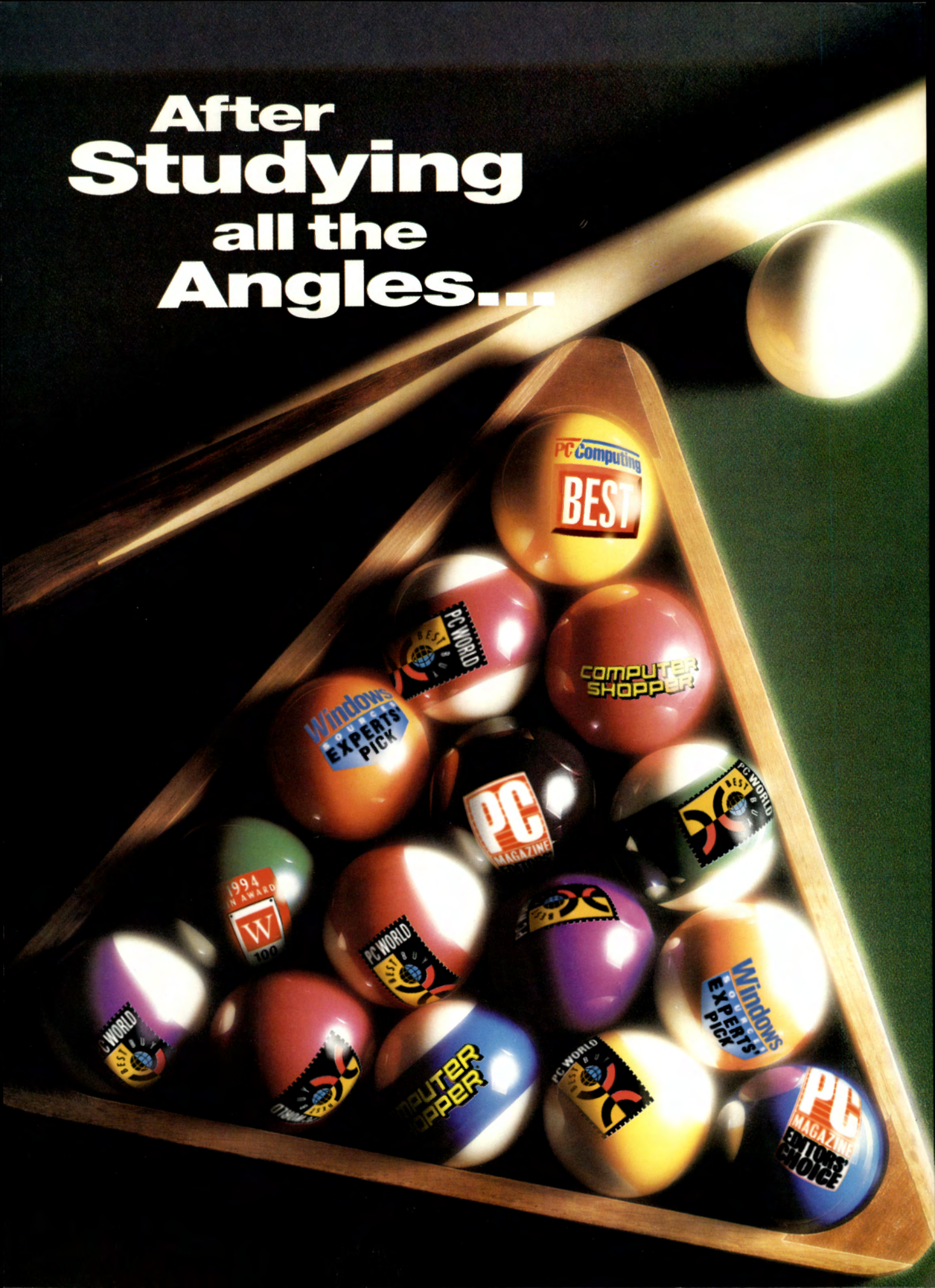
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486DX-33	**$1645** Lease $60/mo.	**$1945** Lease $71/mo.	**$2445** Lease $87/mo.	**$2995** Lease $110/mo.
486DX2-50	**$1645** Lease $60/mo.	**$1945** Lease $71/mo.	**$2445** Lease $87/mo.	**$2995** Lease $110/mo.
486DX2-66	**$1695** Lease $62/mo.	**$1995** Lease $73/mo.	**$2495** Lease $91/mo.	**$3045** Lease $101/mo.
Pentium-60	**$1995** Lease $73/mo.	**$2295** Lease $84/mo.	**$2795** Lease $102/mo.	**$3345** Lease $111/mo.
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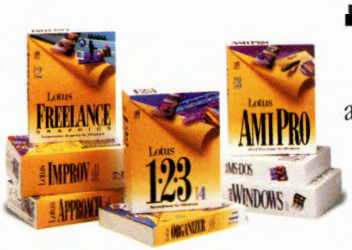

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PC MAGAZINE EDITORS' CHOICE
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1994 WIN AWARD W 100 WINDOWS MAGAZINE
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- 2X CD-ROM drive, 3.5" 1.44MB FDD
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- 14" SVGA color monitor
- MS-DOS, Windows for Workgroups, Microsoft Mouse
- Choice of Lotus Windows application

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Pentium-66 $3538
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- 16MB RAM, 256K SRAM cache
- 528MB local bus IDE hard drive, 256K cache
- 2X CD-ROM drive, 3.5" 1.44MB FDD
- 16-bit sound card, stereo speakers
- Diamond Stealth 64/PCI local bus graphics card 2MB VRAM
- 17" SVGA color monitor
- 10-bay vertical case
- MS-DOS, Windows for Workgroups, Microsoft Mouse
- Choice of Lotus Windows application

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CIRCLE 155 ON READER SERVICE CARD.

■ PCMCIA

PCMCIA Card Readers Bring The World to Your Desktop

BY WINN L. ROSCH

With a PCMCIA card reader on your desktop PC, you can expand your computing horizons by using the same credit card–size devices as you do with your notebook. The long list of potential applications include sharing a modem between your desktop and portable, substituting a flash memory card for the floppy disk your subnotebook lacks, or using a PCMCIA hard disk for backup. These card readers, the Cardwell CardBay20200-1, Databook ThinCard TMB 250, Greystone CardDock GS-220, and SCM SwapBox Premium X2, deliver essentially equivalent performance and differ in price—from $99 to $499— and number of slots—from one to four.

Your first concern is sockets: their number and location. The sockets fit either on an expansion board (typically a 16-bit ISA board that also serves as the host adapter), in a drive bay, or both. Cardwell, Databook, and SCM pattern their bay-mounted reader sockets after 1- by 3.5-inch floppy disk drives. By contrast, the Greystone CardDock fits into a half-height 5.25-inch drive bay, arraying two sockets side-by-side.

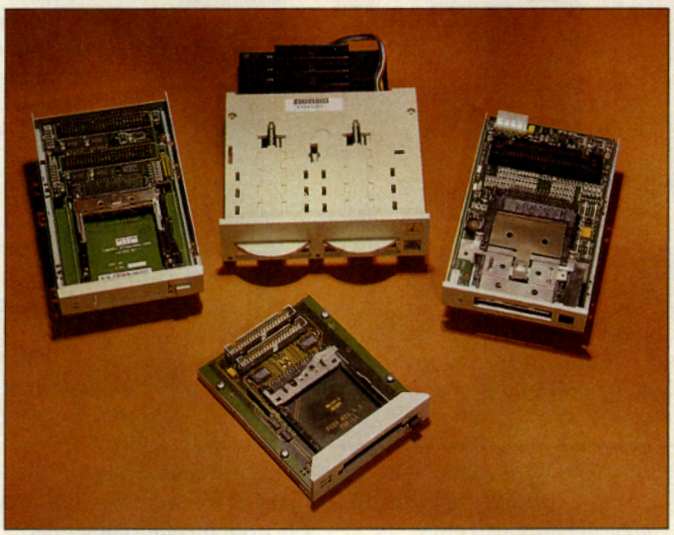
TWO SOCKETS, NO WAITING

Putting two PCMCIA sockets in a 3.5-inch bay requires a little more ingenuity. Cardwell, Databook, and SCM each combine two sockets in one, over/under style. Cardwell allows one thin (5 mm) Type II and one thick (10 mm) Type III card together; the others permit the use of either two Type II cards or a single Type III card per slot.

As an added bonus, the Greystone card reader can accommodate two 15-mm thick cards, while the Cardwell system can accept one. The 15-mm thick card format is for modems that include a built-in RJ-11 phone plug. These modems eliminate the cumbersome PCMCIA dongle connector.

The hardest portion of the installation was routing the wide ribbon cables, which could easily have challenged a Persian weaver. SCM uses a pair of 2-inch ribbon cables for each of its bay-mounted sockets. Databook gets by with a pair of 2-inch cables for two sockets by using a separate power connection. Cardwell and Greystone require two 2.5-inch ribbon cables for each socket; Greystone also adds an extra bundle of wires for its external modem jack, an addition that eliminates wires going from front to back. Unfortunately, none of the manufacturers adequately key their cables, so wiring errors are easy to make.

Each vendor automates software installation. Cardwell and SCM start the process from DOS, Databook gives you the option of using Windows for installation, and Greystone requires Windows. In any case, the installed memory-resident PCMCIA Card and Socket Services will steal about 100K from your PC. As a default, SCM installs the most, albeit the smallest, drivers: seven, versus six for Cardwell, five for Greystone, and four for Databook. Cardwell and SCM use SystemSoft services, Greystone uses Award Software, and Databook uses its own proprietary services.



CONNECT: *Using one of these desktop PCMCIA card readers can be a link to your portable PC. Clockwise from front: SCM SwapBox Premium X2, Cardwell's CardBay, Greystone's CardDoc and Databook's ThinCard.*

SWAP AND DROP?

PCMCIA compatibility can be a nightmare, and hot-swapping cards aggravate the conflicts. Any of these products will allow hot-swapping of cards from, say, a flash memory card to a hard disk without further ado. Tests with a SunDisk and AMD Flash memory card showed that all four were able to write to a Flash disk through DOS at about 4MB per minute.

Potential conflicts arise with allocating system resources used by modems or network adapters, which usually require explicit software configuration. All incompatibilities discovered during evaluation were traced to improper configuration.

In addition, all reader makers include a Windows-based utility to associate resources with each card. That way, every time the card is inserted, resources are automatically assigned. Databook even allows a card to launch an associated application.

While PCMCIA cards remain too expensive to consider replacing ordinary expansion boards quite yet, these card readers let you take advantage of their versatility and give you a taste of what's to come.

▶ **CardBay 20200-1.** List price: *$139.* Requires: *DOS 5.0 or later; Microsoft Windows 3.x; 2MB disk space; ISA slot and drive bay.* Cardwell International Corp., *110 Blue Ravine Rd., #156, Folsom, CA 95630; 916-985-1880; fax, 916-985-1899.*

Circle 419 on reader service card

▶ **ThinCard TMB 250.** List price: *$299.* Requires: *286 or better microprocessor, 16-bit ISA slot, 1MB RAM, 500K disk space, DOS 5.0 or later; Microsoft Windows 3.1 or later.* Databook Inc., *3495 Winton Pl., Building E, #6, Rochester, NY 14623; 716-292-5720; fax, (716) 292-5737.*

Circle 420 on reader service card

▶ **CardDock GS-220.** List price: *$199.* Requires: *4MB RAM, DOS 5.0 or later; Microsoft Windows 3.1 or later (optional).* Greystone Peripherals Inc., *130-A Knowles Dr., Los Gatos, CA 95030; 800-600-5710;408-866-4739, fax, 408-866-8328.*

Circle 421 on reader service card

▶ **SwapBox Premium X2.** List price: *$499.* Requires: *DOS 5.0 or later, MIcrosoft Windows 3.1 or later.* SCM Microsystems Inc., *985 University Ave., #7, Los Gatos, CA 95030; 408-395-8782.*

Circle 422 on reader service card

■ Printers

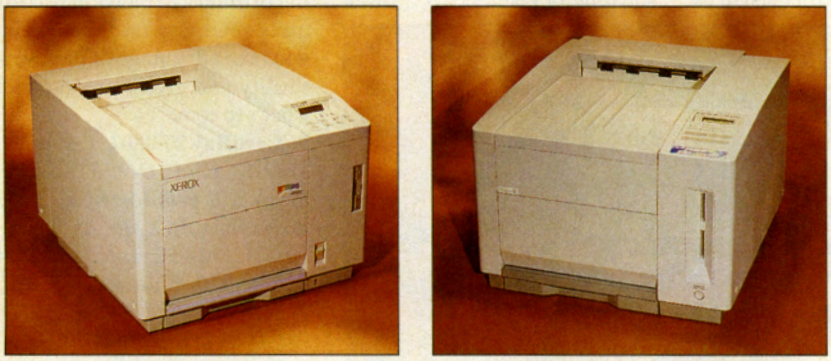
Laser Color Printers Make the Grade

BY M. DAVID STONE

The newest laser printers seek to combine the best aspects of both the monochrome and color printer worlds. Equipped with enough memory to handle high-resolution printing, The $10,999 QMS *magicolor* Laser Printer and the $9,444 Xerox 4900 Color Laser Printer offer the ability to print in either monochrome or color with surprisingly good results.

Both printers are based on offshoots of the same Hitachi engine, and both share the same 21.5- by 23.5- by 14.5-inch size. But there are enough differences in speed, resolution and price to make them seem like fraternal twins rather than identical twins.

The most striking differences are in claimed speed and resolution. As configured for testing, the Xerox 4900 offers 300-, 300- by 600-, and 300- by 1,200-dots per inch (dpi), and 12-page-per-minute (ppm) speed for monochrome or 3 ppm speed for color in all resolutions. The QMS *magicolor* printer is slightly slower and offers a slightly different mix of resolutions: 300- by 300-dpi and 600- by 600-dpi resolution, with a speed of 8 ppm for monochrome or 2 ppm for color. However, where the toner hits the paper, there's less difference between the two than you night guess based on the numbers. Be warned, though, that each requires a 16MB upgrade to handle high-resolution printing. For each system, this memory costs about $1,000.



COLORIZE: *With the ability to print in either color or monochrome, the Xerox 4900 Color Laser Printer (left) and the QMS* magicolor *Laser Printer (right) provide extra flexibility.*

BLACK-AND-WHITE OR COLOR—YOU CHOOSE

Given that color laser printing is the new kid on the block among color technologies, it's worth noting that both of these printers offer the level of text quality that you would reasonably expect from a monochrome laser printer, and go a step further with the ability to print in color. More important, both offer the kind of brilliant, fully saturated colors typical of thermal wax transfer, but they can print on plain copier paper. The only notable problem was that the toner for the QMS printer had a hint of shininess to it.

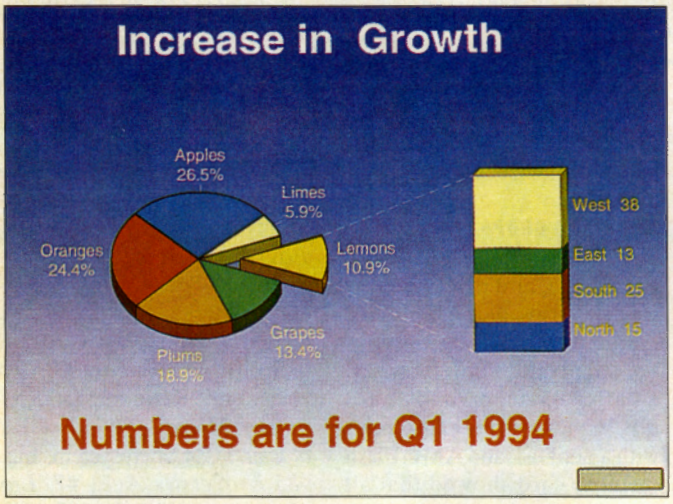
With each printer's default line and screen angles, the Xerox 4900 shows fewer gradations in shading—which gives it an edge for wash effects in graphics. On the downside, the Xerox printer shows obvious dithering patterns, giving the QMS *magicolor* printer the advantage for photorealistic images with both units set at 300- by 300-dpi resolution. In fact, the 300- by 300-dpi QMS *magicolor* output is almost on a par with the 300- by 1,200-dpi product of the Xerox 4900 printer.

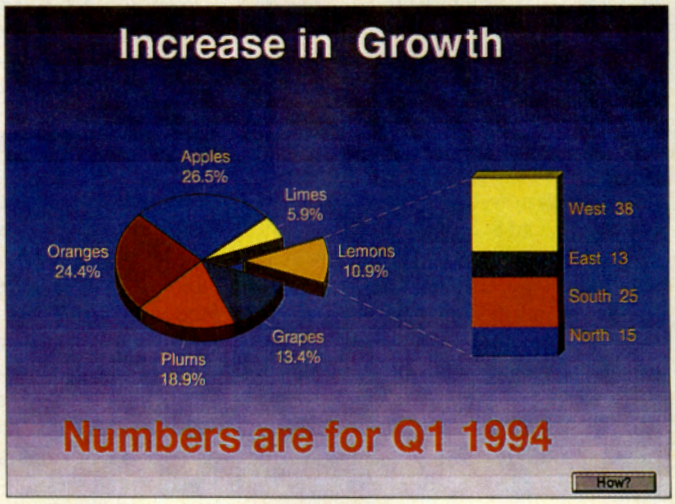
The 600- by 600-dpi *magicolor* output was a bit dark on our test images. Keep in mind, though, that you can improve or degrade the output from any color printer dramatically by adjusting screen settings for individual images.

PRINTER RACE

Speed differences between the printers are less clear-cut. QMS claims that the *magicolor*'s faster processing speed makes up for the slower engine speed. And, indeed, on our tests, the QMS printer managed 0.9 graphics pages per minute (gppm) on the graphics speed test in its proprietary PostScript Level 2 mode, compared with just 0.6 gppm for the Xerox 4900 with Adobe PostScript Level 2 mode turned on.

On the other hand, the Xerox printer takes a slight lead in PCL





CHOICES: *While the print sample of the QMS* magicolor *printer (left) has richer colors, the comparable output for the Xerox 4900 printer (right) produces smoother gradations in tone.*

5 mode at 1.6 gppm, compared with 1.4 gppm for the QMS printer. Text was printed at 7.1 to 8.2 ppm, depending on the emulation for the Xerox 4900 system, versus 6.6 to 6.8 ppm for the QMS *magicolor* unit.

PLUSES AND MINUSES

Comparing the operating costs of these two printers is also less than straightforward. The Xerox 4900 costs 2 cents per page for text printing with 5 percent coverage, compared to 4 cents for the QMS printer. But the QMS printer's color toner is less expensive that the toner used for the Xerox printer. For printing in color at 5 percent coverage, it is a dead heat between the two. The QMS *magicolor* costing 19 cents per page compared with 18 cents for the Xerox 4900. At 30 percent coverage, the *magicolor* is actually less expensive to operate—32 cents per page compared with 38 cents.

Both printers offer a choice of interface cards for hanging them off a network, along with the ability to accept jobs from any port, and determine if those print jobs are in PostScript or PCL format. In our tests, both of the printers guessed wrong mode at least once.

On balance, both color laser printers are impressive beasts and show that this technology has come of age. They are suited for any department or workgroup that's discovered the benefits of color, and particularly the benefits of mixing color and text on the same page using standard-weight paper.

▶ **Xerox 4900 Color Laser Printer.** List price: *With parallel, serial, and LocalTalk port, $8,495); 16MB RAM upgrade (needed for 300 by 1,200 dpi color), $949; media server option (includes floppy disk drive so printer can read and print files directly from disk), $250; Ethernet adapter (NetWare, TCP/IP, TokenTalk), $849; 250-sheet lower paper feeder, $625; additional paper tray, $125; envelope tray, $135.* . Xerox Corp., *80 Linden Oaks, Rochester, N.Y. 800-275-9376; fax, 716-256-4499.*

Circle 428 on reader service card

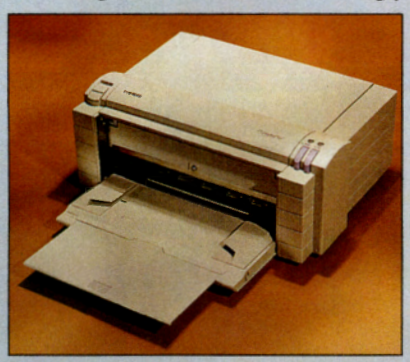
▶ **QMS magicolor Laser Printer.** List price: *With parallel, serial, and LocalTalk ports, $9,999; 16MB RAM upgrade (needed for 600 by 600 dpi color), $1,000; Ethernet adapter, (NetWare, TCP/IP, TokenTalk), $849' Token-Ring adapter (NetWare, Token-Ring TCP/IP or TCP/IP with DECnet), $999; bottom-mounted second paper tray and feeder, $625.* QMS, Inc., *Mobile, Al; 205-633-4300, 800-523-2696; Fax, 205-633-4866*

Circle 429 on reader service card

PrimeraPro: Split Personality Color Printer

The $1,895 PrimeraPro is first cousin to the Primera printer that Fargo introduced last year. It shares the same compact 17- by 13.9- by 6-inch size with paper trays at the ready, as well as the same flexible personality that allows it to print either thermal wax or thermal dye transfer output.

In order to switch from one mode to the other, you simply change ribbons and paper stock, then set the printer driver for the appropriate mode. There's one key difference, though. Instead of printing at 203- by 203-dot-per-inch (dpi) resolution, the PrimeraPro offers 300 by 300 dpi and a step up to 300 by 600 dpi. That puts the PrimeraPro in the same resolution ballpark as far more expensive color printers, though without the enhancement algorithms that are increasingly common.



DOUBLE DUTY: *At up to 300- by 600-dpi resolution, the Fargo Primera can print in either thermal wax transfer or thermal dye transfer mode.*

The relatively low price is the result of using the attached computer to rasterize the image prior to printing. More expensive color printers include RISC processors, lots of RAM, and a PostScript interpreter in firmware—often with a PCL mode as well. The PrimeraPro is simply a dumb printer with a 32K buffer, a design that cuts hardware costs considerably.

Included with the package is a Windows GDI driver, which will let you print from any Windows program. An Amiga driver is also available, and Fargo sells a Macintosh version with a LocalTalk connector instead of a parallel port, but we concentrated on the Windows version.

For those who prefer PostScript, Fargo plans to sell an Adobe PostScript software interpreter for Windows for $399.95. The interpreter was not available for testing.

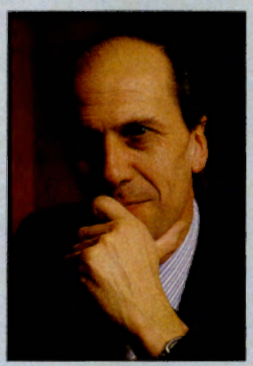


PHOTO-FIDELITY: *In dye sublimation mode, the PrimeraPro produces excellent photo-realistic images.*

Output quality is every bit as good as it should be for the resolution. For graphics, thermal wax transfer offers saturated colors, but with noticeable dithering patterns. Thermal dye transfer graphics show even better color saturation and brilliance, with barely visible dithering. Scanned photos can appear somewhat grainy in thermal wax mode, but still attractive. With thermal dye transfer, they approach photographic quality.

The price per page for non-transparencies ranges from 30 cents to 45 cents for thermal wax and $2.50 to $2.79 for thermal dye transfer, which is typical for the technologies.

Print speed for the PrimeraPro depends on the computer it's attached to. Maximum speed for color is a claimed 1.5 minutes per page for thermal wax and 9 to 12 minutes for thermal dye printing. Monochrome prints, using monochrome ribbons, take about one third the time.

The speeds—particularly the thermal dye transfer speeds—are slow even for these technologies. But the output is worth waiting for, and the Fargo PrimeraPro is the most inexpensive route by far to high quality, color printing.—*M.D.S.*

PrimeraPro Color Printer. List Price: *$1,895; 3-color or 4-color thermal wax transer ribbon, $45; monochrome thermal wax transfer ribbon, $39.95; paper for thermal wax transfer: 200 sheet letter size, $14.95; A4-size, $15.95; 200 sheets premium grade letter size, $19.95; A4-size $20.95; 50 sheets of letter size transparencies, $34.95; A4-size, $36.95; thermal dye transfer refill kit with ribbon and paper for 25 images, $89.95; for 100 images, $279.95; monochrome thermal dye transfer refill kit for 100 images, $162.* Fargo Electronics Inc., *7901 Flying Cloud Dr., Eden Prairie, MN 55344; 800-327-4622, 612-941-9470; fax, 612-941-7836.*

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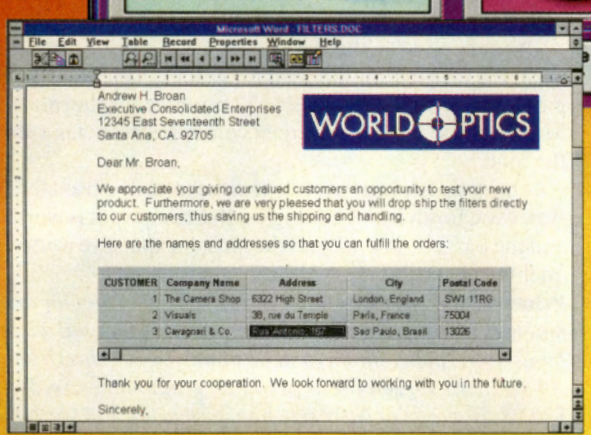



▲ *Paradox for Windows has superior integration with Perfect Office and Microsoft Office applications. Thanks to OLE 2.0, you can place a "live" Paradox table into a Microsoft Word or WordPerfect document and edit the data in place. (Access 2.0 cannot do that.)*

February 1994 November 1993 June 1994

◀ *Paradox for Windows is the most award-winning Windows database on the market with over 20 major industry awards for excellence.*

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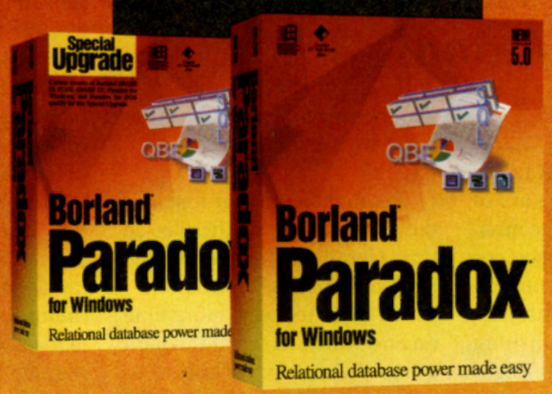

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New Paradox 5.0 for Windows has been tuned to give you better performance. It stores and retrieves data faster, and delivers answers to queries with more speed than ever before.

And Paradox 5.0 for Windows has kept developers in mind too. There's a new Integrated Development Environment and more than 300 new Methods and Properties help you develop ObjectPAL™ Windows applications faster. Plus, with Borland's new high-performance native SQL links, Paradox is ready when you are to upsize your applications to the Client/Server environment.

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Comparison Facts

End-user Features	Paradox 5.0	Access 2.0
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Experts/Wizards to guide you step-by-step	✓	✓
Integrated graphics	✓	
Built-in workgroup and mail capabilities	✓	
Quick Filters without query process	✓	
Power-user/Developer Features		
OLE 2.0 client and server support	✓	
Compatibility with applications from previous version	✓	
Visual Data Model Designer	✓	
Transparent connectivity and scalability with database aliases	✓	
Record level locking	✓	
Full range of data types, including Time, Graphic and Autoincrement	✓	
Graphical Integrated Development Environment (IDE)	✓	
ODBC-compliant	✓	✓
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Presentation Graphics

SPC Shines a Spotlight On Presentations

BY TIN ALBANO

More and more presentations are being given with the aid of laptops hooked up to large monitors instead of transparencies or slides. But today's presentation packages are not without their faults. Software Publishing Corp.'s $129 Harvard Spotlight for Windows starts where traditional presentation packages leave off by giving users a way to effectively present, organize, and rehearse on-screen presentations.

Spotlight acts as a control panel for SPC's own Harvard Graphics, Lotus's Freelance Graphics, or Microsoft PowerPoint presentation software. What makes it special is that it allows for two different screens—an audience screen and a presenter's screen.

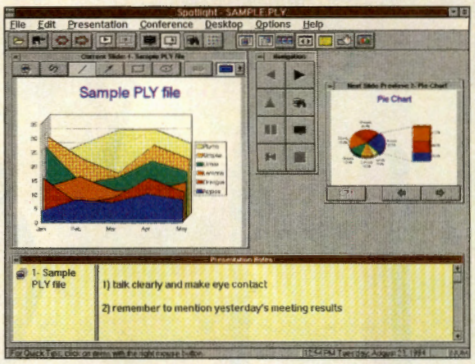
By putting this split personality on presenter's laptop, Spotlight allows simultaneous viewing of the projected slide, speaker's notes, timing information, and a convenient preview of the next slide. The audience, of course, sees only the current slide.

Spotlight uses a customizable VCR-like interface—the Navigation Bar—to control the presenter's screen. The Navigation Bar lets users display as many as seven different windows, each with different information. A Slide Manager allows the presenter, when prompted, to jump to a specific slide, change the order of the slides on the fly, or—if need be—display an alternate slide. Chalk and pointer tools let presenters draw and highlight on-screen.

These tools make giving presentations a lot easier, but SPC also built a nifty timing device into Spotlight that can help fine-tune and pace a presentation. Each slide, for example, can be given a specific on-screen time which is monitored in another window on the presenter's screen.

Spotlight lets a user rehearse the presentation with the allotted time frames and automatically feeds back pacing information—which slides to spend more time on and which to scroll through quickly. An Advisor tool constantly provides the speaker with tips on posture, eye contact, gestures, and voice modulation.

SPC saw the need for a presentation add-on that lets users customize not only their slides, but also the way they deliver their presentations. Harvard Spotlight for Windows goes far beyond the rehearsal features of today's presentation software and is an indispensable tool for those who find themselves behind podiums on a regular basis.



SPLIT: *Spotlight lets you divide your attention between your notes (bottom) and the screen the audience sees (top).*

▶ **Harvard Spotlight for Windows.** List price: *$129.* Requires: *4MB RAM, 6MB hard disk space, Microsoft Windows 3.1 or later.* Software Publishing Corp., *3165 Kifer Rd., Santa Clara, CA 95056. 800-234-2500, 408-986-8000; fax, 408-980-0729.*

Circle 434 on reader service card

Remote Control

KopyKat: The Basics of OS/2 Remote Control

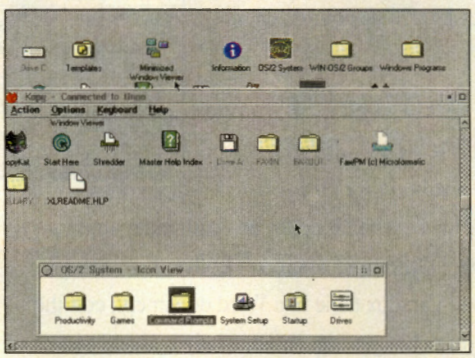
BY AMARENDRA SINGH

Hilgraeve is a respected name in the world of communications software, and its latest product, KopyKat, opens up remote control to OS/2 users. The $99 package is easy to set up and use, but be aware that KopyKat does only remote-control operations. It does not have file sharing or drive mapping—just the basics.

Installing the package is as simple as double-clicking the setup icon, which opens an install notebook. This typical OS/2 loading metaphor allows you to browse through setup in any order. Unfortunately, it is neither clear nor in any way intuitive that you must shut the notebook to finish loading the program.

When first launched, the program takes you through the hardware selection process by asking for a COM port and the type of modem you have. If you choose, you can use NetBIOS for network-based remote control. The package offers connections at up to 115 kilobytes per second and supports ISDN.

Operating the application is divided into two elements: Kopy, which denotes the controlling PC, and Kat, which represents the host system (the one being controlled). KopyKat prompts you for an account to call, using the default settings it just received; you can also have individual settings for individual numbers. The next step is to call the machine waiting in "host mode." Once the connection is made and you have entered the correct password, you can run a session on the remote machine, although KopyKat will only give you a window view. You can run DOS, OS/2 for Windows, and OS/2 sessions on the host.



CONNECT: *KopyKat sets up a window called Kopy for the remote PC.*

In our testing, remote operation went without a hitch. It is, however, unfortunate that KopyKat has so few features as compared with other Windows remote-control programs or even PolyPM/2, another OS/2 remote-control package that we reviewed recently ("How to Be in 2 Places at Once," August 1994). But the minimalist approach of KopyKat seems to follow a trend whereby the simple release of a native OS/2 package is enough to guarantee a certain level of sales. We expected better from Hilgraeve considering the quality of its applications, and we hope it will enlarge KopyKat's scope.

▶ **KopyKat, Version 1.0.** List price: *$99.* Requires: *6MB RAM, 800K hard disk space, OS/2 1.3 or better.* Hilgraeve Inc., *Genesis Center, 111 Convent Ave., Monroe MI 48161; 313-243-0576; fax, 313-243-0645.*

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■ Accounting

Peachtree Refines Low-End Accounting Software

BY KATHY YAKAL

Peachtree Accounting for Windows Release 3.0 remains the product to beat in the small-business accounting market, and has extended its lead by including many features and functions you would expect to find only in more expensive accounting packages. The $169 program remains easy to learn and use, making it flexible and sophisticated enough to fit into the way businesses operate.

Targeted at small- and medium-size businesses ranging from start-up operations to companies with roughly 100 employees, Peachtree allows you to custom-build an accounting system that reflects your company's structure. For example, you can define five custom fields for every customer, vendor, employee, job, and inventory item, as well as nine shipping addresses for each customer.

Vendors, customers, and inventory items can be assigned 20-character identification codes. Inventory can be tracked using either the average costing method, LIFO, or FIFO, and each item can have five pricing levels. One-time cash receipts can be generated, and you can maintain up to ten pay rates for hourly and salaried workers. In addition, Peachtree's General Ledger comprises 60 sample charts, including those for accounts, processing transactions for accounts receivable and payable, payroll, job-costing, and inventory.

FORM AND FUNCTION

As with invoices or purchase orders, creating custom forms can be a grueling and frustrating task for most accounting products. Building your own forms in Peachtree is still no walk in the park. It requires a steady hand and an eye for design to come up with a professional-looking result, but it's much easier to place and move objects, due in part to a series of simple tools. A similar set of tools is used in the financial report writer for generating business documents, such as a balance sheet or a list of overdue accounts.

Accounting software is based on multiple document layers, so the capacity to find related data quickly is crucial. Just double-click on line items in transaction-related reports to see, for example, a copy of the account's original invoice. This intuitive display of information is key to designing an efficient accounting system. The Action Items file folder, which automatically appears at start-up and can be invoked anytime, contains tabs for data sets that you use for browsing through information.

WAKE-UP CALLS

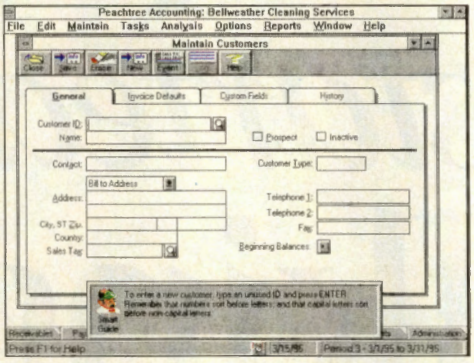
The Events folder holds reminders for things such as transactions, calls, or letters that must be—or have been—generated; you can drill down to the underlying transactions here as well. There are over 60 programmable Alerts that can be set to flag you when, for example, a customer has exceeded a certain sales volume or an employee has worked too many overtime hours.

More than ever, an accounting program must coexist with other applications and act as a conduit for business data. Peachtree is a network-ready, double-entry accounting system that conforms to Generally Accepted Accounting Principles (GAAP).

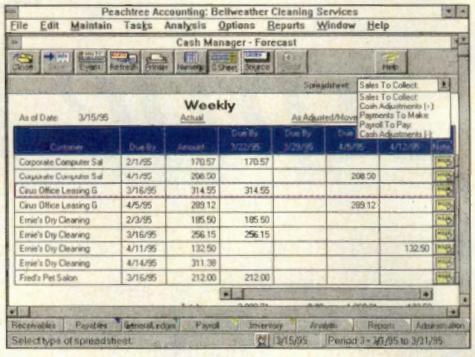
The program did have a few minor glitches, however. First, you can't import a .BMP file (such as a company logo) into the forms designer because of an apparent incompatibility with OLE 2.0; using the clipboard is an acceptable but awkward alternative until Peachtree fixes the problem. Second, the program offers no help in ordering fields of databases to be imported, or even a thorough explanation in the manual—though a faxback document is available. While this isn't standard in entry-level accounting programs, it's offered by applications like contact managers and would greatly facilitate the flow of information from outside sources.

Peachtree covers its support bases well, with phone and fax support, in addition to forums on CompuServe, Prodigy, and America Online, and 85 authorized Peachtree Support Centers. Our calls to phone support were answered within 10 minutes and faxes were delivered quickly. Unfortunately, documentation has been slimmed down in this version, so some processes are cursorily explained in print. SmartGuides—small text boxes that pop up to explain what's happening on-screen—provide additional guidance, as does context-sensitive on-line help. Peachtree is also available on CD-ROM, which sells for the same $169 as the diskette edition, despite the fact that it includes Avery LabelPro for Windows, SofNet's FaxWorks, and CompuServe Information Manager.

Peachtree is chipping away at the upper edges of small-business accounting by enhancing its customizability and flexibility. The program is a tool for managing many aspects of business, not just numbers. If you're a first-time accounting software browser, you must consider Peachtree Accounting for Windows 3.0. Current users will likely find it well worth the upgrade cost.



TRACK: *By incorporating a unique identification number, Peachtree can help track customers, vendors, and inventory.*



BUILD: *Putting together professional-looking forms and reports is made easy with a set of powerful, yet simple, tools.*

► **Peachtree Accounting for Windows Release 3.0.** List price: *$169;* upgrade, $89. Requires: *4MB RAM, 14MB hard drive space, Microsoft Windows 3.1 or later.* Peachtree Software Inc., *1505-C Pavilion Pl., Norcross, GA, 30093; 800-228-0068, 404-564-5700; fax, 404-564-5888.*

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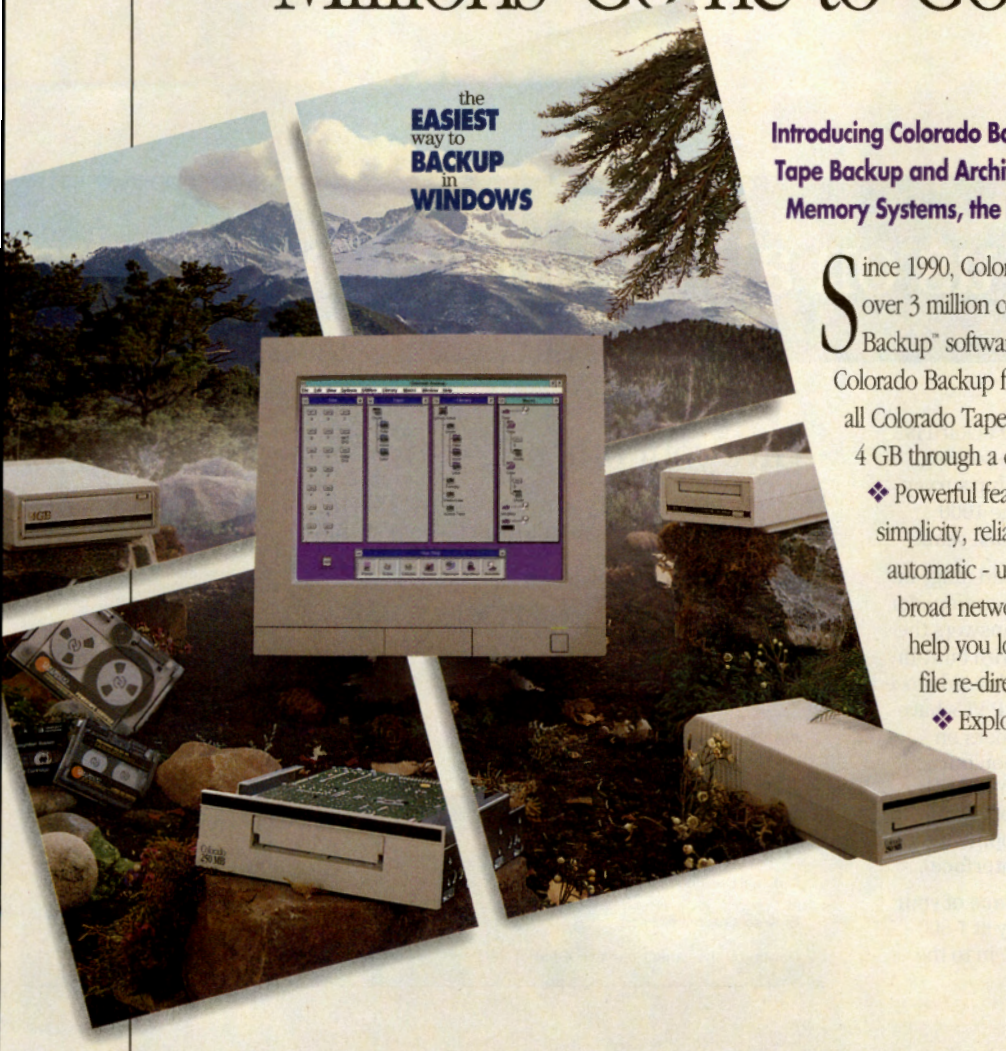

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Advanced Bus Architecture	PCI	VL		
Integrated Networking Interface	32-bit	16-bit		
Integrated, multiprotocol Boot-ROM	X	X		
ISA Plug-n-Play Compliant	X	X	X	
Multilevel Security Features	X	X	X	X
Asset tracking	X	X	X	
PC tattooing	X	X	X	
Optional Desktop Management Software	X	X		
Bi-directional parallel port	X	X	X	X
Desktop Management Interface (DMI)[3]	X	X		

HP quality in value-priced PCs.

- *Intel 33-MHz 486SX, 50- and 66-MHz 486DX2, 100-MHz DX4, upgradable to Pentium Overdrive; Intel 60-MHz Pentium*
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High-performance network-ready PCs in a slimline package.

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- *210-MB, 14-ms Fast-IDE hard drive[1]*
- *32-bit Fast-IDE local-bus hard disk interface*
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High-performance PCs for the connected office.

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- *Optional 128- or 256-KB second level cache*
- *Four mass storage shelves; four expansion slots*
- *One available 32-bit VL-bus slot*
- *210-MB, 14-ms Fast-IDE hard drive[1]*
- *32-bit Fast-IDE local-bus hard disk interface*
- *8-MB RAM, expandable to 96-MB*

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- *Two available 32-bit PCI expansion slots*
- *270-MB, 12-ms Fast SCSI-2 hard drive[1]*



HP Vectra VL2

- *Desktop Power Management*
- *EPA Energy Star certified*
- *Local bus Fast-IDE hard disk interface**
- *1280 x 1024 video resolution**
- *Optional 128- or 256-KB cache memory**
- *Free three-year limited warranty for parts and labor[2]*

from
$1,049†



HP Vectra N2

- *1 MB of video RAM standard, expandable to 2 MB*
- *Slimline package with two mass storage shelves and three ISA slots*
- *Optional integrated 10Base-T networking*
- *Multilevel security*
- *EPA Energy Star certified*
- *ISA Autoconfiguration utility (Plug-n-Play)*
- *Integrated Desktop Management Interface (DMI)[3]*
- *Free three-year limited warranty for parts and labor[2]*

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$1,429†



HP Vectra M2

- *Ultra VGA2 local-bus accelerated video supporting up to 1280 x 1024 resolution*
- *Optional integrated 10Base-T networking*
- *Systems Diagnostics Utility*
- *EPA Energy Star certified*
- *ISA Autoconfiguration utility (Plug-n-Play)*
- *Integrated Desktop Management Interface (DMI)[3]*
- *Free three-year limited warranty for parts and labor[2]*

from
$1,509†



HP Vectra XM2

- *8-MB RAM, expandable to 96-MB*
- *PCI Integrated 64-bit S3 Vision-864 graphics accelerator supporting up to 1280 x 1024 resolution*
- *Optional PCI Integrated 32-bit 10Base-T networking*
- *Integrated Desktop Management Interface (DMI)[3]*
- *EPA Energy Star certified*
- *Free three-year limited warranty for parts and labor[2]*

from
$2,069†



HP Vectra XU

- *Integrated 32-bit PCI SCSI-2 interface*
- *PCI integrated 64-bit S3 Vision-864 graphics with 1280 x 1024 resolution or PCI MGA Ultima Plus graphics with up to 1600 x 1200 resolution*
- *32-bit PCI IDE hard disk interface*
- *8 or 16 MB of RAM, expandable to 256 MB*
- *PCI Integrated 32-bit 10Base-T networking*
- *Integrated Desktop Management Interface (DMI)[3]*
- *Free three-year limited warranty for parts and labor[2]*

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All HP Vectra PCs come with MS-DOS® 6.2 and MS Windows for Workgroups 3.11 pre-installed; HP mouse and keyboard included. *Feature included with some models. †U.S. list price, dealer prices may vary. Monitor not included. [1]Other capacities available. [2]First year on-site, 24-hour service. Second and third year return to dealer. [3]Available 10/1/94. ‡With permission CRN/Benchmark. MS-DOS is a U.S. registered trademark and Windows is a trademark of Microsoft Corporation. Pentium and the Intel Inside logo are U.S. trademarks of Intel Corporation. PPG407 ©1994 Hewlett-Packard Company

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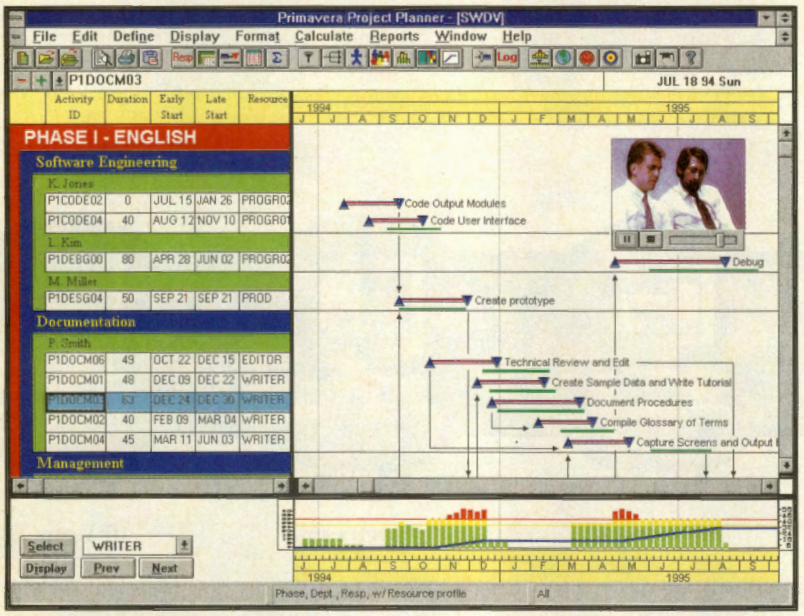

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NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Adam A. Hicks

NEW

Pass the RemotePoint: Infrared Pointing Alternative

Interlink Electronics has used its VersaPoint pressure pointing technology to create a variety of pointing devices, the newest of which is the compact, rugged RemotePoint infrared pointing device. With no cord and an estimated maximum range of 40 feet, you won't be stuck next to a computer during presentations. The pointing device is powered by three AAA batteries. The receiver can connect to your standard serial or PS/2 mouse ports.



Walk up to 40 feet with the RemotePoint cordless mouse.

▶ **RemotePoint.** List price: *$199.* Interlink Electronics, *Camarillo, California; 805-484-1331; fax, 805-484-8989.*

Circle 402 on reader service card.

IMPROVED

InfoRecall Gives Structure to Nonformatted Data

Phantech Software has designed InfoRecall for data stored on your desktop PC that you need, but that does not readily fit into a spreadsheet or database format. Free-form information managers such as InfoRecall and askSam's askSam for Windows let you throw different types of information together in a "pile" without losing the ability to make relationships and search the data. With InfoRecall, you can create fully indexed records that can be as small as a note or as long as 25 pages. These records can be linked via hypertext and queried using a variety of search tools such as Boolean operators, keywords, dates, and partial matches. The software package also lets you import and export data, do merged printings, and create DDE links to compatible Windows-based word processors.

▶ **InfoRecall, Version 4.0.** List price: *$99.95.* Phantech Software Inc., *Toronto, Canada; 800-208-1311, 416-502-1311; fax, 416-502-1345.*

Circle 403 on reader service card.

HOT PROSPECT



Full-Featured Videoconferencing via Analog Phone Lines

For $1,599, the ShareVision PC3000 from Creative Labs provides a point-to-point videoconferencing system that uses analog lines instead of more expensive and harder to find ISDN connections. You don't have to compromise because you're not using ISDN: The PC3000 has acceptable video transfer rates and includes things that even some ISDN packages don't, such as application sharing and whiteboard software capabilities.

The ShareVision PC3000 comes with a full-length 16-bit Video Blaster video-capture board, a half-length audio and data communications card, an external V.Fast 28.8-Kbps fax modem, an NTSC-compliant camera, and a Plantronics ear piece with integrated microphone. The package transmits maximum resolutions of up to 160 by 120 pixels at speeds ranging from 5 to 10 frames per second using the VATP (Vector Adaptive Tranform Processing) compression algorithm. The ShareVision software negotiates bandwidth allocations between video, voice, and data transfer, so if you transfer a file, the video performance may drop but the job gets through. If you only need a point-to-point whiteband software and application-sharing package, the ShareVision PC300 ($749) will work for you.

▶ **ShareVision PC3000.** List price: *$1,599.* Creative Labs Inc., *Milpitas, California; 800-998-1000, 408-428-6600; fax, 408-428-6699.*

Circle 401 on reader service card.

NEW

V_Graph's OZone Multimedia Tool Wears Two Hats

V_Graph has a software package that bridges the gap between object-based development tools such as Microsoft Visual Basic and authoring tools such as Multimedia ToolBook. The object-oriented package, called OZone, acts as a multimedia authoring system and is suitable for creating presentations of all kinds. It's also a visual programming application that you can use to assemble cross-application scripts. Four different synchronized interfaces let you view programming objects the way you work best, in either a time line view, a flowchart view, a spreadsheet view, or an output view. The package lets you choose and edit icons from palettes that you use for linking multimedia files, including text and video, and also lets you create links to OLE objects. There is also a complete group of VBX controls included in the package. The viewer portion is included free for noncommercial use, but you can buy a one-time license for a fee of $1,000 to distribute the viewer portion of OZone commercially.

▶ **OZone, the Object Zone.** List price: *$495.* V_Graph Inc., *Westtown, Pennsylvania; 800-852-6284, 610-399-1521; fax, 610-399-0566.*

Circle 404 on reader service card.

IMPROVED

ActionWorkflow Manager for Notes Adds Task Management

Your work consists of more than forms and documents, and now, so can your workflow-management software. The ActionWorkflow System from **Action Technologies** has added preprogrammed forms to one of its modules, ActionWorkflow Manager for Lotus Notes, Version 1.5. The new version allows you to assign and follow through on tasks, create to-do lists for workgroups and projects, and coordinate meetings from scheduling to summaries. The package adds a new icon to the Notes database; this icon becomes the central control from which your tasks and meetings can be assigned, tracked, and grouped according to project. This version loads onto a Lotus Notes server; Action has not released a 1.5

Photography by Thom O'Connor

update of its SQL version of ActionWorkflow.

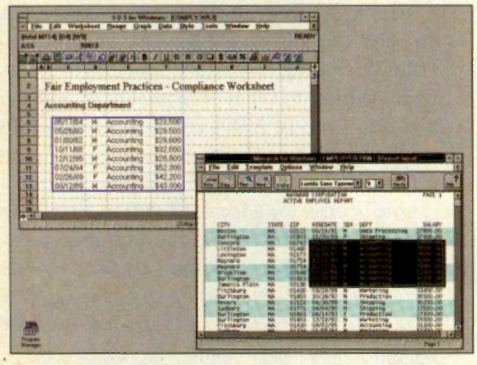
▶ **ActionWorkflow Manager for Lotus Notes, Version 1.5.** List price: *10-user license, $1,990.* Action Technologies Inc., *Alameda, California; 800-967-3569, 510-521-6190; fax, 510-769-0596.*

Circle 405 on reader service card.

NEW

Monarch Report Viewer Gives Life to Report Data

We all get reports on paper, but with Monarch for Windows from **Personics Corp.** your report data is transformed into fully editable information on-screen instead of just figures on the page. Unlike database front-end tools, with Monarch for Windows you are not creating links to central data to create reports, you are reinterpreting filtered report data. When a report is processed Monarch imports the report file, which contains all the characters and control codes sent to the printer, including data and formatting. The advantage for people who



Monarch for Windows lets you copy formatted data directly into your spreadsheet.

work with lots of reports is a more flexible data control that can be searched, annotated, copied to other files, and selectively printed--all without re-keying data.

▶ **Monarch for Windows.** List price: *$499.* Personics Corp., *Willmington, Massachusetts; 800-445-3311, 508-658-0040; fax, 508-988-0105.*

Circle 406 on reader service card.

NEW

Modatech's Suite Targets Maximum Sales Coordination

Modatech Systems employs a best-of-breed packaging approach to create its Maximizer Sales Suite software package, which is specifically tailored to client tracking. On its own, Maximizer for Windows was a full-featured contact-management system that offered unlimited customized fields, task and appointment scheduling, and call tracking with a flexible user interface. Now it comes bundled with a suite of software that includes MapLinx Corp.'s self-named mapping software; Crystal Services' simple-to-operate yet powerful report writer, Crystal Reports; and SofNet's FaxWorks low-end Windows fax software. These packages are integrated to let you manipulate the information you've stored within the Maximizer contact-management database. Now you can visually display the location of clients on a map so that you can schedule visits, fax groups or individuals using a single phone book, and generate presentationready reports of client data.

▶ **Maximizer Sales Suite.** List price: *$395.* Modatech Systems Inc., *Irving, Texas; 800-804-6299, 214-929-7111; fax, 214-929-5177.*

Circle 407 on reader service card.

BRIEFS

Software

The WizardWorks Group has released a collection of software called Notebook Companion as part of its CompuWorks home office productivity line. The $59.99 bundle includes software for security control for you hard disk, virus protection, and battery monitoring for DOS and Windows to keep your notebook running smoothly. You also get ScheduleWorks for Windows to keep appointments and phone numbers and a copy of Expense Wiz for Windows for keeping track of your money on the road. In addition, the seven games included in the game pack will keep you distracted while traveling. 612-559-5140.

TouchStone Software Corp. will take care of your desktop with a collection of its PC utilities and troubleshooting software. WINCheckIt has a variety of tools for maintaining your system, improving its performance, and recovering important system files if they are changed or lost. The Windows-based package includes utilities for finding duplicated files, unistalling unwanted applications, and optimizing memory into the largest available blocks. WINCheckIt will be priced under $50 and will also offer system performance tracking, a configuration advisor, and a system file editor, among other features. 800-531-0450, 714-969-7746.

WinSales, makers of contact-management software for sales people has enhanced its namesake software program. WinSales, Verison 2.1 ($495 for a single-user license) lets you track all your sales procedures in one area, called the Fulfillment Center. This area acts as a task manager by keeping track of who is to receive what letter and when, giving you an overview of what needs to be done. The new module lets you sort and query the records and print labels and envelopes. It automatically updates the contact-management database, confirming that an individual has been sent a particular correspondence. 206-854-9580.

Niad Corp. already has Perfected! Version 2.0, for WordPerfect 5.1 for DOS users. Its new productivity tool for

NEW

One Color Printer for Proofs and Final Production Printing

Even with color printer prices dropping, it is still expensive to output final dye sublimation prints. The Professional ColorPoint 2 PSF, Model 4, from **Seiko Instruments USA** cuts the cost by providing one engine that can do both thermal wax transfer and dye sublimation printing. This gives you the option to print 8.5- by 11-inch proofs at up to 16.7 million dithered dot colors with thermal wax and then do final printouts in 16.7 million continuous tone true-color with dye sublimation. Designed for graphic artists, the unit is loaded with professional features such as autotrim, full-bleed printing, and a 33-MHz RISC based controller with Adobe PostScript Level 2 embedded inside.

▶ **Professional ColorPoint 2 PSF, Model 4.** List price: *$8,999.* Seiko Instruments USA Inc., *San Jose, California; 800-888-0817, 408-922-5000; fax, 408-922-5835.*

Circle 408 on reader service card.

NEW

Dukane Integrates LCD Panel into Its Overhead Projector

Overhead projectors enter the computer age as **Dukane Corp.** releases two overhead projection systems with built-in active-matrix color LCD panels. The MagniView 850 and MagniView 864 display computer data without the need for an additional LCD unit, so you'll see

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Used to be the expression "powerful end-user database" was like "the Long Island Expressway" or "jumbo shrimp."

A contradiction in terms.

Of course, that was before the introduction of Microsoft Access® relational database system 2.0: the database that's as powerful as it is easy to operate.

Are you a seasoned developer? Or are you working with a database for the first time? As people are discovering, it's no longer an issue. Because with Microsoft Access, routine tasks are automatic. And complex tasks aren't complex at all.

Do you have to create a table for your data? Just click on the Table Wizard and you'll be led through the process step by step.

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What is it that makes this wonderful stuff so easy? Something we call IntelliSense™ technology: a feature unique to the Microsoft® Office family of programs, and one reason why Microsoft Access has garnered so much critical acclaim.

Suppose you're ready for something more adventurous. Like developing a database application of your own. Microsoft Access can help you do just that. Pose a query and its Rushmore™ query technology will provide an answer – not quickly, but immediately. Revise a piece of data and that revision will be reflected wherever your data is used – automatically. Plus, no matter where your data happens to be stored – Paradox™, Microsoft SQL Server™, you name it – with Microsoft Access you can, well, access it.

As if that weren't enough, even finding a helping hand is pretty easy. Microsoft Access comes with unlimited product support at no service charge.*

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Microsoft Office

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The MagniView 680 is an LCD panel for computers and an overhead projector in one.

brighter computer projections and still be able to switch to standard overhead projection mode. Both units will project up to two million colors and feature a four-element wide-angle optical system. The 864 supports NTSC, PAL, and SECAM video inputs and has a 575-watt metal halide lamp, a built-in speaker for audio output, and a remote control, making it multimedia ready. The 850 is the entry-level model; it operates from a halogen lamp (less white than the metal halide), requires an optional upgrade for video input, and does not include speaker or remote control

▶ **MagniView 850.** List price: *$5,995.* **MagniView 864.** List price: *$8,495.* Dukane Corp., *St. Charles, Illinois; 708-584-2300; fax, 708-584-5156.*

Circle 409 on reader service card.

IMPROVED

Future Labs' Whiteboard Software Adds Meeting Preparation

Now that whiteboard software lets people get together to share ideas via computers, managing an electronic meeting is a new skill to learn. To address this need, **Future Labs** has released TalkShow 3.0, a new version that gives you greater control over sending slides for presentations. TalkShow 2.0 limits your ability to collaborate on creating presentations (see "Remote Possibilities," June 14, 1994) because it assumes there will be a single presenter who wants to send slides for shared viewing. The new version turns that limitation into an asset because it lets you send multiple pages to participants and autoload them during a meeting or send slides in advance to get everyone up to speed before a meeting occurs. The software package now supports OLE 2.0, which means you'll be able to perform in-place editing of any OLE 2.0 objects directly from the whiteboard environment. The new version also lets you display multiple images simultaneously and allows any participant to resize or move the shared images.

▶ **TalkShow, Version 3.0.** List price: *Single-user license, $279; upgrade from previous versions, $49.* Future Labs Inc., *Los Altos, California; 415-254-9000; fax, 415-254-9010.*

Circle 410 on reader service card.

BRIEFS

Software

anyone using WordPerfect 6.0 for DOS is Perfected!, Version 3.0. The $59.95 package combines basic mail-merging and bookkeeping functions with simple-to-use macros to get a small business group organized from within their word processor. The most important tools include a searchable address book, invoices and purchase orders, and preformatted, ready-to-process forms. The program can be activated from a button bar menu from within WordPerfect. For text you commonly reuse but don't want to retype, Perfected! lets you create a library of up to nine different blocks of text that can be inserted into any document. 800-263-5833, 905-470-0868.

WinWare has a Windows-based development tool for creating help files. Visual Help ($49), as the name implies, walks you through the creation of Windows help files in a visual step-by-step process. You start with the Project Wizard, which creates the structure, then you build the help files with 18 predefined objects or any type of user-defined objects. The package lets you design the look and feel of your help windows, including support for multimedia files. 800-507-4357, 714-586-4492.

Hardware

Tektronix's new Phaser 440 ($7,995) is a photographic-quality color dye sublimation printer that does full-color bleed to the edge of 8.5- by 11-inch paper, an improvement over its Phaser IIsdx dye sublimation. The 440 ships standard with 16MB of RAM but the full-bleed and oversize (up to a 9.3- by 12.7-inch image area) printing capabilities require you have 32MB. The 440 uses a RISC processor that Tektronix has optimized so the unit is able to print 1 page in 2 minutes, which is twice as fast as the Phaser IIsdx. The 440 also offers dual input trays, Adobe PostScript Level 2 support in the hardware, and multiprotocol connectivity options.800-835-6100, 503-682-7377.

Epson America has a new 170MB Type III PCMCIA hard disk priced at $629. To deal with PCMCIA compatibility issues the 1.8-inch-high Model EHDD170 features self-installing driver

IMPROVED

Copy Files to Near-Line Storage Without Seeing Double

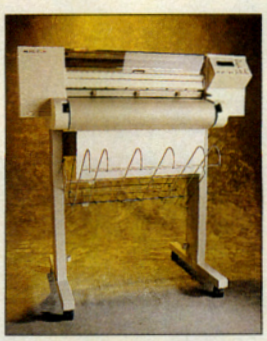
Even when you're storing data on large capacity optical disks, wasting space by saving an entire document because you changed one paragraph is unwise. Instead you may want to try **Host Interface International**'s Double Image, Version 2.1, which searches bit by bit for file modifications and isolates the smallest block that your I/O driver has to send in order to record only the changes. You can recall any version of the document saved to the optical disk in its entirety because the software links the changed portions to the original. Double Image operates in the background, and will reduce the total time you will spend writing data to disk. The package operates faster and more efficiently than the DOS xcopy command or using your Windows File Manager. With an optional scheduler program ($149) you can do basic network backup scheduling. If you spend too much of your resources sending identical data to storage devices, Double Image may prove very useful.

▶ **Double Image, Version 2.1.** List price: *DOS version, $349; Microsoft Windows version, $449.* Host Interface International Inc., *Bellevue, Washington; 800-746-4361, 206-746-4361; fax, 206-649-8652.*

Circle 411 on reader service card.

IMPROVED

Get the Big Picture with HP's Color Ink Jet Plotter



DesignJet 650C color-inkjet plotter for large-format printing.

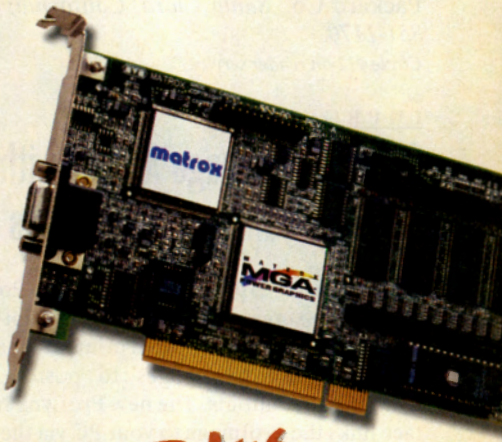
Ink Jet technology makes the large-size printing that is required for GIS and CAD users more affordable than other options. One of these large-size color ink jet printers is **Hewlett-Packard Co.**'s DesignJet 650C plotter, which has improved printing speeds and higher memory capacities to handle the multiple megabyte files required for large color printing jobs. HP has two versions: one for printing D-size documents (24 inches wide) and another for printing E-Size (36 inches wide). Both come standard with 4MB of

FREE! 3D Games Pack
For a limited time only

MGA Impression Plus

The ultimate combination in graphics for only $449[1]

Don't be fooled by the competition's FALSE speed comparisons. Matrox's MGA series of 64-bit graphics accelerators won ALL five Editors' Choice Awards in PC Magazine's graphics review of June 28, 1994 due to a combination of superior performance and productivity features. MGA Impression Plus - the newest addition to the MGA family - takes graphics performance one step further by adding multimedia upgradability, over 20 productivity features, 3D acceleration, and exciting, new 3D games for FREE. Move into the FUTURE with MGA!



The Best 64-Bit Graphics

- 40 million honest WinMarks of 64-bit speed [2]
- 1600 x 1200 resolution in 256 and 65K colors [3]
- 1280 x 1024 in 16.7M colors [3]
- 120 Hz flicker-free display at 1024 x 768

DynaView 3D AutoCAD Features

- Interactive 3D movement and rotation
- Instantaneous Gouraud shaded rendering
- Real-time 3D rendered walkthroughs and fly-bys

Plus

Over 20 Productivity Features

Why even consider the competition's stripped down graphics boards, when you can get the most advanced and comprehensive set of Windows and CAD productivity features for free?

MGA PowerDesk 2.0 Features

- Instant Modeswitch for on-the-fly resolution and color depth switching without restarting Windows
- Pixel Touch hardware pan and zoom
- QCDP true color simulation in 8 and 16-bit modes
- Virtual Desktop sizes up to 1600 x 1200
- Monitor Selection
- Center Pop-Up and Center Window
- MaxVIEW
- PanLock
- Quick Access
- 3D Screen Saver

DynaView 2D AutoCAD Features

- Double buffered Spy Glass and Bird's Eye views
- Windows-like Scroll and Zoom bars
- Resizeable and repositionable Main Window
- Scrollable Text Window
- Programmable pop-up Iconic Menus and Tool Strip

Plus

The Future Built In

With MGA Impression Plus, you won't need to change your graphics accelerator every six months because the future is already built in. You can upgrade your 2 MB VRAM PCI board to 4 MB of VRAM for added speed, resolutions and color depths. You can add up to 15 VM-Channel based peripherals through MGA's Video XL upgrade module. And because MGA supports standard 3D APIs such as, 3DR, Open GL, HOOPs and VAGI, you'll be able to take advantage of exciting new 3D software applications and 3D games!



Plus

Superior Video Playback

Looking for a low-cost, high quality video solution for your PC? MGA Impression Plus gives you the option of either software video acceleration through Microsoft DCI support, or hardware video acceleration with MGA Video XL for the smoothest, photo-realistic video playback at ultra-high resolutions.

- 30 frames per second with Microsoft DCI software video playback
- Video XL upgrade module gives you:
  - 1280 x 1024 at 30 frames per second video playback
  - Resolution scaling using Pixel Interpolation for high quality, full screen video playback
  - Color space conversion from YUV to RGB



Plus

3D For Free

Why pay more for 3D? MGA Impression Plus is the only graphics accelerator on the market that offers powerful 3D acceleration for the price of a 2D board!

By accelerating 3D directly in hardware, MGA Impression Plus frees your CPU of computing-intensive rendering functions, allowing you to not only display - but interactively manipulate complex 3D drawings in real-time. You can then pan, zoom, slice and walk through your 3D models at resolutions as high as 1152 x 882. That's the same level of 3D performance as dedicated work-stations from Silicon Graphics!



Plus

Free 3D Games Pack

Now you can play arcade-quality 3D games right from your PC! MGA Impression Plus is bundled with thrilling new interactive, real-time 3D games created specifically to take advantage of MGA's powerful 3D graphics engine. And by accelerating the rendering process directly in hardware, MGA Impression Plus gives you higher frame rates, more bad guys, and harder interactive punches!

June 28, 1994

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MGA Impression ISA

PC MAGAZINE EDITORS' CHOICE
MGA Impression VL-Bus

PC MAGAZINE EDITORS' CHOICE
MGA Ultima Plus VL-Bus

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Matrox Graphics Inc.
Tel: (514) 685-2630 Fax: (514) 685-2853

WinBench 4.0 scores based on 4 MB PCI boards using a PentiumP5-60, 16 MB RAM, 256KB cache. ©1994 All rights reserved. Matrox, Matrox MGA, Matrox QCDP, Matrox Instant Modeswitch are registered trademarks of Matrox Electronic Systems Ltd.

Notes:
(1) Price for the MGA Impression Plus with 2MB VRAM, PCI local bus.
(2) Speed performance based on in-house testing of a 4 MB PCI board using Ziff-Davis' WinBench 4.0 on a PentiumP5-90, 16 MB RAM, 256KB cache, 1024 x 768 x 256 colors.
(3) Requires 4 MB of VRAM.

matrox

CIRCLE 124 ON READER SERVICE CARD

RAM but can now be upgraded up to 68MB. The plotters also have added scatter half-tone dithering technology, along with other HP color optimizations for higher overall printing quality and less banding.

▶ **DesignJet 650C.** List price: *D-size model, $7,495; E-size model, $8,995.* Hewlett-Packard Co., *Santa Clara, California; 800-851-1170.*

Circle 412 on reader service

IMPROVED

Get Your Message Across with Desktop Banners and Posters

Varitronic Systems' ProImage PosterPrinter is a stanalone unit with a 400-dot-per-inch scanner and poster sized printer that automatically enlarges images to poster- and banner-size printouts. The new ProLynx Interface links the ProImage to your PC via the parallel port so you can do the same enlarging for files sent from DOS and Windows applications. The package gives people who need to create posters and banners for messages to corporate workers or enhance presentations on demand a professional look with little effort. The unit stores a single 23-inch-wide, 100-foot paper roll that can produce posters in four different sizes: 23 by 31 inches, 17 by 22 inches, 33 by 44 inches, and 45 by 59 inches, or banners up to 23 inches wide and 100 feet long. The thermal transfer paper rolls are available in different colors and textures for prices that range from $79.95 to $199.95. The printer outputs single-color printing at 300 dpi and also does reverse printing.

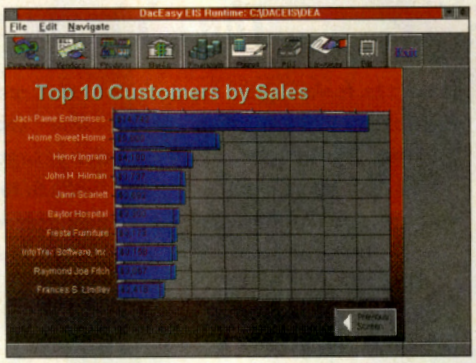
▶ **ProImage PosterPrinter with ProLynx Interface.** List price: *$3,995.* Varitronic Systems Inc., *Minneapolis; 800-637-5461, 612-542-1500; fax, 612-541-1503.*

Circle 413 on reader service card.

NEW

DacEasy EIS: Windows Display For Executive Information

If you enter your accounting information using **DacEasy**'s DOS-based accounting software because of its faster performance, you can now have Windows-based reports if you use the new DacEasy Executive Information System (EIS) for Windows. This Windows software links to DacEasy Version Five DOS modules and other appplications to display data graphically in a variety of preformatted templates. In addition to DOS accounting data, the EIS software offers open database connectivity and Dynamic Data Exchange so you can import and display data from other database and spreadsheet applications. All updates to data automatically show up on the charts, so you can use the EIS manager to keep track of incremental changes to inventories and sales as they happen. The



With EIS you can have graphics displays without changing from your DOS accounting package.

templates can be modified to create custom formats so your view corresponds to how you analyze the data. EIS also acts as a presentation software package that includes background templates, clip art, transition effects and even the ability to incorporate video and sound.

▶ **DacEasy Executive Information System for Windows.** List price: *$299.95.* DacEasy Inc., *Dallas; 800-332-3279, 214-248-0305; fax, 214-713-6331.*

Circle 427 on reader service card.

NEW

Mediaverse: Multimedia Authoring Tool Has Interface Builder

Looking Glass Software has taken its VyperWrite hypertext word processing program one step further and created a full multimedia authoring system called MediaVerse. The database developer portion of the package is fully OLE 2.0–compliant and includes five built-in media editors for text, audio, graphics, video, and 3-D animation. The text editor includes a hypermedia text engine that lets you create duplicate layers of text, each with different formats and hyperlinks. With the interface builder, you have complete control of where images, animations, and videos appear on the screen during presentations. Looking Glass lets you develop for Windows, Windows NT, and Macintosh using the same authoring software and provides two different players (one for Macintosh and one for Windows) that can be distributed royalty-free.

▶ **MediaVerse.** List price: *$799.* Looking Glass Software Inc., *Inglewood, California; 310-348-8240; fax, 310-348-9786.*

Circle 416 on reader service card.

BRIEFS

Hardware

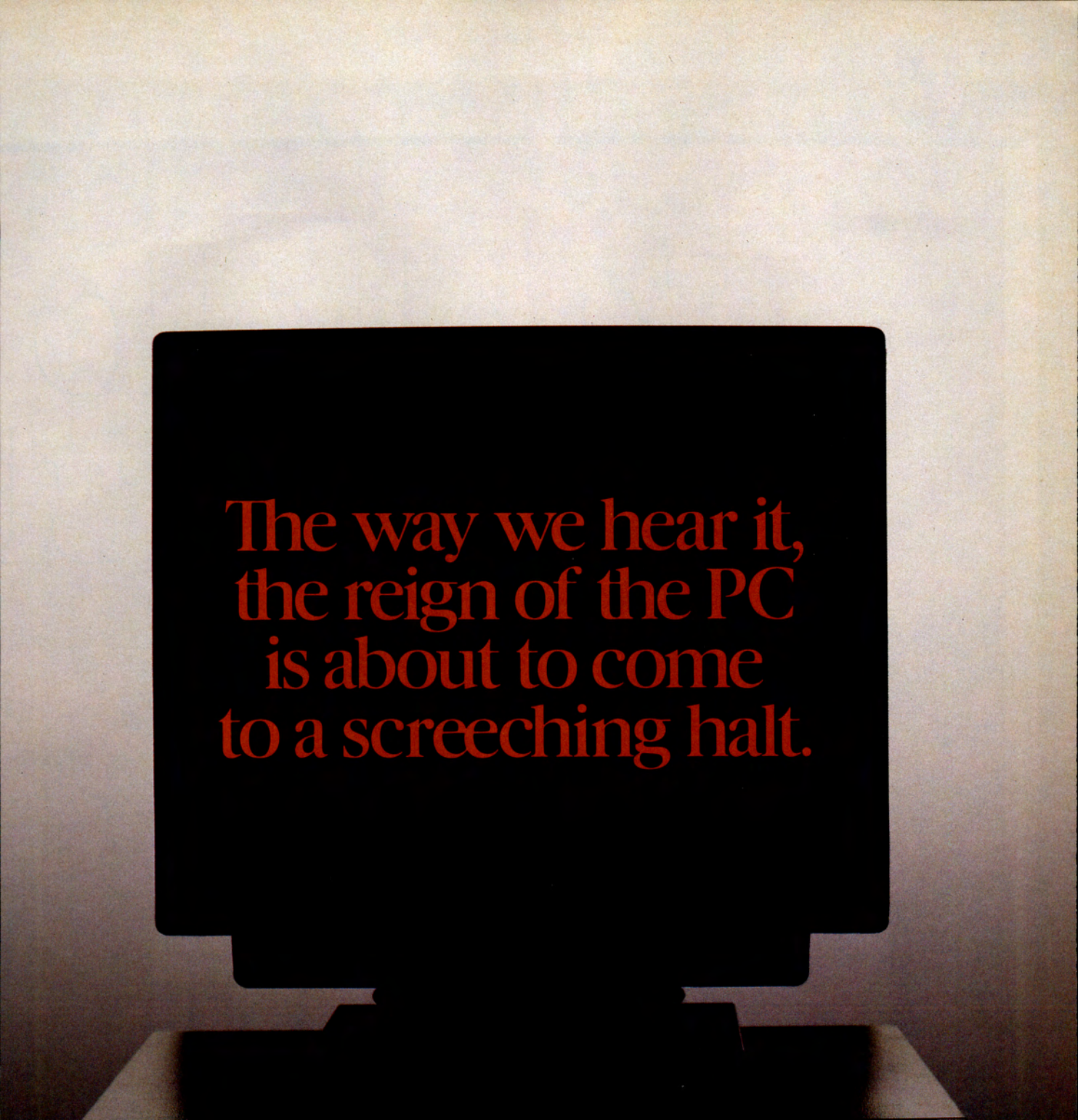
software. Designed for mobile users to quickly swap data between machines, the card comes with a shock-proof case and is designed to draw minimal power from the notebook's battery. 800-289-3776, 310-782-0770.

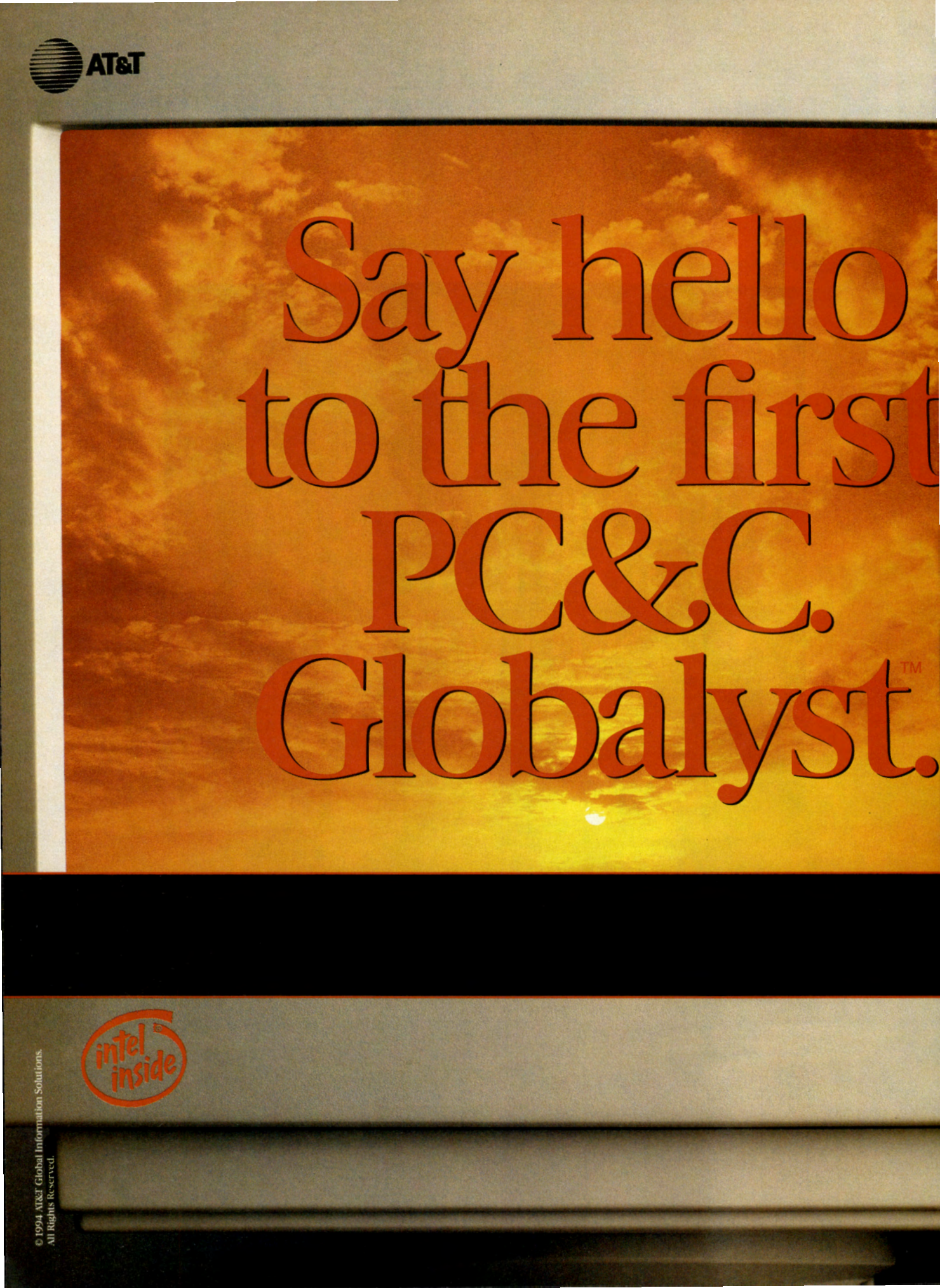
Quantum Corp. is shipping the Quantum QCard family of flash memory cards for PCMCIA Type I and Type II drives. The nonvolatile memory cards are available in 1MB, 2MB, 4MB, and 10MB capacities. The cards meet the PCMCIA Release 2.1 and JEIDA Release 4.1 specifications and offer the unique ability to accomodate 512-byte data-transfer blocks for improved data-transfer performance. The 10MB Type II card is priced at $520 and will be available in November. The other cards are all Type I and are shipping now in 1MB ($90), 2MB ($160), and 4MB ($270) capacities. 800-624-5545, 408-894-4000.

Nokia Display Products has a new $695, 17-inch monitor called the Valuegraph 447L that combines high-quality display and built-in speakers. The Valuegraph is priced to be a low-cost alternative to the Multigraph 447X for those who want to step up to 17-inch displays and get the added speakers for business or home entertainment use without paying lots of money. The .28-mm dot pitch CRT screen delivers resolutions of 1,024-by-0768 at refresh rates of 75 Hz. The monitor has anti-glare and anti-static coatings and comes standard with VESA DPMS power-saver technology. 800-296-6542, 415-331-6622.

And Finally. . .

The XSoft Division of Xerox has expanded distribution of its TabWorks Windows Software interface for organizing and managing documents. Before now, the only way to get TabWorks was to get it bundled with a Compaq computer, but now it is available through retail channels for $49.95. . . Two competitors in the statistical software market are becoming one; SPSS has announced it will acquire SYSTAT. SPSS plans to continue to sell and develop both of these companies' statistical software programs in the future.


The way we hear it,
the reign of the PC
is about to come
to a screeching halt.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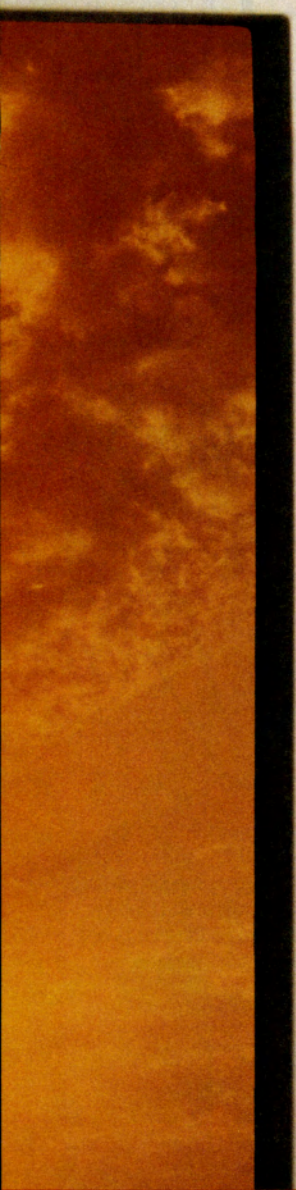

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Five Good Reasons To Buy Peachtree Accounting For Windows.

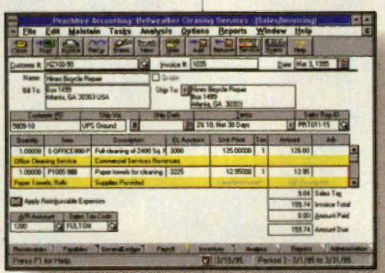
December 18, 1993 — March 1994 — January 1994 — March 1994 — January 25, 1994

First It Won Every Major Award. Then We Made It Better.

Now more than ever, Peachtree Accounting for Windows is the easiest, most powerful tool you can use to build your business.

The critics were already raving about Release 2.0. Now we've taken real-world input from users to make an incredible program even better.

Release 3.0 offers all the essentials you need to organize your company's finances. You can keep up with accounts payable and receivable, track inventory, keep your general ledger, take care of payroll, prepare budgets, and create invoices. Plus you can design business forms, create custom reports, track contacts with your prospects, analyze your sales, and reconcile your checkbook, all within one easy-to-use product. And Release 3.0 includes support for multiple users and networks at no added cost.



Unlike so-called bookkeeping programs, you'll have the solid foundation of true double-entry accounting working for you every step of the way. And using it couldn't be easier. You just fill out on-screen forms that look like the purchase orders, invoices, and checks you use every day.

Powerful Tools To Help You Make More Money.

If this were only an accounting package, it would still be the best in the business. But Release 3.0 offers much more.

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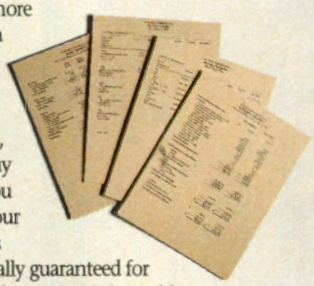

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System Requirements: IBM Compatible 386 or higher, DOS 3.3 or higher, Windows 3.1 running in standard or enhanced mode, 4 MB RAM, 12 MB free hard disk space, VGA or higher monitor, mouse. Works with any Windows 3.1 compatible printer.

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CIRCLE 393 ON READER SERVICE CARD

Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Tin Albano

Learning to Tame the Internet Monster

BY RICK AYRE

Have each of the Internet's 20 million users written a guidebook? Judging by the stacks at your bookstore overflowing with Internet books, you'd certainly think so. Unfortunately, trying to decipher which of these books is worthwhile and informative is as difficult as filtering valuable e-mail from junk messages.



LET'S GET STARTED

The Internet is so vast and intimidating that many choose to ignore it, pooh-poohing about how complicated it is. *The Internet Starter Kit for Windows,* by Engst, Low, and Simon, does an excellent job of alleviating fear and getting the uninitiated—the newbies—up and running. The book comes with a complete complement of software that's so easy to use it can get even the most PC-paranoid people started.

Our favorite guidebooks are not only a pleasure to read but are also full of valuable reference material that's well indexed and easy to find. *The Internet Starter Kit* is all of that. It does an admirable job of describing the Internet, a creditable job of leading you though the Byzantine procedures you need to sort through to get connected, and a very good job of letting you in on what to do once you're there.

What most distinguishes *The Internet Starter Kit* from the myriad of similar titles is that it was written for PC users, and everything is presented from that perspective. It assumes you'll be connecting from Windows, which is not the assumption most starter texts make. As a result, it's very specific when explaining how to do things—like saying you need a version of WinSock (which comes with the software) in order to connect using TCP/IP or SLIP/PPP.

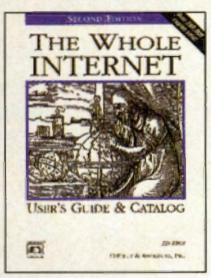


A VERY BIG BOOK

The Internet Unleashed is a massive book that contains just about everything you'll need to know about the Internet. That the book was written by a conglomeration of authors is apparent in the uneven levels of detail and varying writing styles you encounter from chapter to chapter.

The Internet Unleashed is one of the few books that presents both user and administrator information side-by-side. For example, it talks about Gophers from the user's perspective, explaining how to find them and what software you need to connect to them. It also tells you how to set up a Gopher server and what you should be concerned about if you plan to tackle this project.

You'll often find that chapters covering programs were written by the people who authored the software. The bottom line: Most topics are covered by people who really know what they're talking about.



. . .AND STILL THE CHAMP!

The Whole Internet User's Guide & Catalog, by Ed Krol, used to be the Internet book to have. The second edition returns *The Whole Internet User's Guide & Catalog* to that level of prominence. Where the first edition guide was strong, the second is stronger still. It's one of the best-written computer books on any topic—clear, concise, and fun to read—and this new edition has added huge sections that cover what to do on the Internet organized according to topic, content, and PDIAL lists.

The Whole Internet is better than all the rest not only because it is better written but because it does the best job of explaining the big picture.

Figuring out how to be productive on the Internet is difficult, but these three books are a great help.

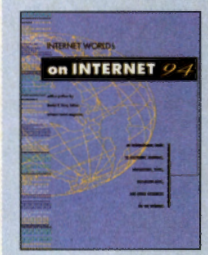
▶ **The Internet Starter Kit for Windows,** *by Adam C. Engst, Corwin S. Low, and Michael A. Simon, $29.95.* Hayden Books, *800-428-5331. ISBN: 1-56830-094-8.*
Circle 444 on reader service card

▶ **The Internet Unleashed,** *$49.95.* Sams Publishing, *800-428-5331. ISBN: 0-672-30466-X.*
Circle 445 on reader service card

▶ **The Whole Internet User's Guide & Catalog, Second Edition,** *by Ed Krol, $24.95.* O'Reily & Associates Inc., *800-998-9938. ISBN: 1-56592-063-5.*
Circle 446 on reader service card

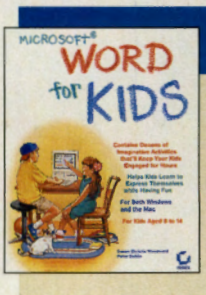
Two More for Your Collection

On Internet '94 is the best index to news groups, mailing lists, WAIS servers, Gopher servers, and more. It's like an Internet telephone book, but better. $45.00; Mecklermedia, 203-226-6967; ISBN: 0-88736-929-4.



Sometimes drawings can really enhance our understanding. Sometimes they just take up a lot of space. Illustrations in Mark Butler's *How to Use the Internet* fall into the first category, which makes it the only really good illustrated Internet guide. $17.95; Ziff-Davis Press, 800-688-0448; ISBN: 1-56276-222-2.

Read Only Recommends



It's difficult to pry kids away from shoot-'em-up computer games, but *Microsoft Word for Kids,* by Susan Christie Woodward and Peter Dublin, may be just the ticket. This book makes using Microsoft Word 6 as fun as playing a game while teaching kids the art of creative writing. $14.99; Sybex Inc., 800-227-2346; ISBN: 0-7821-1510-1.

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INFO WORLD

ReachOut has earned three major awards in the past 18 months. The latest being "Product of the Year" for 1994 from LAN Magazine. Which goes to show that ReachOut is one powerful networking tool. InfoWorld proclaimed "ReachOut offers superb screen, mouse, and file transfer speeds and provides as many security options as Sing-Sing. Operation is as smooth as silk." InfoWorld rated ReachOut as #1 and awarded it their Buyer's Assurance Seal. And PC Magazine UK confessed ReachOut "was the only remote control program that worked right out of the box." They named ReachOut The Editor's Choice and called it a top notch value. The new ReachOut Version 4.0 for Windows continues the tradition of excellence with support for all high resolution monitors up to 1280 by 1280 with 256 colors. What's more, it makes no modifications to the Windows initialization files. And speed is as much as 40% faster than the version InfoWorld had reviewed.

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Michael J. Miller

Bill Gates Ponders the Internet

It's not often that Microsoft CEO Bill Gates admits he was wrong. But even he admits that he did not see the phenomenal growth of the Internet coming on so soon. He assured me, however, that Microsoft plans to be a major player in providing information and services on the much-ballyhooed information highway and that his company has a far broader agenda than many may have realized.

PUTTING VALUE IN THE PIPE

"We've shaped our on-line strategy and how we're going to provide value-added information on top of it," Gates said. He told me he was surprised by the growth of the Internet, popularized by the Mosaic interface to the World Wide Web and helped by the government-subsidized Internet backbone. Still, the Internet has become a base level of interoperability for on-line services, and Microsoft wants to publish software that takes advantage of it.

It has been widely rumored that Microsoft is working on an on-line service, code-named Marvel, that could be part of the next release of Windows (Chicago). Many expect it to be integrated directly with Chicago's InfoCenter front-end e-mail client and Microsoft's Exchange back-end server. Gates wouldn't confirm this for me, but he did say that he believes the basic tools for electronic connections should be part of the operating system.

Microsoft's view is that today's on-line capabilities are just a beginning and will have to undergo a complete revolution. Today, the on-line community is hampered by a narrow communications bandwidth and a turnover rate that's very high except among computer enthusiasts.

INFINITE BANDWIDTH

"We'll have infinite bandwidth in a decade's time," Gates said. He fully expects that in ten years a majority of U.S. homes will be wired to accept full-screen, high-resolution applications over an on-line system. In his view, this gives all computers an effectively infinite capacity.

Microsoft's Advanced Technology group is working on a variety of projects designed to suit Gates' vision of the electronic future. The company has demonstrated its "Tiger" project for delivering real-time video on demand. It is also working on software for set-top boxes and investigating how applications need to change, because working with a PC at arm's length and viewing a TV at a distance are two very different experiences. All this is in preparation for major tests in Seattle and Denver next year.

As with its business software, Microsoft expects to take advantage of its strong position in this future environment. The goal is to create both operating software and applications for use within this higher-bandwidth communications paradigm. Gates noted that "most platforms don't have applications."

What are these applications going to look like? You might find a clue in the many CD-ROM titles Microsoft is now producing. As Gates pointed out, while today's on-line services operate at a relatively low bandwidth (they are constrained by the phone lines), CD-ROMs already have a relatively high bandwidth. Microsoft has been working on creating CD-ROM titles since 1986, the year that it hosted the first CD-ROM conference.



You may be surprised by the things Microsoft's forward-looking CEO has planned for the Internet.

CDs ROLL DOWN THE HIGHWAY

Already we are seeing some connections between on-line and CD-ROM technology. Take a look at Microsoft Complete Baseball, a CD that includes a link to an on-line service for downloading that day's baseball statistics. Others have seen the possibilities this linking may have to

Illustration by Jean-Christian Knaff

Michael J. Miller

offer, including CompuServe, which offers its own CD.

Gates postulates a future where Complete Baseball, available over an on-line connection, offers tickets as well as chat lines. And Cinemania, Microsoft's movie CD-ROM, would have not only reviews, but also links to information sources telling you exactly what your friends have watched, as well as providing links to the actual movies themselves.

This, of course, is just the beginning of what such services could provide, and it will take a while to get this really going, but at least we have gotten started. Software is starting to come with electronic documentation, electronic registration, and even electronic distribution for small updates, such as new drivers. More and more people are looking at the PC as a communications device. With ISDN coming into the business market, we're beginning to see new applications for collaborating over and sharing documents.

Eventually, the availability of such high-bandwidth communications will affect all areas of business. A few of Gates' examples: In medicine, you could easily push a button and talk to your doctor or to a specialist across the country. In education, this could radically change the ways teachers work together and share information. In law, this could change how you find lawyers and how lawyers file briefs.

This could also be used to help people find others with common points of view. In addition, Gates believes multiplayer electronic games will become very popular in the near future.

How quickly will all this happen? Gates said that an optimistic guess would estimate approximately 20 percent of all U.S. homes as having such penetration within five years, although for businesses much higher levels would already be reached.

FIRST, COMMUNICATE

Even further into the future, Microsoft is working on the technology that would be required for a "wallet PC." This would be a $500 to $600 PC companion and scheduler that would require and take advantage of pervasive wireless networks, digital certificates (as a money substitute), and low-cost global positioning.

Such a product would be far more advanced than today's personal digital assistants, which Gates said failed simply because they were too expensive and did not do enough. As Gates sees it, the hardware was not good enough, and the handwriting technology was not good enough. Gates again admitted "I was wrong, but I don't feel bad" about believing that the technology was closer than it was. "We'll get it right someday," he added.

Handwriting recognition (and speech recognition, which Microsoft is also looking into) is "just hard to do," Gates said. It requires deep, fundamental improvements. Still, he said that working on these problems is important. "At all times in our history, we've been able to take a much longer-term approach."

Today, we look at Microsoft primarily as a provider of operating systems, desktop applications, tools, and even CD-ROMs. But Gates knows that the kinds of applications and the kinds of platforms we will want in the future will be radically different. His final thought: "The killer app is communications." □

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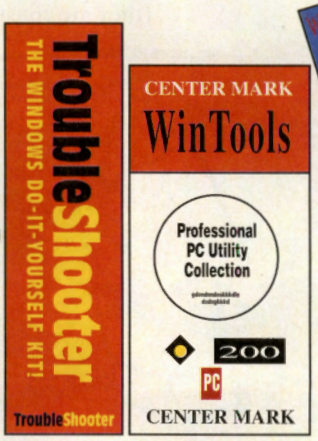



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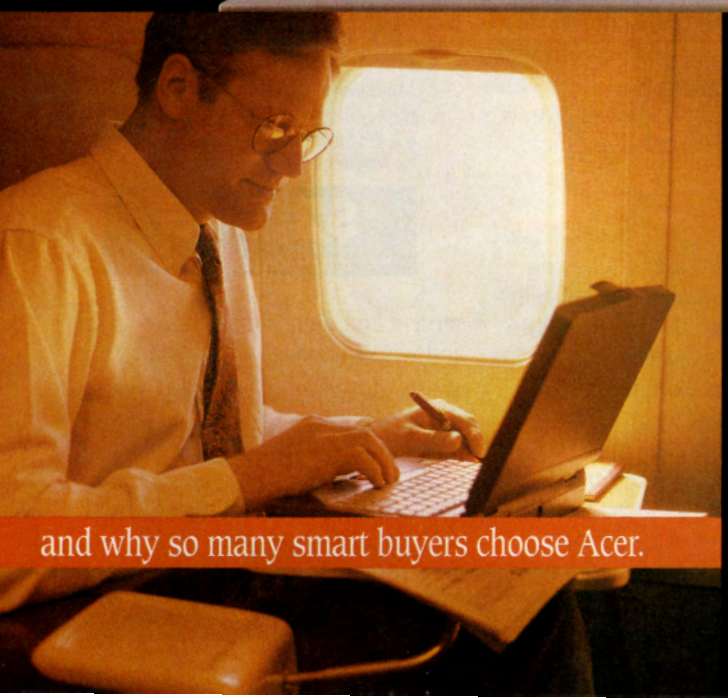

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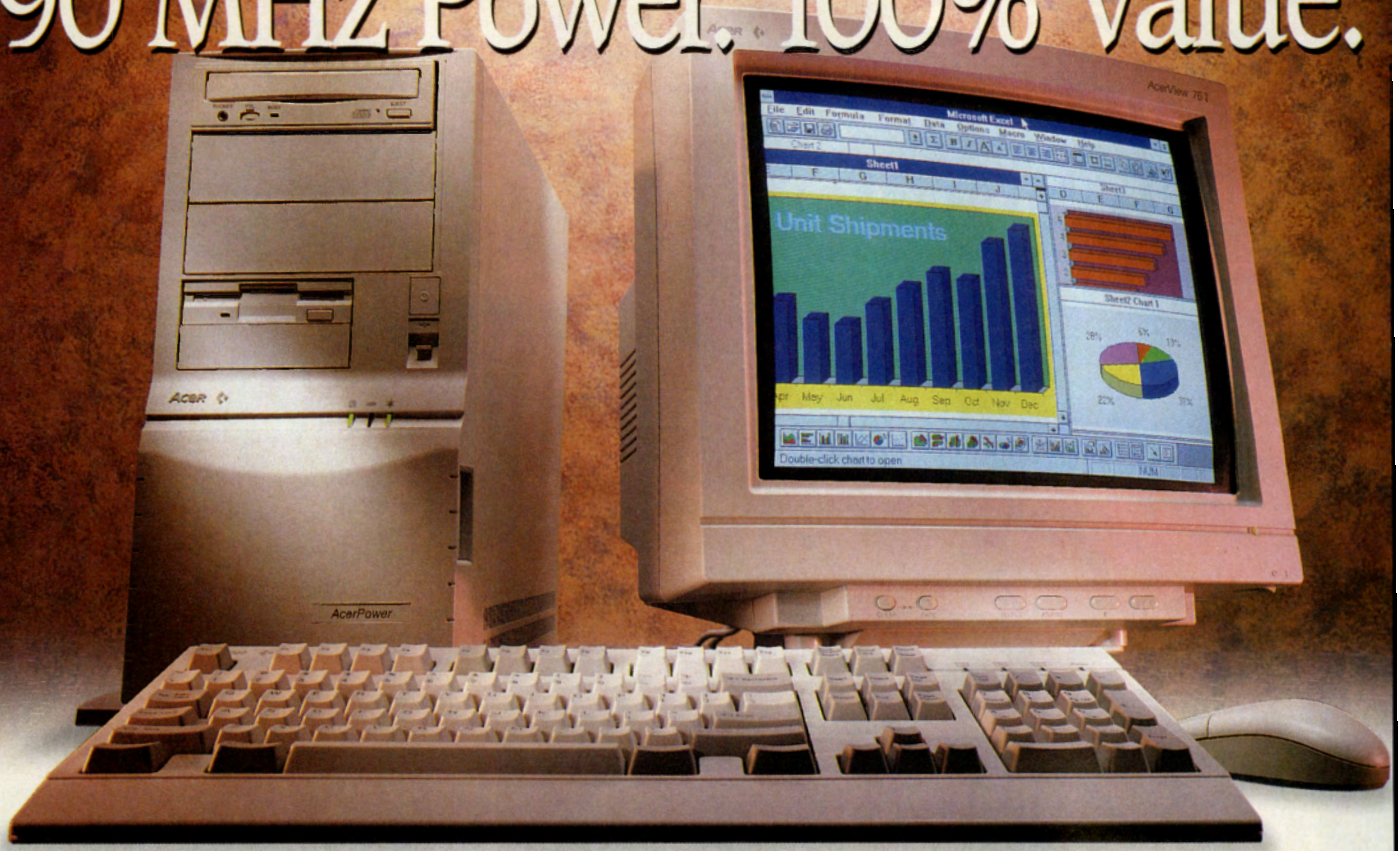

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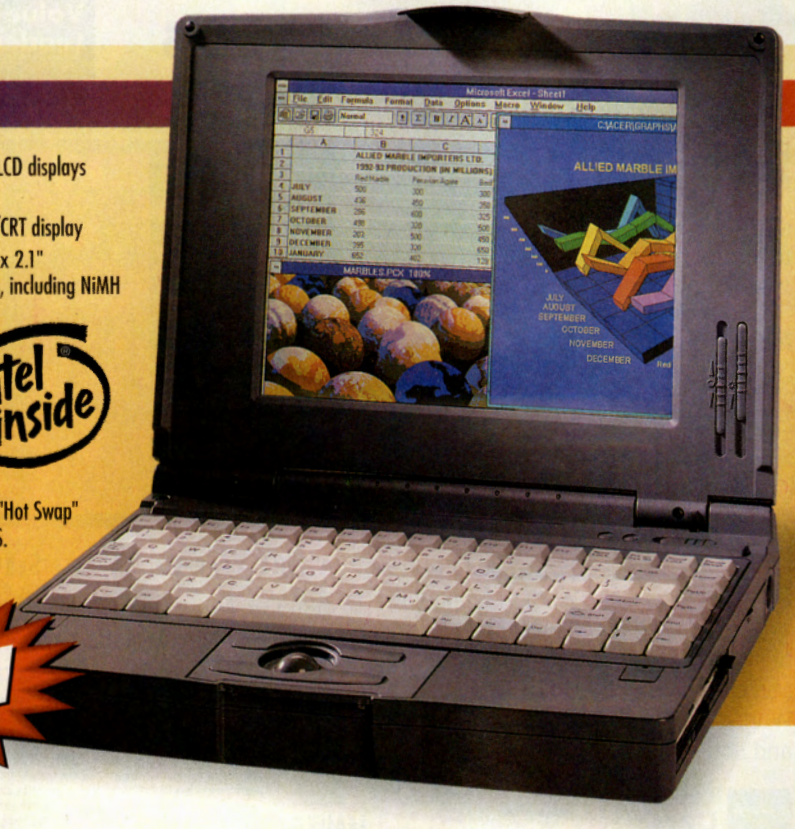

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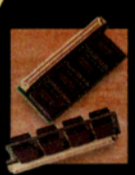

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Bill Machrone

Code Bloat: The Ugly Truth

New: Smaller! Faster! Tighter Code! Have you ever seen those slogans emblazoned on a software package? Me neither. If you had, would you have been motivated to buy the product? The problem with having us old guys around who "remember when" is that we do remember when programs were smaller and programmers seemingly cared more about size, efficiency, and overall performance. You've heard the litany before: "Eight megs of memory? 16 megs? Hah! I remember when we only had 64K! And let me tell you, those old 8-bit machines were pretty fast. . . . 64K? Hah! I remember when we wrote an entire billing system that ran on a machine with only 4K of core. When they upgraded it to 8K, we didn't know what we were going to do with all that room. . . ." And so on.

MINE'S BIGGER

I don't want to bring back the past. My concern is the future. Sure, the amount of capacity and power you can get for today's prices is truly wonderful, but doesn't it bother you, just a little, that programs have doubled and tripled in size in recent years in order to give you only a handful of new features? Throwing more storage and faster hardware at a problem seems to me a bad solution.

Here are six problem areas that together add up to an era of bloated code:

There's no penalty for bad coding. Software developers are utterly focused on features and meeting a delivery schedule. Making the software work is paramount; making it work fast is secondary. Also, the enormous amount of memory available in today's systems has made developers feel as if they can use it all.

Compilers are dumb. If you want something to be small and fast, you code it in assembly language; unfortunately, this is the slowest kind of programming and takes the most skill. I recall one study in which assembly programmers averaged seven lines of code per day. High-level languages make it far easier to code complex applications, but they generate inefficient code—and lots of it.

Linkers are even dumber. Linkers are like octopuses; they typically incorporate all the virtual functions, whether they're used or not. If you want to take the time, you can issue very specific instructions to the linker so that it leaves out pieces of unused code. Unfortunately, since a significant amount of unused code tends to be included, few developers take the time.

Object orientation may be the enemy, not the savior. One of the key tenets of object-oriented programming is the creation of objects that can be reused, both within a program and by other programs. Depending on the way you create and use an object, it winds up—in its entirety—in your code each time you refer to it.

Graphics takes resources. It takes more code to move icons and graphical elements than ASCII characters. Granted, a lot of support is built into the operating system, but applications still need extensive routines to make the graphics calls. Not only that, but now we have so many little icons that we need pop-up labels to tell us what the darn things do.

Features do not come for free. Aside from all the efficiency issues, the single biggest contributor to bigger programs is more features. All the easy stuff is a given, so manufacturers strive ever harder to add functions that will differentiate their products from the competition. If one has smart icons, the next has smart objects.



Applications are more memory-hungry than ever, and it's all your fault.

MINE'S BETTER

Borland's Philippe Kahn and Symantec's Gordon Eubanks find themselves at opposite ends of most arguments, but they agree about bloated code. Eubanks points out that while applications such as The Norton Desktop for Windows start out quite small, they can grow dramatically as small

Illustration by Jean-Christian Knaff



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applications are integrated—a full antivirus package, calendaring, a disk optimizer, backup utilities, and so on. Add all the help files and you're looking at more than 20MB of disk space. "Why is it," asks a frustrated Eubanks, "that companies put in more and more, yet customers seem to want even more and more?"

Kahn agrees, saying, "As we go to component software, why are we still building the equivalent of nuclear power plants? Most people use 10 or 20 percent of their word processor. It might not be the same 10 or 20 percent, but it never amounts to more than 40 percent for most of the people." He says that the other 60 percent—the esoteric, little-used features—is the hardest to code, debug, and integrate into the product.

Kahn also feels that developers never stop adding features long enough to give their products a sorely needed top-to-bottom rewrite. Those myriad features could be made into modular, reusable elements that would take less space, work faster, and do more. Rewrites, however, are difficult and more time-consuming than incremental additions.

Meanwhile, the elements that are already modular are no bargain either. For instance, in Windows OLE 2.0 the DLLs alone take up 750K. Not bad for a feature that almost nobody uses. Yes, OLE is Microsoft's core technology for modular applications, but I haven't heard people say that their applications will be smaller because of OLE. While Microsoft's Windows applications share the same spell-checker, applications from other vendors, of course, will use their own spell-checker. I found six of them on my PC, several using the same core code, but each blithely unaware that the others exist.

HERE TO STAY

I'm enheartened by new, smaller, more efficient applications, such as Borland's Sidekick for Windows, that come on only one or two disks instead of six or eight. Unless some of the bigger-is-better vendors find themselves getting pounded in their entrenched markets, however, I don't think this'll make much of a difference. Users have no choice but to shell out for the latest and greatest versions of their applications, whether or not they use the new features. The grim truth is that bloated code is here to stay. □

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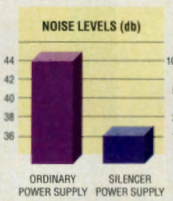

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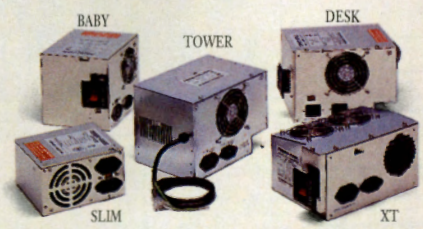

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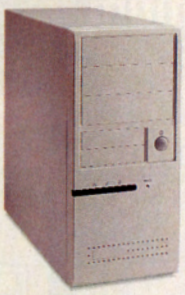

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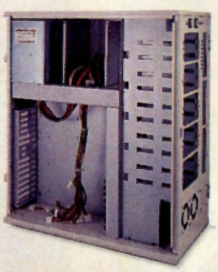

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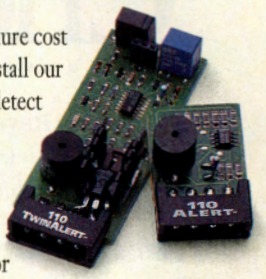

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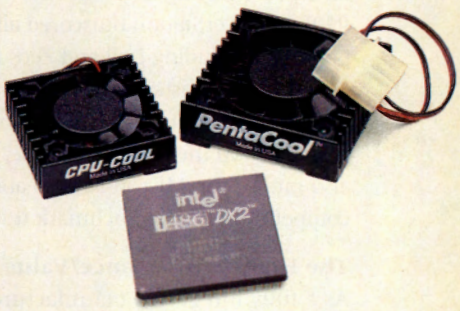

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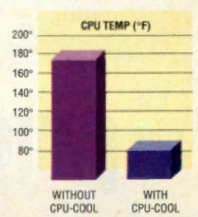

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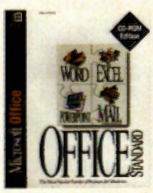

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intel inside pentium PROCESSOR

SERVICE & RELIABILITY PC MAGAZINE READERS' CHOICE
July 1994

CIRCLE 119 ON READER SERVICE CARD



John C. Dvorak

Plug and Pray

In the middle of 1993, Compaq, Intel, Microsoft, and Phoenix Technologies got together to redefine the PC environment. Like the Mac, your next PC would be Plug and Play. The system would be smart enough to recognize peripherals and configure itself accordingly. That's all there was to it.

The plug-and-play idea goes back to pre-PC times. Self-configuring machines have come and gone. Remember the Fortune 32/16, circa 1981? The PS/2 Micro Channel architecture (1987) was designed to do the same thing, but IBM's refusal to license the technology to peripheral makers from the get-go killed it. So now, in 1994 (more likely in 1995), we're supposed to see PC architecture redesigned so that compatibility problems are a thing of the past. Folks, this is to laugh! It's too little, too late, and the wrong people are doing the design work.

Let's look at the cast of characters.

- **Intel.** Can you spell *upgrade sockets*? How many of you have been able to upgrade using the plethora of upgrade and Overdrive sockets Intel has been promoting? What about PCI makeovers? And the most recent on-again, off-again promotion of the DX4/100? When it comes to upgrade concepts, sometimes these guys seem to be throwing mud at a wall.
- **Microsoft.** Ever heard of MSX? That was Microsoft's attempt to create a universal architecture based on 8-bit technology while the world was in transition to 16-bit. When the world was in transition to 32-bit, Microsoft was promoting a 286 as the basis for multimedia. You may even remember Bill Gates's one-time pronouncement that he'd never develop a 32-bit operating system. This is not a company that has the vision for anything futuristic.
- **Compaq.** Remember the failed Advanced Computing Environment (ACE) consortium? Enough said.
- **Phoenix Technologies.** Once the undisputed leader in BIOS technology, Phoenix gambled big on what it believed would be a huge market for Sun workstation clones and never fully recovered from that strategic blunder.

When these four companies joined hands, I expected a S-100 bus–based dishwasher running an 8080 and a Sun BIOS coded in Visual Basic. Who knows? It may still happen.

By the way, at some point, someone will discover that two odd Plug and Play–certified devices won't work together properly when used on some odd (but certified) machine, and everyone will then blame everyone else. Soon after, other incompatibilities will be discovered. The question will be simple: Whom to sue? Like a bad science experiment, this scheme has simply too many variables.

And what about modifications? The specification is bound to change again and again, leaving early adopters (suckers) in the lurch. Just look at the never-ending changes in the Windows API! Each change will introduce new problems.

There's a cost associated with Plug and Play, too. You're likely to see many marketing ploys for odd add-in cards claiming that Plug and Play isn't needed. Expect lowballers to adopt some dubious "universally compatible" or "plug-compatible" moniker, all of which will mean nothing.



Can the Plug and Play initiative save the decrepit PC architecture? Or is it too little, too late?

Then we have to remember that the users who really want Plug and Play either have already gone to a Mac or have a systems guru who makes their equipment work for them.

Plug and Play has neither the right leadership nor the right sociological groundings to work. Those who desire a new, revamped PC platform will prefer starting over with the PowerPC and letting the old clunker die a natural death. Those who don't want to change will keep the current mess, and Plug and Play will become just another ACE consortium. Forgotten.

Illustration by Jean-Christian Knaff

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CIRCLE 177 ON READER SERVICE CARD

John C. Dvorak

Inside Track

Whither the PowerPC Dept.: A recent trade-magazine article discussed IBM's current rapprochement with Microsoft and indicated that there is a possibility IBM would like to see **Chicago ported** to the PowerPC platform. IBM seems unable to produce an operating system for the hot hardware, which is languishing in a warehouse. Personally, I think that IBM should release the machine to developers and then let newcomers write an operating system. **No chance** of that happening, I guess.

IBM seems unable to produce an operating system for the PowerPC. Personally, I think IBM should release the machine to developers and let newcomers write an operating system. No chance of that.

Anyway, porting Chicago to the PowerPC makes **little sense** on the surface because too much of Chicago is Intel-specific. Recoding might take forever. But **is it possible** that what IBM really wants is a Chicago interface on Windows NT? This may already have been done. And it would explain the negotiations.

About six months ago in a research center, I saw a **dual 90-MHz Pentium system** running Chicago, and supposedly, the operating system was running both processors. Chicago **can't do this**, according to everyone I've spoken with. There is no symmetric multiprocessing (SMP) capability in Chicago. But Windows NT is designed for SMP. Furthermore, Windows NT is **running fine** on the PowerPC and could ship tomorrow, as far as I can tell. When I was in Taiwan, I saw almost every PowerPC clone running Windows NT, and the Taiwanese say that's what they **will ship**. In fact, a Mitac executive even told me flat out, "In Taiwan, we subscribe to the Microsoft strategies." But if Chicago is a winner, then the interface of Windows NT will look **old-fashioned** by comparison, and IBM will have a machine that looks like a clunker when compared with a Pentium or even a P6 running Chicago. But if the Chicago user interface is the **only difference**, and if the Chicago interface has already been plugged into NT (as I'm convinced it has), then this is what IBM is negotiating with Microsoft about.

It's quite possible that Microsoft has been **holding back** on upgrading the user interface of NT just to get IBM by the **short hairs** once again. "Sure, we'll do it, since you seem to be having so much trouble with that OS/2 thing. But this time you pay us twice as much!"

That concept may be **small potatoes**, though. **More sinister** is another scenario, which is familiar to Macintosh users. In 1984, shortly after announcing the Macintosh, Apple was about to release an **outstanding BASIC** for the Macintosh but canceled it at the last moment. Books on Macintosh BASIC were even on the shelves. It was **alleged** that Microsoft threatened Apple with pulling the plug on all Macintosh development if this BASIC were released. It was a critical period in the Macintosh's early marketing phase, and Apple's **John Sculley caved in** to Bill Gates. Gates also managed to obtain a license to use features of the Macintosh interface. This latter aspect was discussed publicly in Sculley's book *Odyssey*. Users were incredibly **upset**. You can imagine how the books' authors felt. So here's what Microsoft will tell IBM in this scenario: "We'll give you Chicago/NT, which is ready to go for the PowerPC. We've just been fine-tuning it (snicker). In exchange for the license, you have to cease all development of the Workplace OS and use our operating system exclusively." Home run! High fives all around.

ISDN Update Dept.: I've been exchanging e-mail with telecom observer Mike Gawdun, who passed on this message. I think you'll find it interesting:

"It amazes me how divergent the seven RBOCs and GTE are in their deployment of advanced telecommunication services. Ameritech and Bell Atlantic are competing against each other to see which will be the first to have ISDN fully deployed in its service areas (I believe the target date is the end of 1994), with Pacific Bell and BellSouth following closely behind. NYNEX, Southwestern Bell, and U.S. West are too busy trying to pretend that they are no longer telephone companies.

"I am looking forward to the Communications Act of 1994 being passed by Congress this year so that competition will be injected into the local exchange business. The three telephone companies that are trailing in ISDN deployment have gotten away with infrastructure murder. Did you know that the telephone companies in the U.S. have spent over $100 billion of ratepayers' money on a digital infrastructure (fiber transmission and digital switches) in the last eight years but have not extended the benefits of this investment (in the form of affordable ISDN services) to those of us who paid for it?"

The key to success is for MCI and other long-distance carriers to be given the chance to compete for local phone service against the local monopolies that don't serve the needs of the future. A more recent communique from Gawdun indicates that a squawk from the office of Senator Hollings (D-South Carolina) will most likely result in the new communications act **not being passed**. There seems to be a snag. Please write Congress! □

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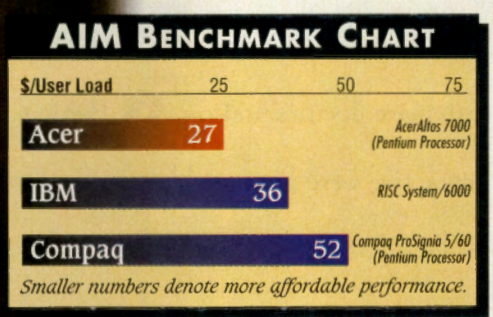

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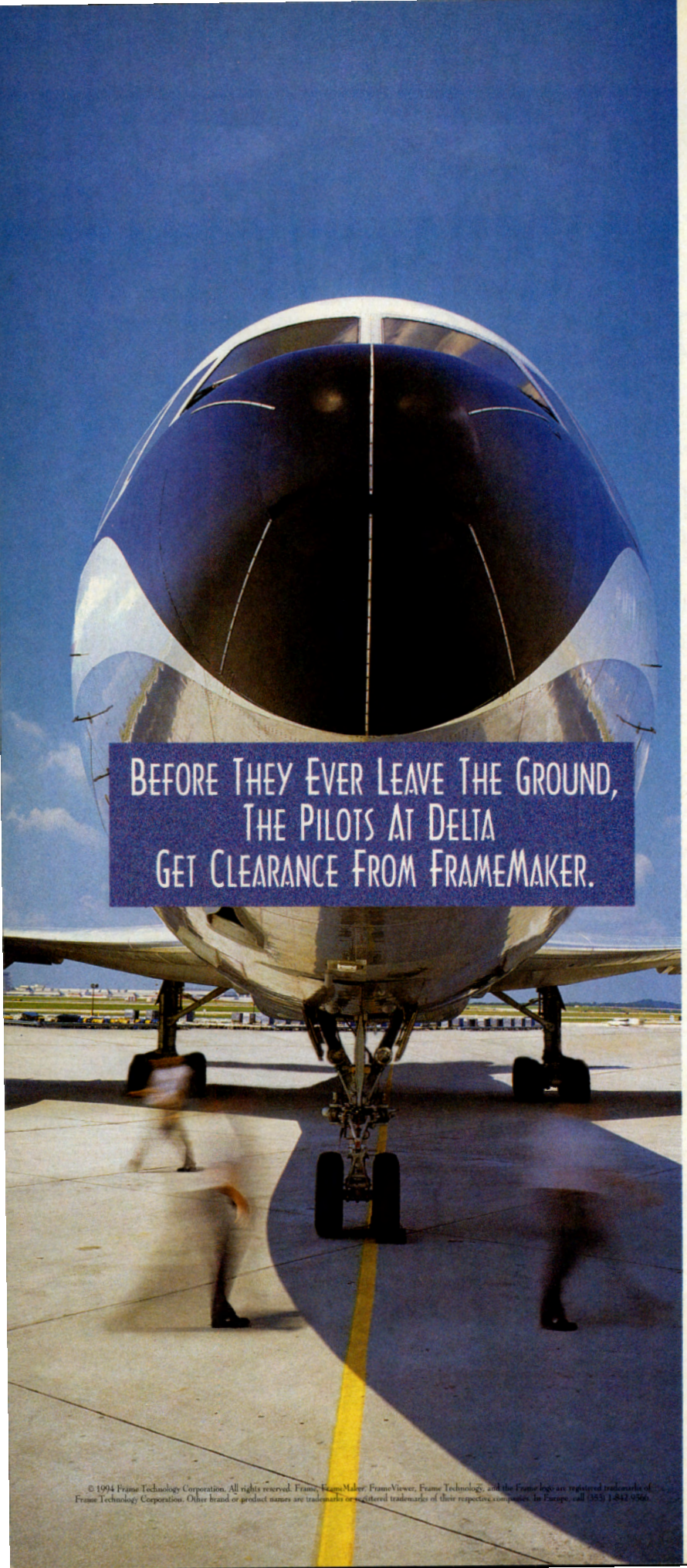

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Jim Seymour

When Microsoft Wins, Do We Lose?

After the Justice Department concluded its inquisition of Microsoft last summer and declared that Gates & Co. will now be as pure as the driven silicon (via the magic of a consent decree), I thought the Microsoft World Domination conspiracy theorists might take a break.

They haven't. Instead they've been keeping busy by pointing out how few clothes the emperor was wearing when the attorney general assured us things had been set aright by Justice's Big Sit-Down with Microsoft. The theorists also still see Microsoft making a play for global dominion with a "DOS and Windows *über alles*" policy. And I think they're missing the boat.

If that has them worried—and you worried—then let me spoil your day and tell you of Microsoft's real threat: a back-door attack through Microsoft Office.

While you, Ray Noorda, Ann Bingaman, and I have been busy worrying about whether MS-DOS, Windows, and Windows NT give IBM and Novell (and maybe NeXT, SunSoft, and a few others that are turning out operating systems) a fair shot, Microsoft has launched a strategy that is likely to keep many users far more securely in its grip than any present attachment to DOS and various flavors of Windows.

Microsoft Office is already the dominant player in the software-suite business, with an 80 percent market share. Lotus and Novell/WordPerfect understandably wouldn't agree with me on this, but I think that huge share owes as much to merit as it does to Microsoft's marketing clout. The individual apps in Office are, to my eye, the performance leaders in their categories, and their integration is superb.

For every time I curse OLE 2.0's bloat and consumption of system resources, ten other times I bless it as I drag things from one app's document to another, or as I edit in place, a feature which really has made my life at the computer easier.



Microsoft's real bid for dominance isn't its DOS/Windows-for-everyone policy; it's Microsoft Office.

IN THE BEGINNING

Microsoft Office began as a loose affiliation of similar products, then moved in its second phase to this high level of cohesion and cross-application integration, which truly makes it a suite. Several months ago, the appearance of Visio Express, an Office add-in from Shapeware, marked the beginning of the third phase of the Office strategy: creating an "MS Office environment" on our desktops, one from which most PC users need never depart.

With DOS, Microsoft owned the underlying software grid that controlled our PCs. With its early apps, such as Word, Microsoft began to give us tools to do useful work. With Windows, Microsoft reinvented the context of work on our PCs and also cracked the market dominance of the former DOS-era applications champs, Lotus and WordPerfect.

That past was but prologue. With its Office-environment strategy, Microsoft now wants to move us to a cozy, does-it-all world in which it offers the key tools. Microsoft is perfectly happy to let cooperative third-party software developers ready to dance to its tune fill in those pesky little cracks between Office applications. Indeed, the role of those developers is critical here, lest we find things we really must do on our PCs that we can't do within the Office cocoon. Expect to see *lots* of Office add-ins—oops, Office-friendly apps—within the next year.

If Microsoft insulates PC users within the safe space of an Office environment, the company hardly needs to worry about new releases of competitive suites or standalone applications: We'll never *see* them. So what if Ami Pro makes a big leap forward, or Paradox finally tames the last demons of database management? As long as Microsoft keeps users happy within that Office world, users won't be tempted to look

Illustration by Jean-Christian Knaff

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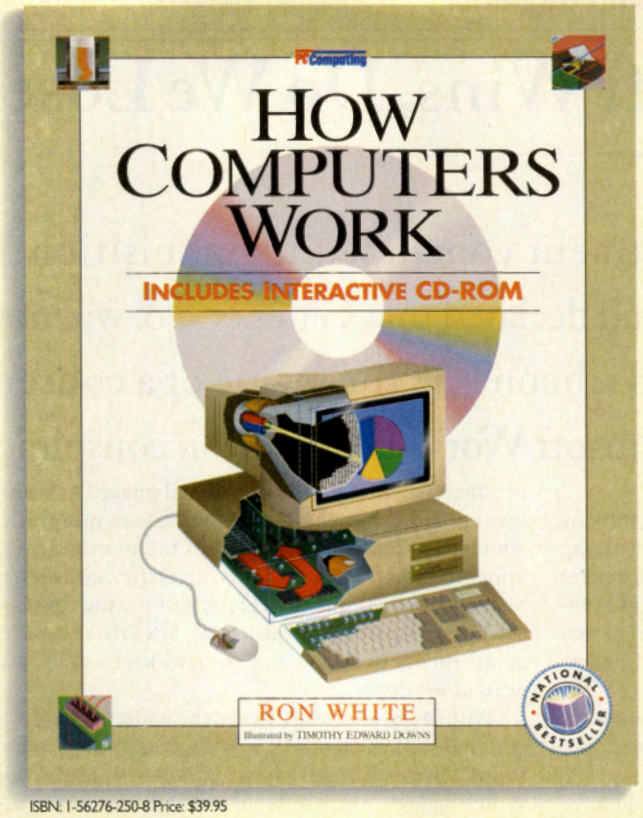

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Jim Seymour

out the (oops, sorry) windows.

Just keep shipping 'em those nice, profitable Office upgrades. And oh yes, give those ISVs developing Office add-ins nice, shiny seals of approval they can slap on their boxes, as long as they keep in line.

Novell/WordPerfect hasn't missed this point, striking back, of course, with its PerfectSolutions response: add-ins for its own suite, intended to accomplish exactly the same results. Some third-party developers play all three sides of the suite triangle. Shapeware, for example, has already moved Visio Express into Lotus's SmartSuite; we can also expect to see a version for WordPerfect's suite soon.

There's an IBM term for such product management, almost a mantra during Big Blue's glory days in the 1950s and 1960s: *account control.*

SO WHO WINS?

There's one thing wrong with my casting this plot as a smarmy scheme for dominance: Microsoft isn't the only winner. You and I are winners, too.

Clearly, many PC users are quite happy with Office applications today. And those apps already go way beyond most users' needs. To the extent that Microsoft induces other developers to extend the Office toolkit, those already happy Office users become even bigger winners.

Is this...ummm...so *bad*?

I don't know whether the Justice Department will be revisiting Redmond anytime soon to reopen, so to speak, its conversation with Microsoft. I hope not.

Users are the big winners when Microsoft adds new functions to an operating system, GUI environment, or applications suite. We'll see that once again early next year, for example, when Chicago/Windows 4.0 appears with very good faxing and e-mail capabilities built in.

Inevitably, however, other software vendors lose ground when one company cleans up in the market. So they turn to the Justice Department. Others—for example, Delrina, which upon seeing the decline of the PC fax market it had dominated, set out to recast itself as a sophisticated communication services provider—smell the coffee and move on.

I hope Washington doesn't try to squelch that survival instinct—even if squelching it deeply satisfies the conspiracy folks. □

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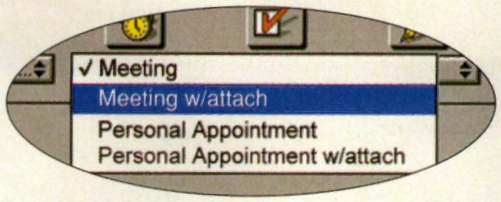

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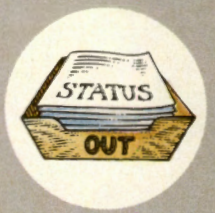

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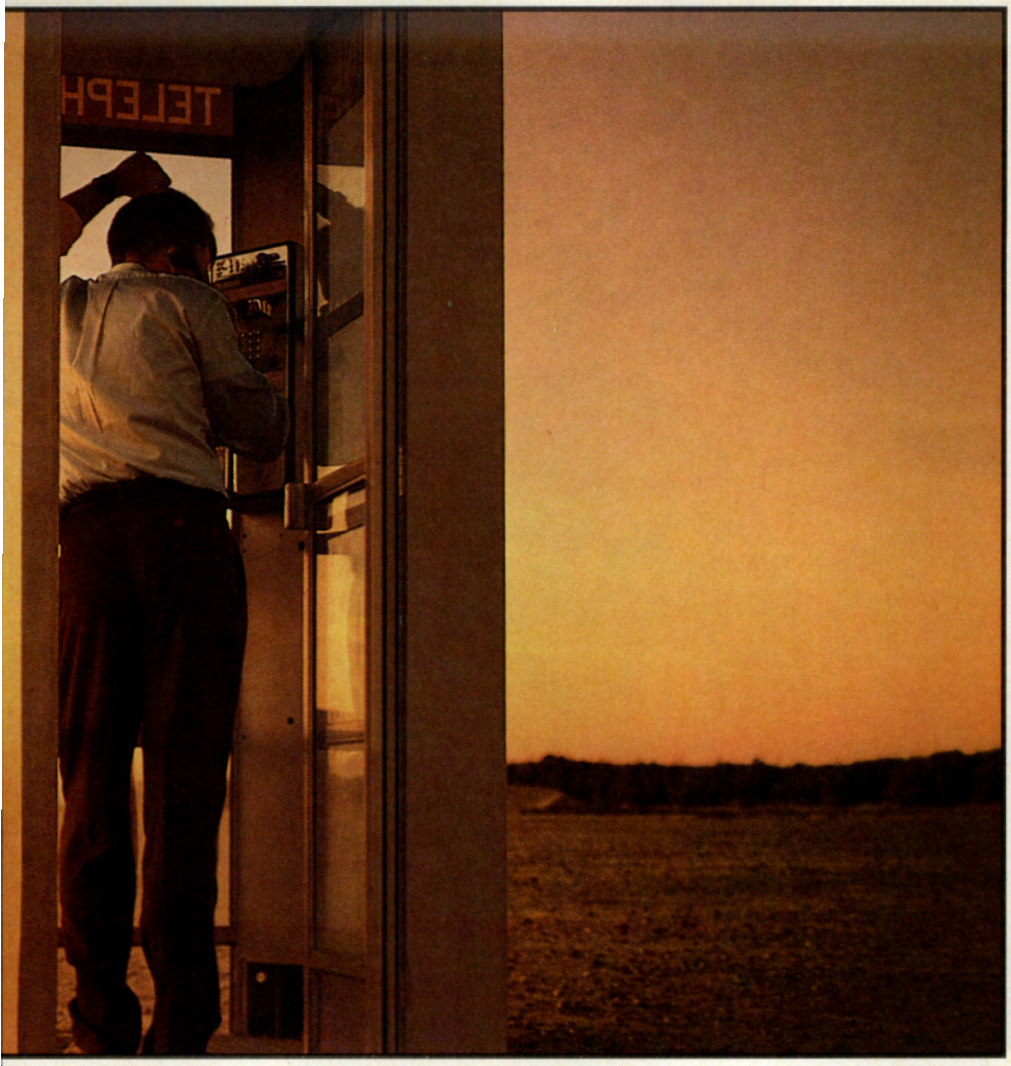

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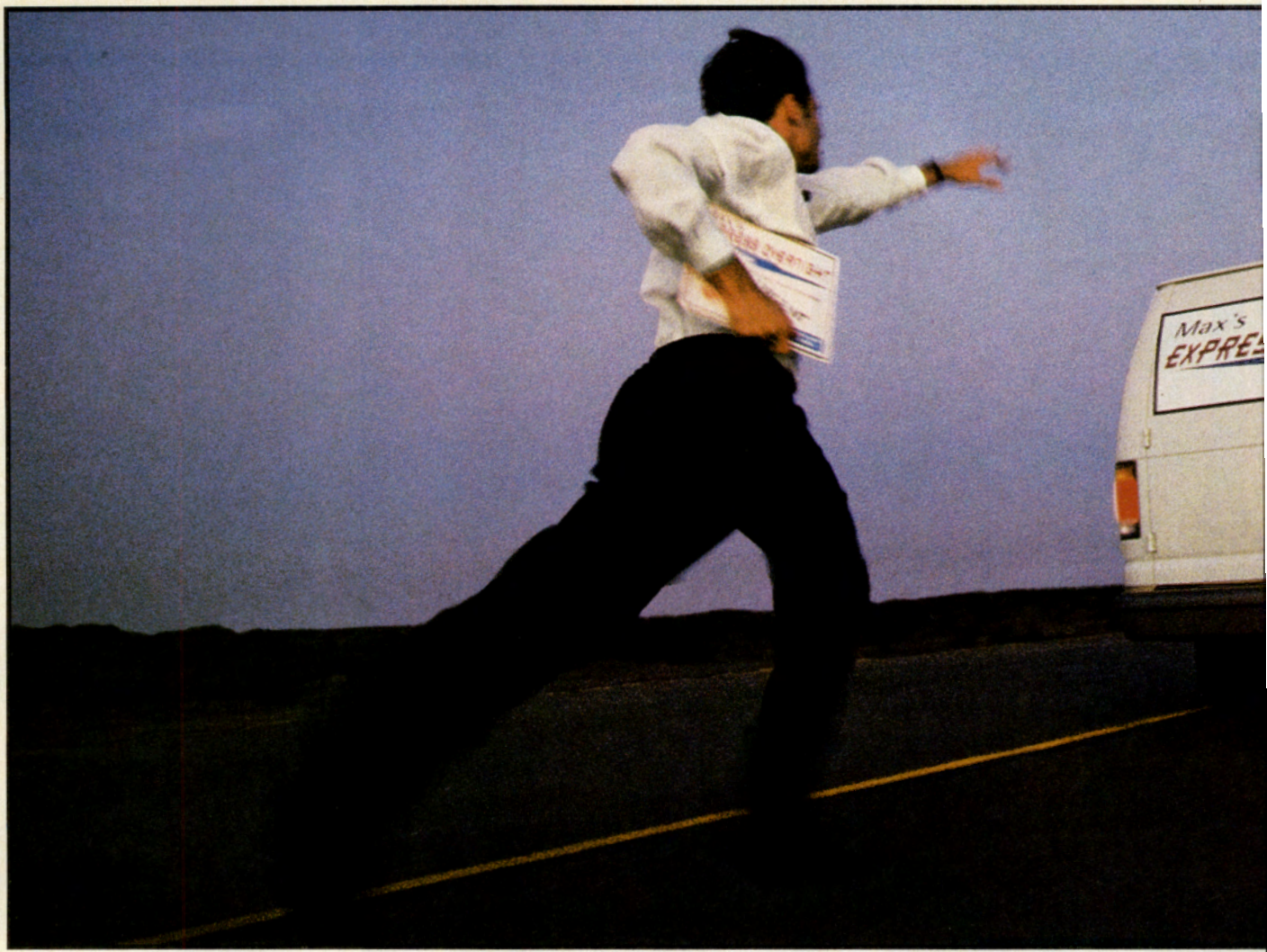

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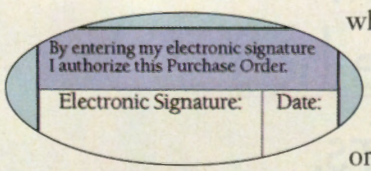

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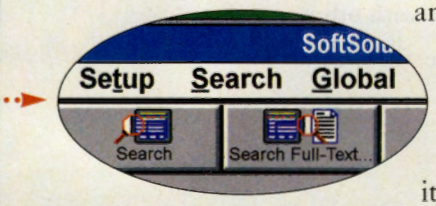
(Or the last five mergers.)



Without committing a weekend to deep storage or rifling through every database on the network, the answer is quite simple—provided you have SoftSolutions, a unique document management application in the family of Novell GroupWare. With one simple keyword entry, you can search and retrieve any information (text, graphic or video) from across most popular applications, platforms and databases. Even if you don't remember who wrote it, when it was written or where it was filed. SoftSolutions will even prioritize similar requests, significantly reducing retrieval time. And SoftSolutions can be used to guard information from unauthorized access. Which might come in handy in the event of merger number six. Call **1-800-370-8987** for your nearest certified reseller or to learn more about Novell GroupWare, the perfect way to put people together with information.





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Bill Howard

Cables, Cables Everywhere

We're drowning in cables. At last count, I had 22 attached to my desktop PC, monitor, and printer. And if you travel with a notebook PC, you're carrying power packs, car adapters, and dongles for your computer, your cellular phone, maybe even your portable CD player. While we do have cordless alternatives, there's little hope of soon becoming a fully cordless society. Here are thumbnail sketches of five wireless devices I've used recently:

• **Pagers.** These are low-tech as high-tech devices go, but they work just fine. You stick a Type II PCMCIA card in your laptop or HP palmtop or use a standalone alphanumeric pager, or both. Of all the devices I've used, pagers have done the most to keep me in touch with the office, and unlike cellular devices, they reach inside buildings. Besides receiving the usual "PLS CALL OFFC" messages and news headlines, you can have your e-mail forwarded. Actually, what you get is the message header and maybe the first sentence of the message.

I've had good luck with the SkyTel paging service using a Toshiba variant of the Motorola Newscard receiver, and passable success with the PageNet service using the HP 100LX. Hewlett-Packard's early dial-up messaging software was unbearably crude. The PCMCIA pager will be more useful when it includes a small LCD (coming, says Motorola); currently you have to boot up your laptop each time a message comes in. Within the year, pagers will be able to send brief responses ("Got It," "Yes," or "No").

• **Cellular phones.** Hooking your laptop modem to your cellular phone sounds great and works adequately. Typically, you buy a PCMCIA modem designed for cellular data (it also works as a regular fax modem). You also buy a cable that runs from your specific modem to your phone (about $100). I found better connections dialing our office LAN than on-line services. Expect lots of dropped connections, and don't expect connections from within a car or train. If you want to try this, you'll find more support from the major phone vendors (Motorola, Nokia). Expect speeds about 2,400 bits per second.

• **Radio modems.** These two-way, data-only (no phone calls), walkie-talkie-size devices connect to your serial port. They're made by Ericsson GE (called Mobidem) and are also resold by Intel (as the Intel Wireless Modem) for about $800 list. You can connect to some public e-mail services. To call your company LAN mail system, you arrange gateway service or attach a radio modem to your LAN. The speed is roughly the same as with cellular data, but I was able to make more reliable connections, even in trains and moving cars. Ericsson says it can put all the technology in a PCMCIA card shortly.

• **Radio-frequency file-transfer devices.** For connecting a laptop to a desktop (or a second laptop) at distances of 30 to 40 feet, Traveling Software's LapLink Wireless ($299 list) is great. For the price you get a pair of National Semiconductor AirShare wireless transceivers and LapLink software. You can access anything on your desktop (network drives, printer, or modem) at 115 kilobits per second, or about half as fast as a floppy disk drive. At home, you can transmit to a PC-connected printer one or two rooms removed. LapLink Wireless will whet appetites for faster wireless Ethernet adapters, of which I believe the Xircom version has the most promise.

• **Infrared tools for file transfer and printing.** Extended Systems' JetEye Lt 9801A ($199 list for a pair) makes wireless laptop-to-desktop or laptop-to-printer connections at 115 kbps, and it uses almost no power—but only from a foot away. It also uses LapLink software. It works fine, but I think this concept makes the most sense when infrared is built into your laptop and isn't a serial-port attachment. □



Wireless devices can help untangle you from cables, but the technology is in its infancy, so you're never fully untied.

Illustration by Jean-Christian Knaff

ONLY

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NATURE

PACKS

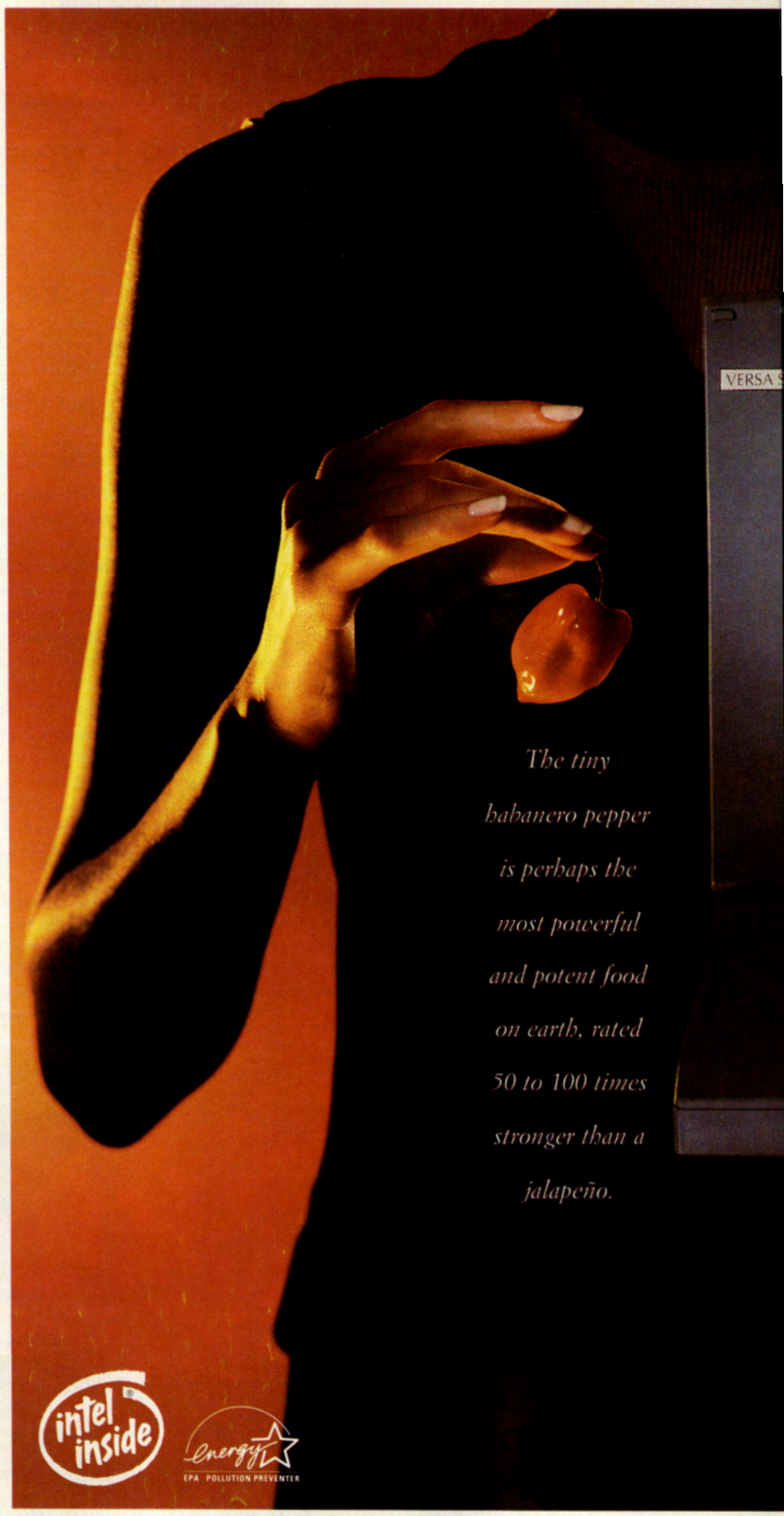
MORE

POWER

INTO SUCH

A SMALL

PACKAGE.



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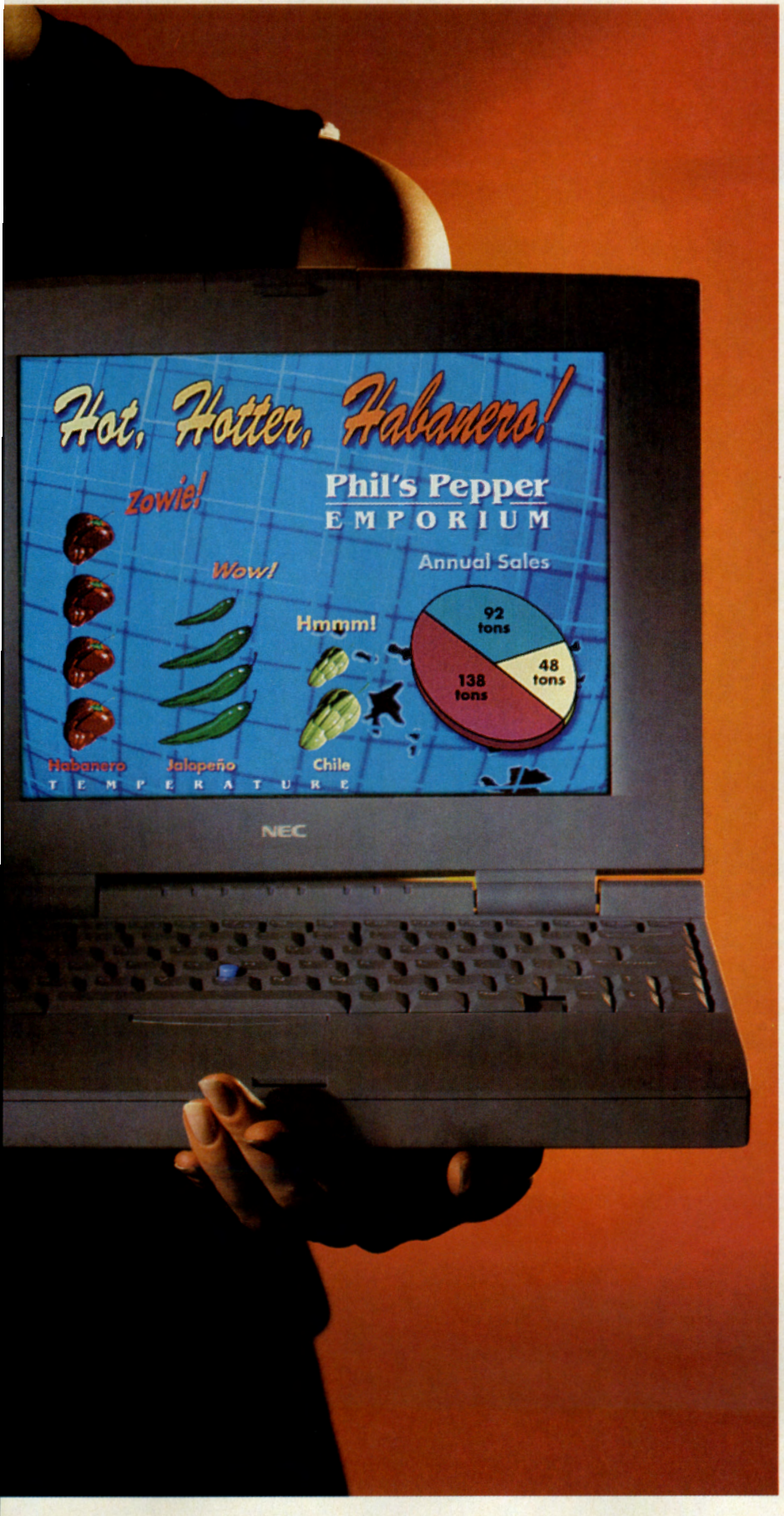

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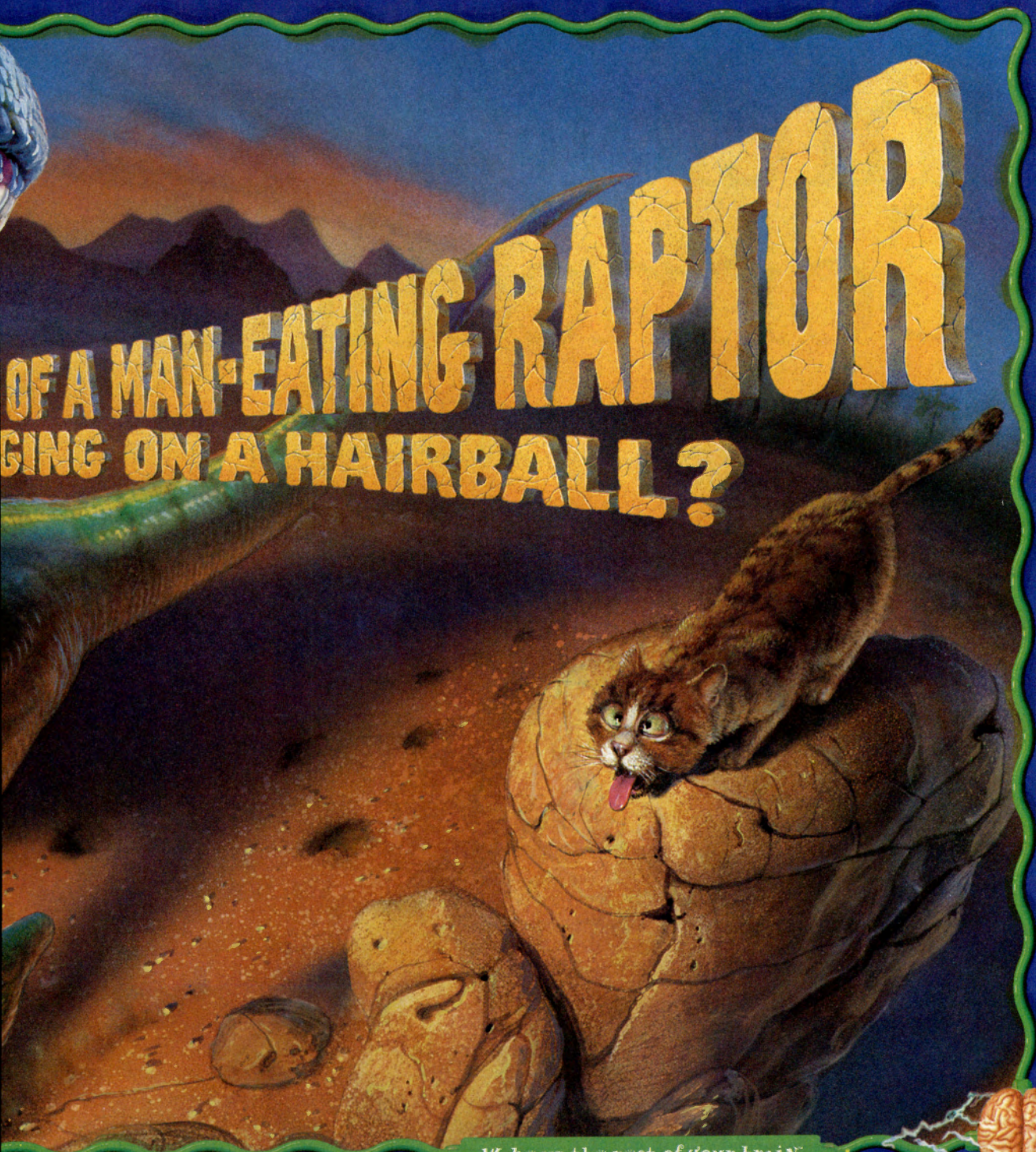

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Making the Internet Connection

Magazine covers scream *Internet, Internet!, Internet!!!* But the glamour masks some practical realities you need to know about. Our three-part tour shows how the Internet works, how you can get connected, and what you'll find once you arrive.

By Rick Ayre

The Internet is, without argument, the most famous computer network that's ever been built—or, to be even more precise, that ever evolved. It's actually a network of networks: tens of thousands of computers connected in a web, talking to one another through a common communications protocol.

You'll want to be there because it's the closest thing we have to a fully wired society. You'll want to be there because there's a staggering amount of information passing through its wires—much of it critical to any business.

But how do you get there? You'll want to give careful consideration to decisions about the costs you'll incur, the infrastructure you'll deploy, the Internet security you'll need, and the goals of your business. All these factors should influence your choice of tools and the route you take.

Three very real challenges face anyone who's deciding to become a part of the Internet: understanding its structure; connecting to it; and taking full ad-

Three Paths To Connect To the Internet

1. Connect your computer to a LAN whose server is an Internet host.
2. Dial into an Internet host using SLIP or PPP.
3. Dial into an on-line service that provides Internet services.

The first two are direct connections, since you run TCP/IP (the Internet's network protocol) on your computer, making you a peer on the Internet. The third is indirect: The on-line host is directly connected; your computer uses terminal emulation software to access the services that the host provides.

The differences between direct and indirect connections are more profound than you might imagine. The type of connection you make will define

1 NETWORK CONNECTION

What you need:
You must be connected to a network that is connected to the Internet; this requires a network adapter card and ODI or NDIS packet drivers. You also need to run TCP/IP on your computer; if you're running Windows, you will need Winsock support.

What you get:
Access to everything the Internet has to offer: mail, news, Gopher servers, Web servers, and more.

What it costs:
The cost of the connection (data lines such as T1, dedicated 56 Kbps, Switched 56 Kbps), which in most cases you won't have to pay directly, plus the cost of connection-related software (TCP/IP and Winsock).

Where to get more information:
- *Connecting to the Internet,* by Susan Estrada. O'Reilly & Associates Inc.; ISBN: 1-56592-061-9.

2 SLIP/PPP CONNECTION

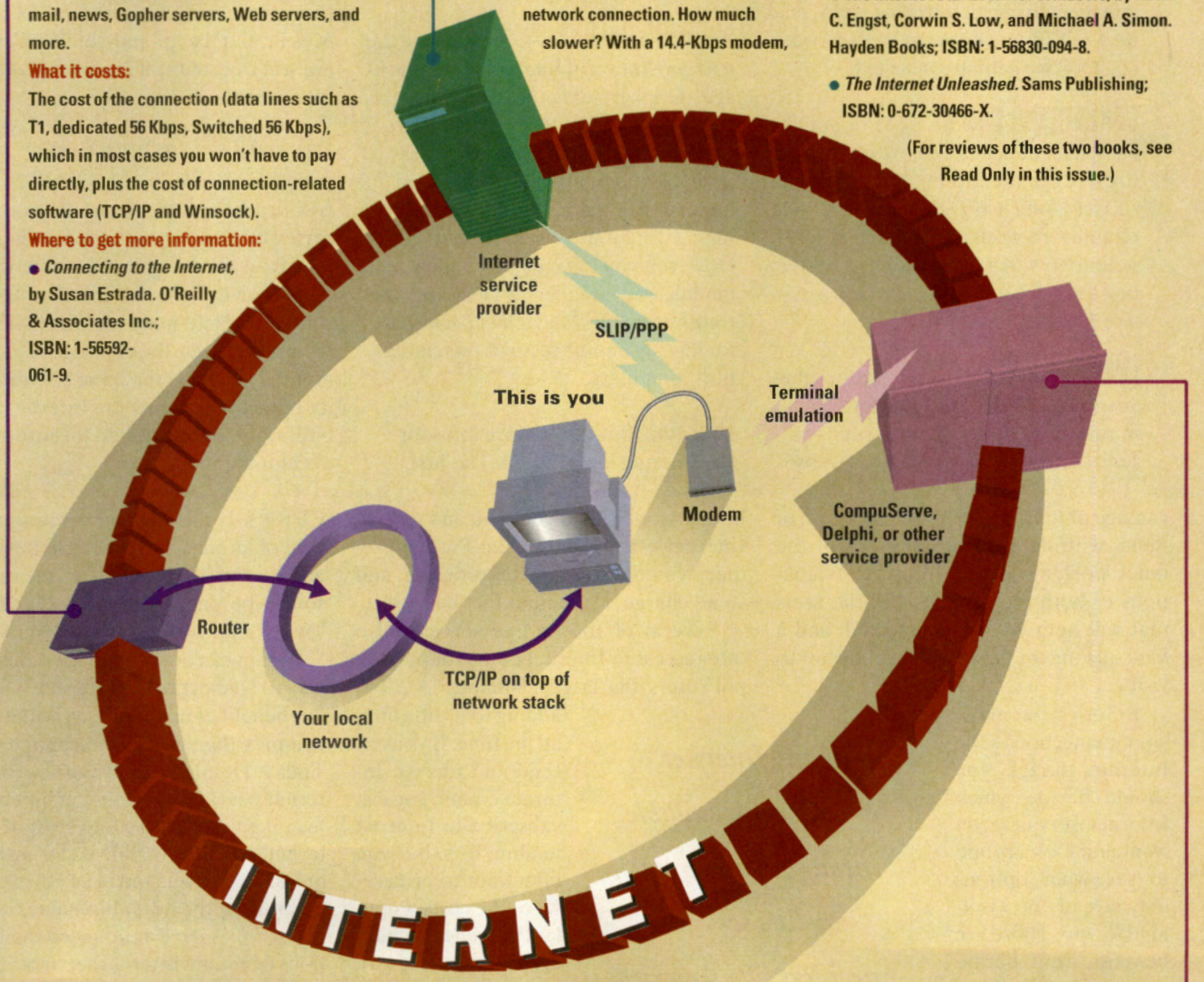
What you need:
A modem and TCP/IP plus SLIP or PPP software; if you're running Windows you will need Winsock software. You must also have a service provider that lets you dial into a SLIP/PPP server.

What you get:
Access to everything the Internet has to offer, although at speeds slower than a direct network connection. How much slower? With a 14.4-Kbps modem, substantially slower; with a slower modem, probably too slow.

What it costs:
The cost of the modem and software, plus the service provider's charges for access to the SLIP/PPP server.

Where to get more information:
- PDIAL list of service providers.
- *The Internet Starter Kit for Windows,* by Adam C. Engst, Corwin S. Low, and Michael A. Simon. Hayden Books; ISBN: 1-56830-094-8.
- *The Internet Unleashed.* Sams Publishing; ISBN: 0-672-30466-X.

(For reviews of these two books, see Read Only in this issue.)



the type of experience you have on the Internet. While on-line services have been adding features that help you interact with the Internet, most still deliver only electronic-mail capabilities. Delphi and America Online are the exceptions: Both provide access to the best of the Internet—mailing lists, newsgroups, and Gopher services.

If you want the freedom to surf the Internet using a browser like Cello or Mosaic, you'll need to make one of the two direct connections.

3 ON-LINE SERVICE CONNECTION

What you need:
A modem, standard communications software, and an on-line service account.

What you get:
Access to the Internet services your on-line service offers. Some services (CompuServe, for example) offer only e-mail and may add per-message charges. Delphi currently offers the most complete Internet support (e-mail, newsgroups, Gopher services, and more). America Online is gaining fast.

What it costs:
The on-line service fee, a per-hour connect charge, and, where applicable, e-mail surcharges.

Where to get more information:
- "Making On-Line Services Work for You," *PC Magazine,* March 15, 1994.

HIGHLIGHTS

Internet Access Software

IT'S A BIG, BIG WORLD: The Internet Society currently claims that there are about 20 to 30 million active Internet users and says that number is growing by about 160,000 users per month. If you're impatient to join the swelling ranks, read on: We'll fill you in on the latest services and tools for getting connected.

CONNECTING CAN BE EASY or not-so-easy; it all depends on how you decide to do it. For the former, turn to on-line services—such as Delphi and America Online—that offer a selection of Internet services. An intermediate step is to buy a service-and-software package like The Pipeline.

FULL INTERNET ACCESS requires that you load TCP/IP, the Internet's communications protocol, onto your system, then connect over a LAN or by modem to a service provider. Setting up TCP/IP is the sort of work usually left to network professionals, but with a little help from tech support, you'll be able to handle it.

GOPHERS GALORE will characterize the *next* generation of Internet access packages. Gophers and other trendy new Internet tools, like World-Wide Web browsers, are scarce in the packages available today. (WWW servers are multimedia capable and can connect to files at distant sites via hypertext links.) However, you *can* count on finding mail modules, newsreaders, FTP utilities for transferring files, and telnet packages for logging on-line sessions on remote host computers.

FREEWARE and shareware tools for the Internet still abound. The first software tools for cruising the Internet came from the same community that built the Internet and, like the Internet, were offered either cost-free or on a voluntary fee basis. Many of these tools, including the famous Mosaic and the up-and-coming Cello, are still free and still the most powerful available.

THE FUTURE of TCP/IP-based connectivity products—which constitute the majority of the ones reviewed here—may be somewhat in jeopardy as new operating systems appear on the market. Popular standalone and network OSs that hit the market over the coming six months will have the basic connectivity tools for reaching the Internet built right in. Stay tuned for future developments.

vantage of it. In this story, we tackle all of them, with detailed descriptions of the inner workings of the Internet; evaluations of both the services and the tools that will help you get connected, and a look at some of the places you'll want to visit.

Before you make your connection to the Internet, though, you should decide which Internet services you want and look around to see what options may already be available to you. There are benefits—and limitations—to each of the connection methods.

Many Internet services are available through commercial on-line service providers like America Online or Delphi.

ON-LINE CONNECTIONS

The first thing you need to know is that many Internet services are available via commercial on-line service providers, depending on what each service sees fit to support. If you're a member of America Online (AOL), CompuServe, Delphi, or GEnie, for example, you already have some Internet access. All of the big on-line services will let you send and receive Internet e-mail; some, like Prodigy, require you to run a special program, and some charge a premium for the service.

Several of the on-line services also offer access to Internet newsgroups: Delphi offers the largest number; AOL is adding to its offerings all the time. If you can send and receive Internet e-mail, you can subscribe to Internet mailing lists, but you may want to be careful of the costs. Popular lists generate hundreds of messages a day, and even if your service charges you only a small fee for receiving mail, costs can mount up rather quickly.

What you won't be able to get from a commercial service, at least not today, is complete access to the hyperlinked, multimedia World-Wide Web (WWW, or "the Web," for short). WWW was developed in Switzerland by the European Laboratory for Particle Physics (or CERN). It has been generating a great deal of interest—as well as hype—lately, and a lot of people think it's the only reason to be on the Internet. Our sidebar "Webs and Gophers" shows you why.

Joining an on-line service is the easiest way to connect to the Internet. The obvious benefit of this approach is that it's less complex than other connection options. Today, Delphi probably offers more Internet services than any competitor; in fact, it gives you access to most of the Internet. America Online is closing the gap quickly, however, and in an effort to catch up, most of the other big-name commercial services have announced their intentions of adding Internet services.

We look at what on-line services have to offer in "The Internet: Services for Connecting." Additionally, we evaluate The Pipeline for Windows, from The Pipeline—a unique product that's actually a dedicated custom front end for the company's own Internet service. This is the only finished product of its kind right now, but NetCom's NetCruiser, which we also review, is another up-and-comer. The Pipeline for Windows and NetCruiser combine service and software in one

How Internet Mail Finds Its Way

Most of the 20-million-plus people connected to the Internet use it for electronic mail. How does the Internet deliver mail reliably to that many users? By using a system that can generate millions of unique addresses.

The Domain Name System, the Internet's addressing scheme, creates multipart addresses that combine geographical and conceptual information. A DNS address consists of several segments, like a telephone number. Here's what a typical address might look like:

`lpasteur @ bio.sorbonne.edu.fr`

The first element, ***lpasteur,*** identifies a user or organization name—in this case, Louis Pasteur.

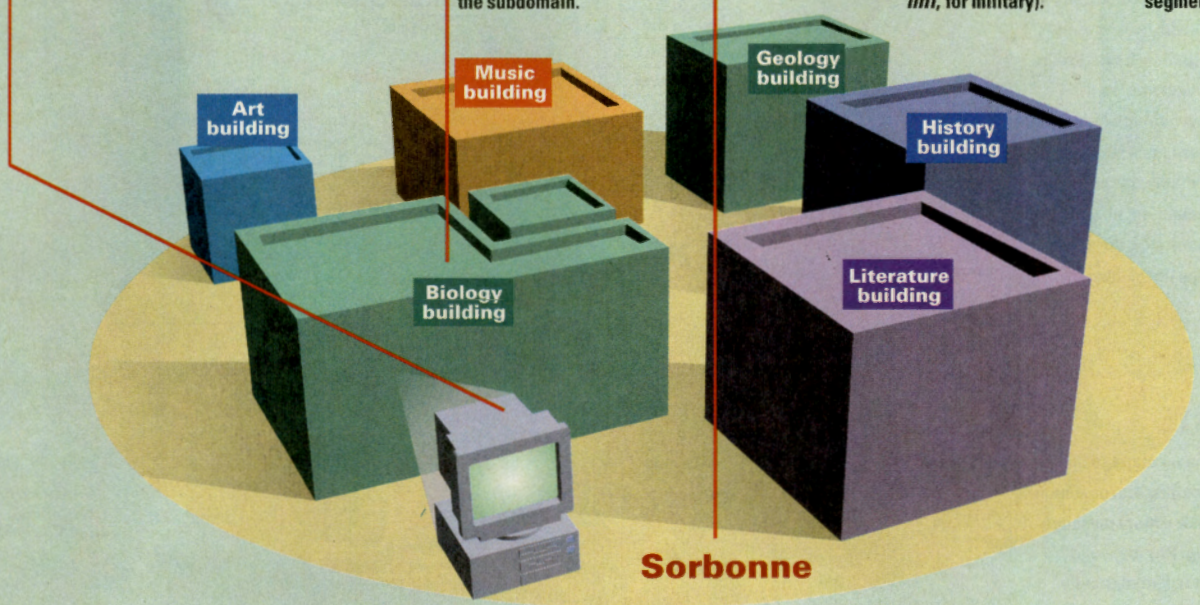
The @ symbol connects the "who" identifier with several "where" identifiers.

The first, ***bio*** (shorthand for ***biology department***), is known as the subdomain.

The second, ***sorbonne*** (the name of a university), is known as the domain.

Following the "where" pieces of the address is a "what" segment, ***edu*** (for *educational institution*), known as the type. (Other types are ***com,*** for commercial; ***gov,*** for government; and ***mil,*** for military).

The type is followed by a final "where" segment, ***fr*** (France), which denotes the country where this particular member of the "type" is located. United States addresses usually omit the country segment.



E-Mail on the Internet

On-line service	Addressing scheme via Internet to on-line service user	Addressing scheme via on-line service to Internet user
America Online	*username@aol.com*	*username@host.address*
BIX	*username@bix.com*	*username@host.address*
CompuServe	*user number@compuserve.com*	*TO:internet:username@host.address*
Delphi	*username@delphi.com*	*TO: internet"username@host.address"*
GEnie	*username@genie.geis.com*	*username.host.address@inet#*
MCI Mail	*username (or number)@mcimail.com*	*EMS:INTERNET* *MBX: username@host.address*
Prodigy	*account@prodigy.com*	Additional software required (jump to Mail Manager for info)

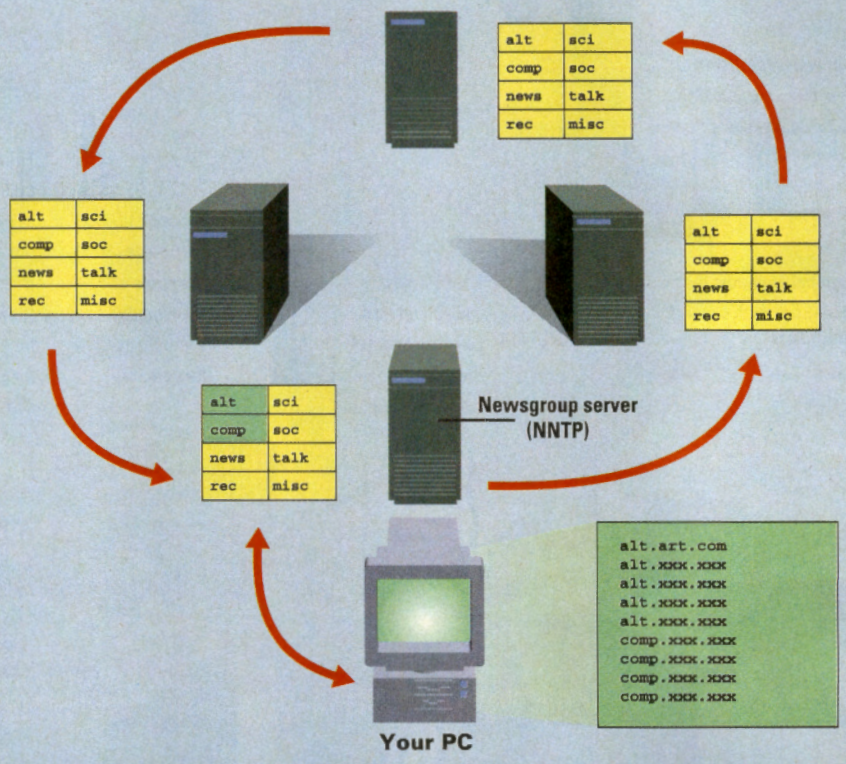
How to Use Newsgroups and Mailing Lists

There are two different ways to participate in discussion groups on the Internet: Usenet newsgroups and special-interest mailing lists. Both have the ability to create large virtual communities of users interested in a particular topic. No matter what question you need answered, what problem you need solved, or what issue you want to debate, there's someone out there who can give you what you're looking for.

USENET NEWSGROUPS

NNTP servers around the globe host newsgroups that share information and commentary on defined topics. Each group takes the form of a large bulletin board where members post and reply to messages, creating *message threads*. Nearly 10,000 groups are replicated to all the servers, so that group members may tap into the discussion from any server. Unlike the more serious nature of many mailing lists, the open nature of newsgroups encourages participation, but discussions tend to become unfocused. As a result of so much active participation, newsgroups can evolve into tight communities.

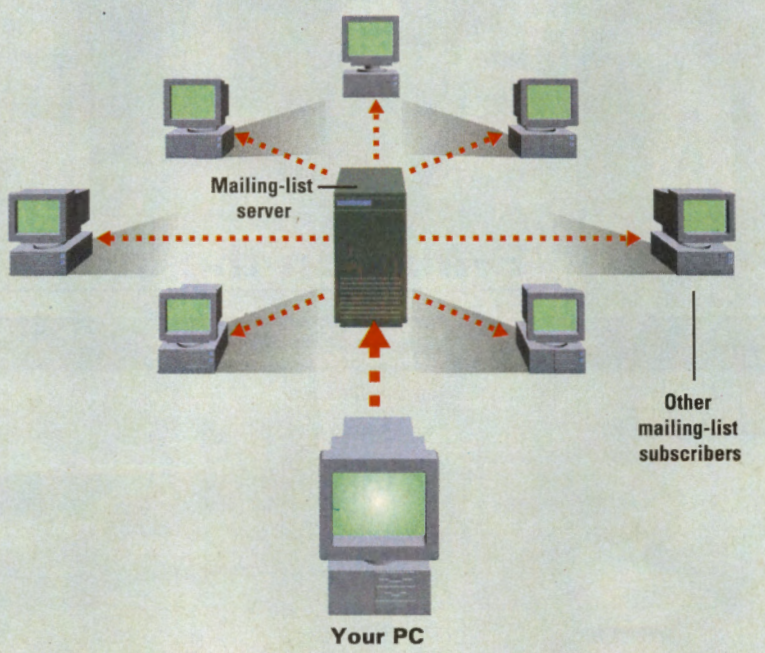
To access a newsgroup, you need an NNTP reader and access to an NNTP server. If you're using the reader provided by a product in this evaluation, all you need to do to subscribe is pick the newsgroup you want from the list of those available.



MAILING LISTS

List servers the world over manage the activities of Internet mailing-list communities. The server acts like a giant message redirector for the group. Any message posted by any member is automatically blasted out to the e-mail box of every other person on the mailing list. Unlike news servers, list servers don't replicate their databases; a server's content remains the domain of its subscribers only.

To join a mailing list, you send an e-mail message that includes your own e-mail address to the list server. This will work even if you access the Internet via an online service such as America Online, CompuServe, or Prodigy. Be warned, however: Some mailing lists generate hundreds of messages each day, and if you subscribe, you'll get them all. If your service provider charges you to receive messages from the Internet, the bills can add up fast.



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What we have here is an entirely new kind of keyboard – a design that fits you like your most comfortable clothes. And promotes a more natural posture for comfortable computing.





But there's much more to say about this keyboard. After all, it's the result of extensive ergonomic and usability research.

We started by watching how people work, taking note of their natural body positions. How they type. And how they use Windows.™

Our findings, to be honest, were incredibly enlightening. We discovered there's a lot of room for improvement in the standard typewriter-keyboard. And that it could fit today's computer environment better than it currently does.



So we proceeded with a redesign. The result? A responsibly designed, split-keypad, gently

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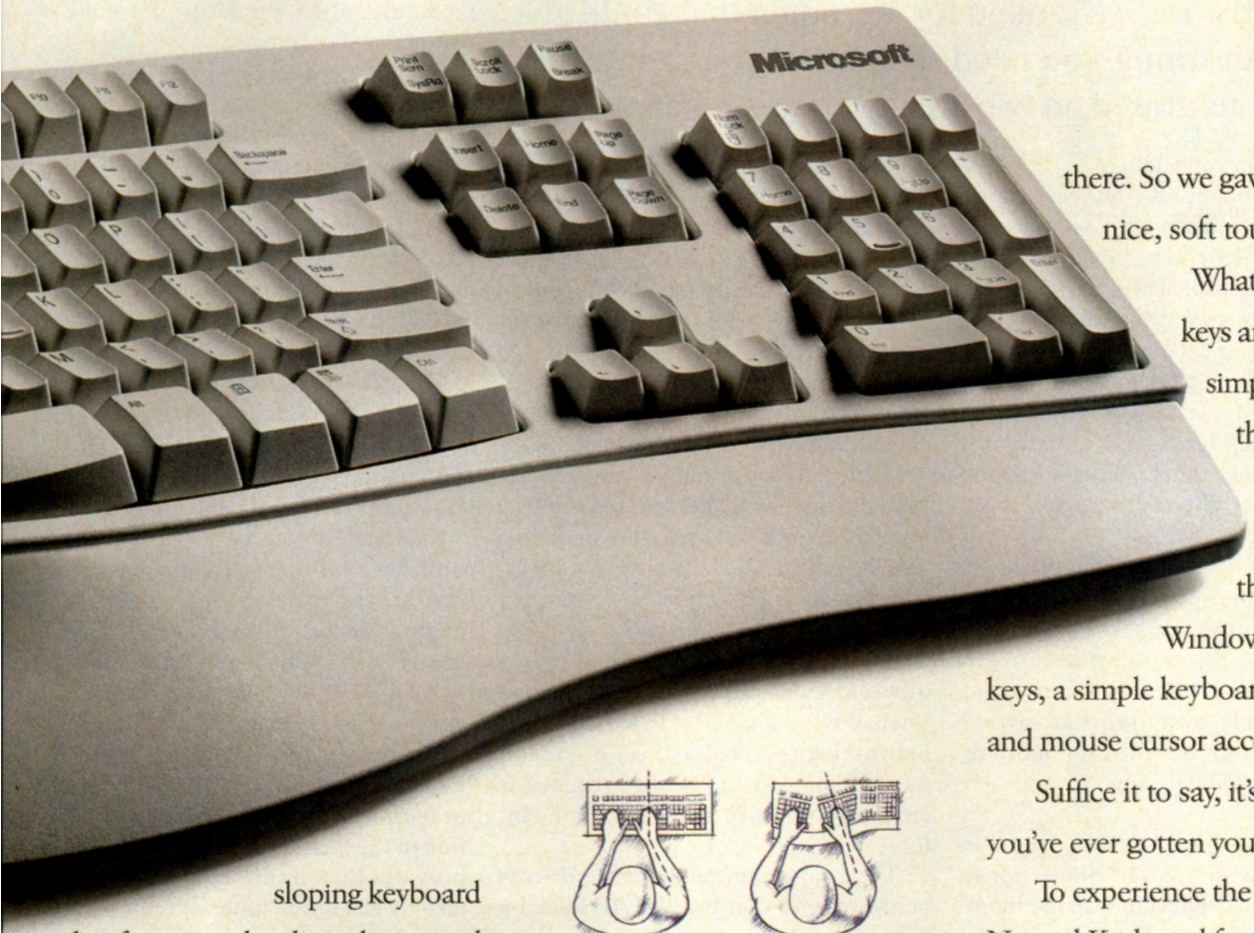
RITE PAIR OF JEANS AS A KEYBOARD.



sloping keyboard that fits more closely to the natural positions of your hands and wrists. And one that is more comfortable, if a bit odd-looking.

With this innovative new design, we were able to encourage a straighter positioning of the wrist. Which helps to relax the forearm. Which then helps to relax the shoulder. All of which makes for a more natural typing position.



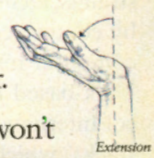
The Microsoft Natural Keyboard fits you, not the other way around.

And then we priced the Natural Keyboard to fit your budget just as well as it fits your hands.

But we simply couldn't stop there. So we gave the keys a nice, soft touch and feel. What's more, new keys and software simplify access to the Windows operating system. Like three new Windows function keys, a simple keyboard manager and mouse cursor accelerators.

Suffice it to say, it's like nothing you've ever gotten your hands on.

To experience the Microsoft Natural Keyboard for yourself, simply pay a visit to your local computer retailer. And slip one on. You won't believe how comfortable it feels.



And you won't even have to wait for a dressing room.

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or hard-of-hearing can reach Microsoft text telephone (TT/TDD) services at (800) 892-5234 in the United States or (905) 568-9641 in Canada. Microsoft and the Windows logo are registered trademarks and Natural Keyboard and Windows are trademarks of

PC MAGAZINE EDITORS' CHOICE

Services for connecting:

- **The Pipeline**

Tools for connecting:

- **AIR NFS**

When we undertook this survey of Internet access software, we looked for a product that could give you everything you need to connect to the Internet. We concentrated on two areas: services for connecting and tools for connecting.

The Pipeline is the best choice among today's available services. The package is tied to The Pipeline's "interpreted" Internet service. For Internet newcomers as well as for those who don't have access to a LAN-based connection, The Pipeline provides a well-developed graphical interface that among other things imposes its own organizational scheme on the vast unstructured cyberspace, making it easy to get to topical content.

On the tools side, we sought out packages that had the TCP/IP transport capability necessary for peer-level connections, along with application modules to handle at least a modest number of the many Internet services and resources—an easy-to-use, one-stop-shopping suite for the Internet. For the most part, what we found was disappointing.

The majority of the products we looked at originated as corporate wide-area connectivity tools—TCP/IP stacks designed to be installed, configured, and maintained by networking professionals. While we were able in every case to get the TCP/IP transports working, in no case was it easy.

Our Editors' Choice, Spry's AIR NFS, Version 3.0, is the only package that provides virtually all the tools that a well-equipped, self-sufficient Internet surfer would want to have, including mail, news, telnet, FTP (server and client), Gopher, and a special version of Mosaic. AIR's many utilities include a graphics viewer and a uu (Unix-to-Unix) encoder-decoder. The individual modules are, for the most part, fully featured and easy to use.

Spry doesn't force you to fend for yourself. It has its own WWW server and Gopher server, giving new users a much-needed point of reference within the Internet. To top it off, Spry gives you not one but two TCP/IP stacks, developed by Microsoft and Novell. The package will also work with any other TCP/IP stack you might have already installed.

Honorable mention goes to Ameritech Library Services' WinGopher Complete. WinGopher has the best Gopher among the reviewed products. It targets users determined to build their own suite of tools using strong components from different vendors and can serve as the cornerstone of a complete Internet connection setup.

package; this is a category where rapid growth is likely over the next several months, so watch out for even more of these combo products soon.

THE BIG T

What about other kinds of connections? Before you can connect fully to the Internet (that is, without the kinds of constraints, technical and otherwise, imposed by commercial on-line providers), your computer must be running TCP/IP, the Unix-based Transmission Control Protocol/Internetwork Protocol. This "protocol stack," which lies at the heart of Internet connectivity, is a way of packaging information for easy movement between many different kinds of computers, large and small. While not the world's most efficient networking protocol, per se, it does an outstanding job in the heterogeneous cross-platform environment that is the Internet.

The connection methods we discuss below require that the TCP/IP stack be running on your system. Herein lies a potential problem, since installing and configuring network protocols is likely to be challenging for the uninitiated. If your organization has a LAN—with a LAN administrator—the job will likely fall to that person. If not, you should be able—with perseverance and some help from tech support—to get the job done yourself.

With TCP/IP running on your system, you can choose to connect to the Internet *directly*, by being connected to a LAN that is itself wired to the Internet, or *indirectly*, through a modem connection to the host system of a public-access provider that in turn is wired to the Internet. The latter solution requires that your system and the host computer be running one of the serial communications protocols—Serial Line Interface Protocol (SLIP) or Point-to-Point Protocol (PPP)—as well.

The eight products we review in the section entitled "The Internet: Tools for Connecting" all provide TCP/IP transport and, in many cases, SLIP and PPP as well. They're today's best hope of connecting fully to the Internet and giving you the kind of productivity you should expect.

Our aim was to cover a group of products that provide all your Internet needs in one box—a kind of Internet suite that combines connection software with user-friendly programs for e-mail, news, and

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CIRCLE 001 ON READER SERVICE CARD

The Argot of the Internet

archie A system for locating files that are stored on FTP servers.

backbone A central high-speed network—the NSFnet, for example—that connects smaller, independent networks.

DNS (domain name system) A scheme for translating numeric Internet addresses into strings of word segments denoting user names and locations.

finger A software tool used to determine whether another user is logged on to the Internet. It can also be used to find out a user's e-mail address.

FTP (File Transfer Protocol) A protocol that describes file transfer between a host and a remote computer; also, programs based on this protocol.

Gopher A search tool that presents information in a hierarchical menu system somewhat like a table of contents.

IP (Internet Protocol) A standard that describes how packets of data are transported across the Internet and recognized as an incoming message.

IRC (Internet Relay Chat) A software tool that makes it possible to hold real-time keyboard conversations on-line.

NDIS (Network Driver Interface Specification) A Microsoft specification for a type of device driver that allows multiple transport protocols to run on one network card simultaneously.

newsgroup A BBS-like forum or conference area where you can post messages on a specified topic. Newsgroups exist for a huge range of subjects.

NNTP (Network News Transport Protocol) An extension of the TCP/IP protocol; describes how newsgroup messages are transported between compatible servers.

ODI (Open Data-link Interface) A standard interface, developed by Novell and Apple, that performs the same functions as NDIS.

PING (Packet Internet Groper) A TCP/IP utility that sends packets of information to a computer on a network; it can be used to determine whether a computer is connected to the Internet.

protocol A set of rules or standards that describes ways to operate to achieve compatibility.

router A hardware/software solution that directs messages between LANs.

SLIP/PPP (Serial Line IP/Point-to-Point Protocol) Two protocols that allow dial-up access to the Internet through a serial link. Most Internet access packages support both, though you can use only one at a time.

SMTP (Simple Mail Transfer Protocol) The protocol in a TCP/IP network that describes how e-mail moves between hosts and users.

SNMP (Simple Network Management Protocol) A protocol that describes how information is passed between reporting devices and data collection programs; it can be used to gather information about hosts on the Internet.

TCP/IP (Transmission Control Protocol/Internet Protocol) A compilation of network- and transport-level protocols that allow a PC to speak the same language as other PCs on the Internet or other networks.

telnet A terminal emulation protocol (or a program based on that protocol) that lets you log on to other computers on the Internet.

Usenet (User Network) A public network made up of thousands of newsgroups and organized by topic.

uucp (Unix-to-Unix Copy) Originally a Unix program that permitted file transfer between two Unix-based PCs via a dial-up connection. The term also refers to a Unix networking protocol or to a network using that protocol.

Veronica (Very Easy Rodent-Oriented Netwide Index to Computerized Archives) A search tool, like archie, which searches text that appears in Gopher menus.

WAIS (Wide Area Information Server) Software that is used to index large text files in servers. On the client side, it finds and retrieves documents in databases, based on user-defined keywords.

WHOIS A TCP/IP utility that lets you query compatible servers for detailed information about other Internet users.

Winsock (Windows Socket) An application programming interface (API) designed to let Windows applications run over a TCP/IP network.

WWW (World-Wide Web) A network of servers that uses hypertext links to find and access files. Many Web sites also support sound and video.

more. What we found was somewhat disappointing: In too many cases, the connection software is difficult to configure and nearly impossible to troubleshoot. The front-end software tools tend to be more like applets than like complete software applications.

In many cases, freeware programs proved far better than the applets provided with the commercial programs we reviewed. Be sure to see the sidebar "Riding the Internet for Free," in which we highlight the best of available freeware and shareware.

DIFFERENT STROKES

For a fuller Internet connection than an on-line service provides, you can contract with an Internet public-access provider for a SLIP or PPP account. You run the TCP/IP stack on your computer, along with a SLIP or PPP program and, if you're running Windows, a Winsock (as in *Windows Socket*) program that manages the application's interface to TCP/IP. With all this in place, you use your modem to call into the SLIP/PPP server; once the connection is made, you're on the Internet and can access any of its resources. Local SLIP/PPP accounts can be purchased for $30 a month or less from regional providers who in some cases add value in the form of news wires or weather or financial information.

The benefit of a SLIP/PPP connection is that you sit on the Internet as a peer, with full access to all the service has to offer. The limitations occur primarily in terms of the bandwidth available using a modem connection. The faster the modems are on both ends of the connection, the more satisfactory your Internet experience will be. We think you need at

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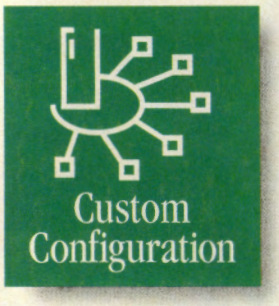

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MS Word 6.0 #226251 ..... 299.99
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Aldus PageMaker 5.0 #548991 ..... 599.99
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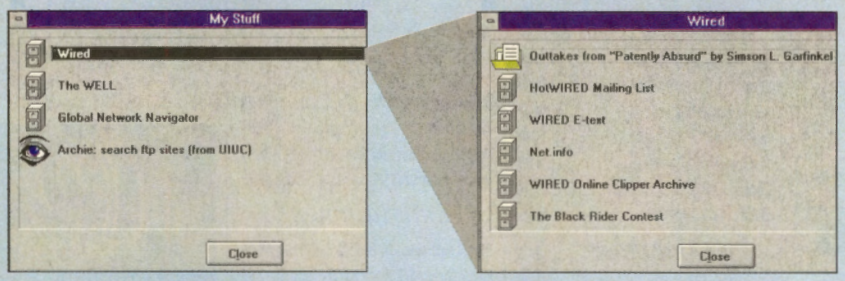
PCM1094

CIRCLE 144 ON READER SERVICE CARD

Webs and Gophers

The World-Wide Web and Gopherspace are two solutions to the problem of how to publish information on the Internet. Gopher servers are mostly limited to publishing text, but WWW servers can publish text and graphics—and even sound and video in some cases—in such a way that you'll be able to read information accurately, no matter what kind of computer you're using. Both solutions link separate elements, whether they're different documents on the same server or documents located on different servers. Both solutions are client/server-based, which means you need Gopher or WWW client software to make them work.

THE GOPHER SYSTEM

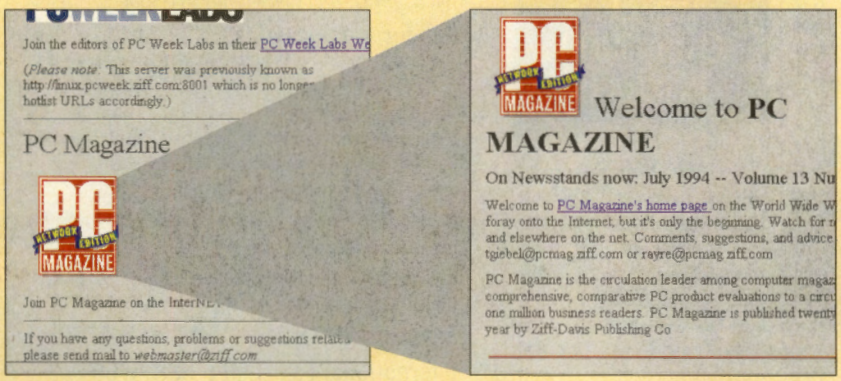


Gopher servers present information in a hierarchical menu system that's analogous to a table of contents. Select a topic on the Gopher menu (left) and you jump to the location of the related Gopher server. What you see is the top menu of that Gopher (right).

One of the best Gopher clients available today is WinGopher, but note that many of the packages in this evaluation include very good Gopher clients. In case your Internet access package doesn't come with one, several freeware and shareware packages are available, too.

To get information about the more than 3,000 Gopher servers accessible today, begin on any Gopher server or start at the University of Minnesota, the mother of all Gophers, at *gopher.micro.umn.edu*.

WORLD-WIDE WEB



World-Wide Web servers use hypertext links to join pieces of infomation in separate HTML-based (hypertext markup language) documents located either at the same or at disparate sites. The links are maintained using URLs (uniform resource locators), a standard way of coding the locations of the HTML documents. WWW pages are loosely analogous to chapters in a book. For example, on Ziff-Davis's WWW home page (left), you can click on the *PC Magazine* icon, which is a hot link to *PC Magazine*'s home page (right).

The two most popular WWW clients are Cello (Windows only) and Mosaic (Mac, Windows, and X Window).

To get more information about WWW, begin on any server, such as *PC Magazine*'s WWW server (*www.pcmag.ziff.com*). Many jumps and references are available there.

least a 14.4-Kbps modem to take advantage of full Internet access.

THE ULTIMATE LINK

As mentioned, you can also connect to the Internet through a LAN, but this is not an option for everyone since it requires a LAN that's directly wired to the Internet. Still, if you can connect this way, you'll have the benefit of the fastest and most complete connection possible. In this case, the limitations are related mostly to cost—of the dedicated lines used to make the connections, of the hardware needed at the local site, and of the personnel needed to keep it up and running.

While you may not be asked to pay the cost of a dedicated leased line, at least directly, such lines for LAN connections to the Net don't come cheap. Prices vary with bandwidth, starting at about $2,000 a month for a "dedicated 56" line (56 Kbps) on up. LAN-based connections also require special (often costly) routers at the local site. For these reasons alone, direct LAN connections to the Internet are usually out of the reach of individuals, but they make sense as a corporate solution where a lot of people need connecting at one site.

By connecting through your organization's LAN, you'll have the fastest and most complete connection possible.

MAIL CALL

Once you're connected to the Internet, there's a lot you can do. The most popular services fall into three main categories: mail; news and discussion groups; and finding and downloading files.

E-mail is easily the single most popular activity on the Internet. The Internet Society claims that there are currently somewhere between 20 and 30 million people on the Net, and most if not all have e-mail addresses. Furthermore, from the Inter-

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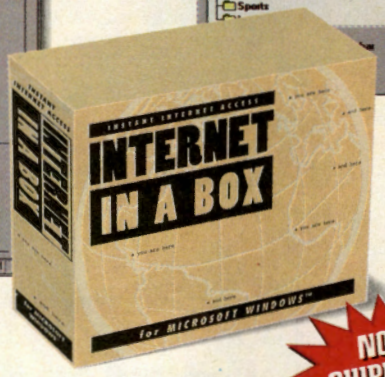
Mosaic's Hotlists provide intuitive access to your favorite Internet resources.



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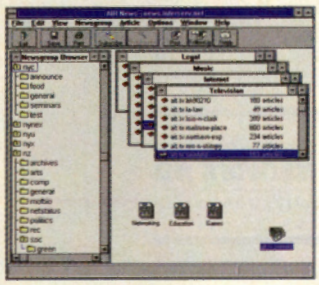

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CIRCLE 028 ON READER SERVICE CARD

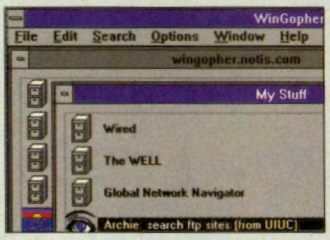
How to Search the Internet

Three useful search tools—archie, Veronica, and WAIS—help you find the information you need quickly, no matter where on the Internet it resides. Searching for information on the Internet is something all Internet users do, so the best search sites are often crowded and slow. Some get so crowded that they refuse log-on attempts during the busiest parts of the day. Your best bet is to find a search site that is available when you are and use it consistently.

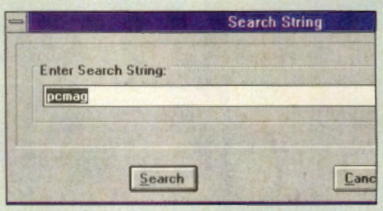
ARCHIE

Archie helps you find files that are stored on FTP servers. FTP sites are regularly indexed by title and keyword—many every night—and archie searches these indexes for the files you want.

A sample search: Find *PC Magazine* utilities available on any FTP server.



Step 1: Select archie from the Gopher menu.

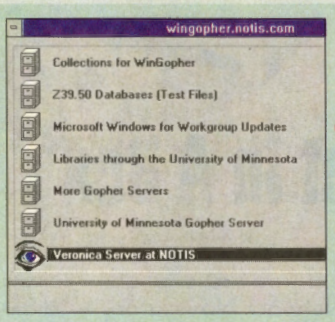


Step 2: Type in a search string relating to the files you want to find.

VERONICA

Veronica searches for text that appears in Gopher menus. That may sound like a small domain, but since there are Gophers that index mailing lists, newsgroups, and more, the results of a Veronica search can often be surprisingly expansive.

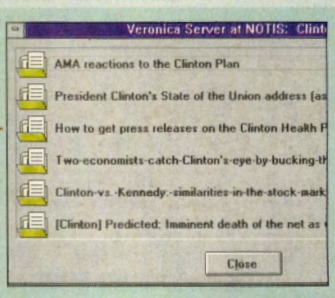
A sample search: Find President Clinton's Inaugural Address.



Step 1: Select Veronica from the Gopher menu.



Step 2: Type in a search string relating to the document you want to find.

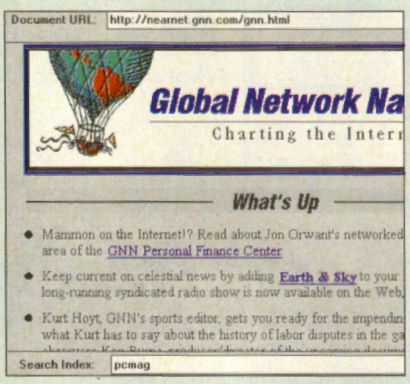


Step 3: See the results of the search returned as a Gopher menu, then select a Gopher site from that menu.

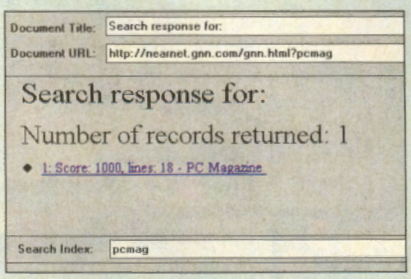
WAIS

WAIS, for Wide-Area Information Server, is full-text indexing software that's used to index large text files, documents, and periodicals. You can search WAIS indexes for everything from the text of the NAFTA treaty to information on Zen Buddhism. A good place to start is the University of Minnesota Gopher that lists all WAIS servers, both by location and by topic, at *gophergw.micro.umn.edu*.

A sample search: Find references to *PC Magazine*'s utilities on-line.



Step 1: From the Global Network Navigator home page, type in "pcmag."



Step 2: The WAIS search returns one result, which is weighted 1,000. (The number 1,000 always indicates the document containing the most occurrences of the search string. A document with half as many occurences would be given a weight of 500.)

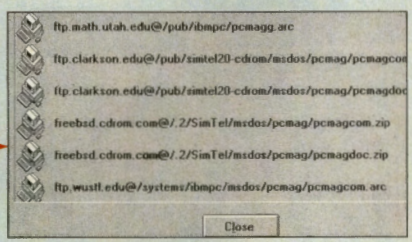
net you can exchange mail with just about anyone who has an e-mail address, even if they're not directly hooked to the Internet. All the big commercial services—CompuServe and Prodigy, for example—readily handle mail both to and from the Internet.

Many smaller corporate nets have established similar Internet mail gateways. The addresses themselves may at first look like some sort of secret code, but once you understand their structure, they're clear enough. For help with deciphering Internet e-mail addressing, see our sidebar "How Internet Mail Finds Its Way."

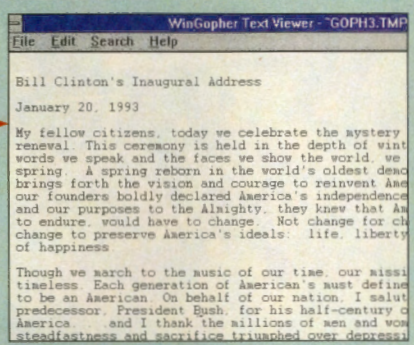
VIRTUAL COMMUNITIES

The second-most-popular Net activity comprises two subcategories: Usenet newsgroups and topical mailing lists. At last count there were almost 10,000 newsgroups and about half that many commonly used mailing lists. Though the two operate quite differently (see the sidebar "How to Use Newsgroups and Mailing Lists" for details), they offer quite similar functionality. Both are essentially discussion groups, loosely organized around topics, in which people inform each other

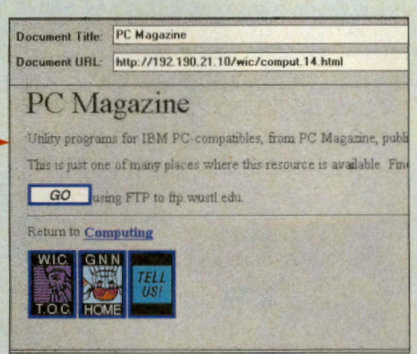
which may mean doing your searches late at night or early in the morning.



Result: A list of locations where the utilities are available, returned in this case as a Gopher menu.



Result: The Inaugural Address.



Result: Click on it to see a hypertext jump to an FTP server where the *PC Magazine* utilities are stored.

and engage in lively debates. Think of them as the world's largest bulletin boards. Some of these groups are free-form, following the direction of the collective will; others are moderated, with an editor reviewing all submissions and posting the only most relevant or entertaining.

Many people participate actively in these discussions; many more only lurk, or read the messages others post. Topics range from computer security to the future of the on-line culture; names take forms like *comp.risks* (a newsgroup) and Cybermind (a mailing list).

Two other activities, Internet Relay Chat (IRC) and telnet, are equally interesting ways to use the Internet. IRC is a way to hold real-time keyboard conversations on-line; it's an experience not unlike playing with a CB radio. Telnet is a terminal emulation protocol that lets you to log on to other computers on the Internet.

DO YOU FTP?

Downloading files is another of the three most popular Internet activities. Most often, files are downloaded using the Internet file transfer protocol (FTP); the acronym is also commonly used to denote programs that use the protocol to transfer files. Out on the Internet are thousands of so-called anonymous FTP servers that store a variety of files of all types and allow users to copy them using the FTP. The designation *anonymous* reflects the fact that when you log on to one of these servers, you normally do so as "anonymous" (after which you type your e-mail address in response to the password prompt).

Newer Internet resources like World-Wide Web and Gopher servers may soon outrank traditionally popular services.

FTP servers are great, but finding the one among thousands that has the file you want can be a daunting task. That's what led to the development of *archie*, a tool for searching FTP servers. For a fuller description of archie and other search methods (including Veronica and WAIS), see our sidebar "How to Search the Internet."

SOPHISTICATED SEARCHES

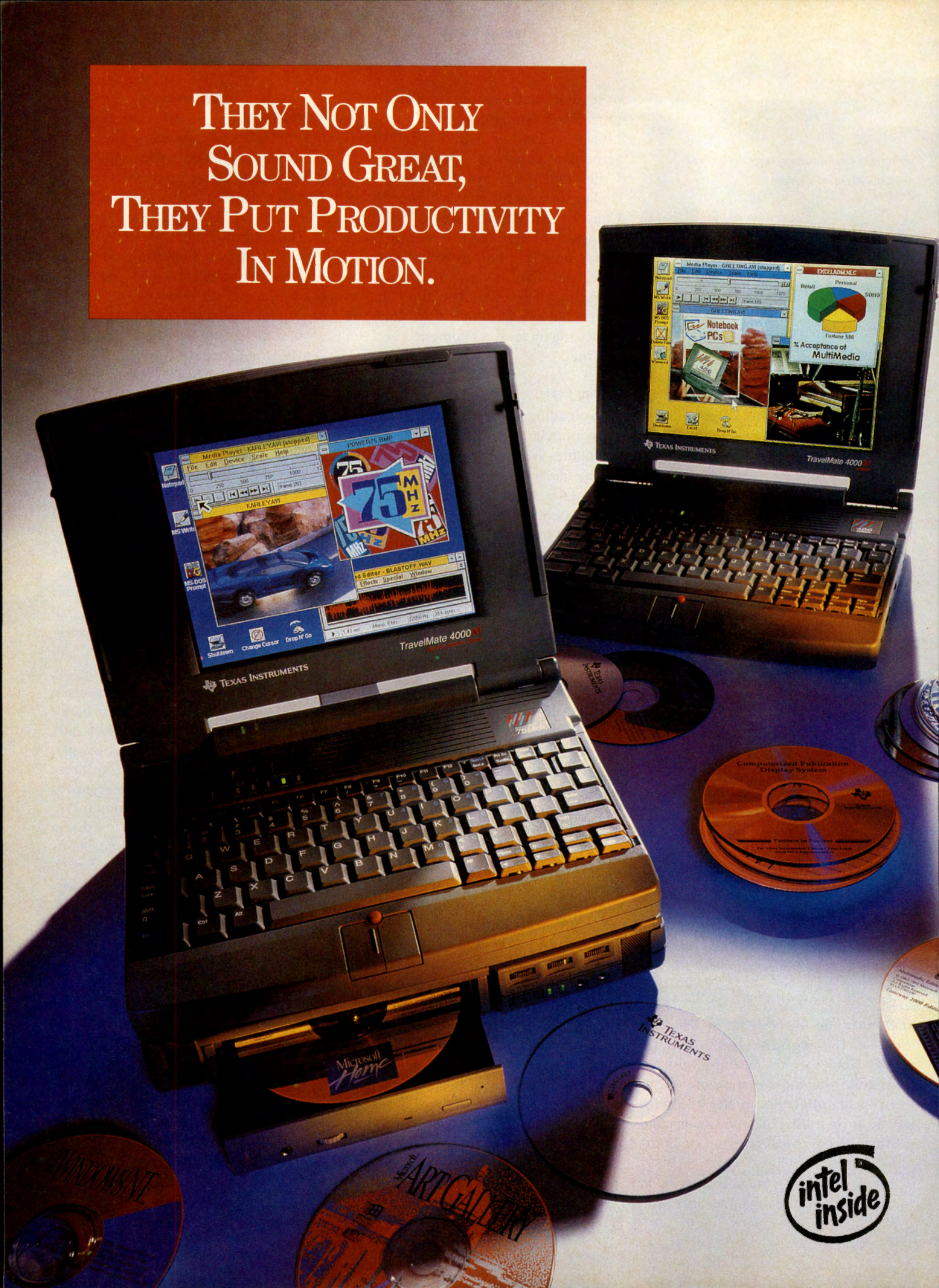
There's more to the Internet that the three main categories. Some of the newer services and resources are creating quite a stir and may soon outrank the reigning champs. Prominent among these are Gophers and the previously mentioned World-Wide Web servers, both of which are tools for Internet-based information publishing. Content providers can make information (text, sound, and images—even video) available in a format that virtually anyone on the Internet can access, regardless of what kind of computer he or she may be using.

The amazing thing about WWW documents is that the hyperlinks they contain can instantly transport you to another document, even if the second document is located on a server halfway around the world. *PC Magazine* has recently established its own WWW server on the Internet: *www.pcmag.ziff.com./~pcmag*.

NO MATTER WHERE YOU GO

Once you've made the leap and gotten connected to the world of the Internet, don't be surprised if you're not welcomed with open arms by those who already "live" there. Millions of long-time Internet denizens aren't all that happy that everyone and her cousin are suddenly clogging their arteries, using up their network bandwidth, and generally behaving boorishly. "Newbies" exploring the Internet via services like America Online (and soon from CompuServe) have sometimes been met with less than a friendly embrace. Get on the Internet by all means, but do so in a spirit of respect, and you'll be accepted more quickly. Hang out a while and learn the culture. Play by the rules. The rewards will be enormous.

There's no doubt about it: Some of the hype the Internet has been enjoying in the past 18 months is definitely justified. This globe-encircling network of computers of all types and models, doing different things for different people, in places as far apart as Tokyo, Toronto, and Tanzania, is truly amazing. That the Internet has grown to its current size without central planning and without anyone being in control is an unprecedented achievement. Get connected and you'll see for yourself.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CIRCLE 304 ON READER SERVICE CARD

Where to Go and What to Find

The Internet is so rich in resources that it's a real challenge to put together a definitive guide of places to go and things to do. This list includes documents available on the Internet to help you learn about the Internet, places to go to find access and search tools, and locations where you'll find fun, entertainment, and conversation. Using these resources you should be able to explore until find your own favorite spots.

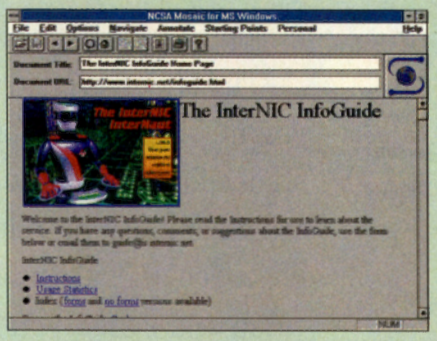
ABOUT THE INTERNET ON THE INTERNET

• The best book about the Internet is available for free on-line. It's Brendan Kehoe's *Zen and the Art of the Internet: A Beginner's Guide to the Internet,* and you can find it at many sites, including *emoryu1.cc.emory.edu* in the */computing/reference/networking/internet* directory, where you can view it with a Gopher client.

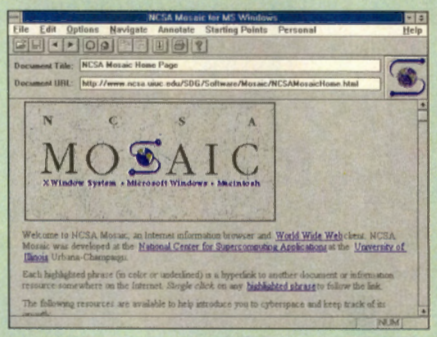
• The second-best text about the Internet is Scott Yanoff's list. Variously known as Yanoff's list, Yanoff's Internet services, and the Internet Services Special Directory, it's a constantly updated list of places to go and things to see. You can find the file in many places, including on the Gopher at *gopher.csc.fi.* Along the same lines is Jeremy Smith's text, *Big Fun in the Internet with Uncle Bert.* You'll think this is big fun if you want lists (the actual IP addresses in most cases) of archie servers, lists of FAQs, or databases of ZIP codes. You can find it on the Gopher at *gopher.fsl.orst.edu.* On the same Gopher is Ed Krol's *The Hitchhiker's Guide to the Internet.* Though it's a bit outdated (it was written in 1987 with funding from the National Science Foundation) it's still good for helping you learn about what the Internet is and how it works.

PLACES THAT MATTER

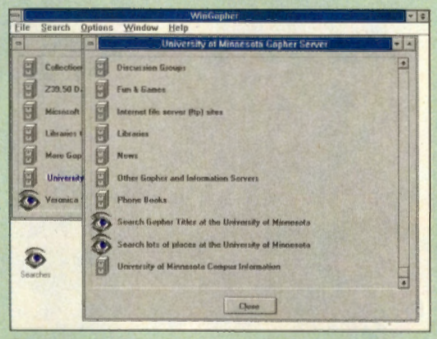
As the Internet grows, it is being documented on-line at many locations, and in some of those same places you'll find the software that's helping it grow. To stay current on the Internet you need not always go to one of these sources, but things change so fast that they're the best places to help you stay up to date.



The Internet Information Center's (InterNIC) home page. InterNIC is the official information provider for the Internet.



The home page for Mosaic at the NCSA. Check here for updates to Mosaic for Windows, the Mac, and X Window.



The top-level Gopher at the University of Minnesota, the mother of all Gophers, and a great place to begin your Gopher tunneling.

• The InterNIC is the official source of information about the Internet. It has three missions: to provide Internet information services, to supervise the registration of Internet addresses and DNS names, and to develop databases that will serve as white and yellow pages to the Internet. Its information services are vast and are distributed through a variety of means. The InterNIC has a WWW server (*www.internic.net*), a Gopher server (*gopher.internic.net*), and an FTP server (*ftp.internic.net*), and it is also available via e-mail at *info@internic.net.* It even has, believe it or not, a phone number (800-444-4345 or 619-455-4600).

• Not only is the World-Wide Web the newest information service to arrive on the Internet, it is also generating much of the latest interest in the Internet. The people who started this hypertext-based client/server system and are the most responsible for its development are at the CERN European Particle Physics Laboratory. Their Web pages are a necessary pit stop on the Internet, and a source of information about WWW client and server software development. Visit at *www.cern.ch.*

• The most popular WWW client for Windows is Mosaic, which we look at in detail in the sidebar "Mosaic and Cello: Freeware at its Finest." Mosaic was developed at the National Center for Supercomputing Applications (University of Illinois at Champaign-Urbana). Not only is its WWW server a good source for Mosaic updates and information, but the NCSA's home page, at *www.ncsa.uiuc.edu,* is a great place to explore using any WWW client. It tracks scientific stuff, it's true, but it does a wonderful job of showing how the Web can be developed as a resource for investigations of all kinds.

• Though the World-Wide Web is generating all the heat, the Gopher-based information system generates at least as much light.

• If the WWW is like surfing over the Internet, the Gopher system, developed at the University of Minnesota, is like tunneling through it. Using Gopher clients, you drill down and across rather than jump from link to link. In any case, Gophers servers are the repositories of a wealth of information. If you want to find out what Gophers have to offer, the University of Minnesota Gophers are a good place to start. You can find the top-level Gopher at *gopher.micro.mnu.edu.*

COOL THINGS TO KNOW

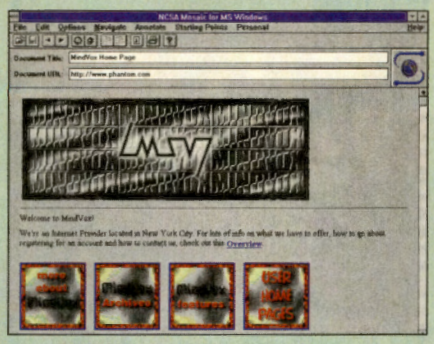
Remember, to be cool on the Internet you have to know everything before anyone else does. The trick, of course, is figuring out what everyone is going to want to know.

• You could start by knowing the names of all the publicly accessible Internet service providers. To get the newest version of that list, just send e-mail to *info-deli-server@netcom.com,* and in the text of your message say "send PDIAL." The list will be returned to your e-mail box, but beware, it might be long.

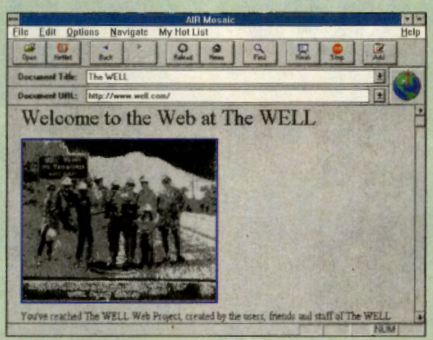
• The next thing you might want to know is the addresses of all of the publicly accessible WAIS databases. To find such a list, get on your Gopher and go to *gopher-gw.micro.umn.edu.*

• To be really cool, you have to encrypt. The best free encryption software is PGP, for *pretty good privacy.* The way to get it, via FTP, is long and convoluted, as this kind of techno-secrecy should be, but you can start at *ftp.csn.net,* in the */mpj* directory, where you'll find directions to begin the hunt cleverly concealed in the README file.

• An adjunct to pretty good privacy is *pretty good security,* and to ensure good security in the Internet you should be sure to read all the posts in the *comp.security.announce* newsgroup, where the Computer Emergency Response Team (CERT) keeps users up to date on security issues. If you want to keep abreast of the latest debates on this subject, you can check out CERT's FTP archives at *ftp.cert.org.*



The MindVox home page. From here you can learn more about MindVox, or check out the MindVox user's home pages.



The WELL (The Whole Earth 'Lectronic Link) is one of the oldest virtual communities in cyberspace. You get a good flavor of The WELL from its WWW home page.

COOL PLACES TO BE

It's true that the Internet puts you on an equal footing with the rich and famous. You can send mail to the President, or even Bill Gates. Of course, the President doesn't read his own e-mail. There's no map to the on-line homes of the stars, but we've visited many of the virtual communities on the I-Way, and two of the most interesting are MindVox and The WELL.

• You can visit MindVox via Gopher (*gopher.phantom.com*) or WWW client (*www.phantom.com*) and read a little about the place, but to get a flavor for it you should hang out in the Bandwidth Conference for a few days. It's a virtual soap opera. People pretend to fall in love, do fall in love, even become other people, in ways possible only in virtual worlds. MindVox is truly mind-boggling.

• The WELL, on the other hand, is a solid sort of place, a virtual community in which you could settle down and raise your kids. There you will find luminaries of a sort—writers, mostly. Conferences on The WELL take on a serious tone. It's the kind of place where topics are discussed at length and then begin to drift far afield. It's the best example of a real community in the virtual world. You can visit via Gopher (*gopher.well.sf.ca.us*) or WWW client (*www.well.sf.ca.us*) .

BIG FUN

For real fun, the Internet offers multiuser dungeons, or MUDS, and their offspring, object-oriented MUDS that are known as MOOS. These fantasy role-playing games are text-based but manage to stretch the imagination to its very limits.

Similar to the old computer game Adventure, these games start out with a shell that the users build into a virtual world and then inhabit. For more information on where the games are and how to play them, visit the newsgroups in the *rec.games.mud* topics.

SIX MORE SUGGESTIONS

• There's a great on-line newsletter for parents and educators about on-line life called KIDLINK. Send e-mail to *opresno@estern.uio.no* to subscribe.

• Visit the Library of Congress on-line. You can find its gopher at *marvel.loc.gov.*

• Download complete texts of classic books placed on-line at Project Gutenberg. The address: *ftp.mrcnet.cso.uiuc.edu.*

• Visit Microsoft's WWW server, where you can learn about its upcoming Internet plans. It's at *www.microsoft.com.*

• Get a list of all the electronic magazines (E-zines) you can find on the Internet. Send e-mail to *e-zines-request@netcom.com.*

• Head for the Ziff-Davis WWW server (*www.ziff.com*) where you will find not only PC Magazine's WWW server (*www.pcmag.ziff.com/~pcmag*) , but also the server of our sister publication, *PC Week.*

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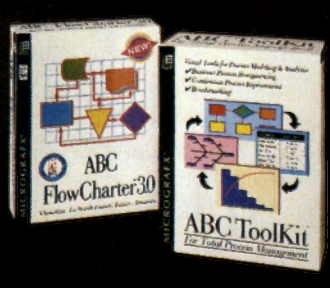
PC MAGAZINE EDITORS' CHOICE
Dec. 21, 1993



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THE INTERNET

Services *for* Connecting

If you want an *easy* connection to the Internet via a modem and a local phone number, but you don't want to fool with installing or configuring communications protocols, the national on-line services we profile here should top your list of resources to investigate. Just sign up and log on; they'll do the rest.

By Ted Stevenson

You may not have a direct connection to the Internet through your computer or your organization's network. If that's the case, your alternative is to gain entry to the Internet using one of the many commercial Internet providers. Internet providers come in many flavors, with varying capabilities and charges. At one end of the spectrum are simple "public-access providers" that offer little more than an open pipe to the Internet. To utilize their services you'll need some of the tools discussed in the next section of this story, "Tools for Connecting." At the other end of the spectrum are the well-known commercial on-line services. Some—such as BIX, CompuServe, GEnie, MCI Mail, and Prodigy—currently offer e-mail access only. Others—America Online and Delphi—offer a much wider range of services. In this story, we look at the Internet offerings of America Online and Delphi and compare them with the integrated tools and services offered by two dedicated Internet services, NetCom On-Line Communication Services and The Pipeline. If ease of connecting to the Internet is your most important goal, you should check out these services.

EASY DOES IT

When you use one of these services, the hassles of connecting to the Internet are reduced to a bare

minimum: You install the end user software (in the case of NetCom's NetCruiser and The Pipeline), sign up, log on, make a menu choice or two, and you're there.

Once you're connected, on-line services simplify your Internet experience by handling most navigation tasks for you. Instead of searching out cryptic listings like */pub/pc/win3/winsock* at cryptic places like *ftp.cica.indiana.edu,* you can make menu choices and sit back.

How many of the Internet's many doors do these services open for you? Several—but details vary with each provider. In fact, no provider gives 100 percent complete access today. Delphi and The Pipeline come close, providing everything but full text-and-graphics World-Wide Web access. Though NetCruiser also promises access to many services—including an existing Web browser—it has some rough edges.

On-line services offer far and away the easiest path to the Internet, and they provide lots of hand-holding once you are there.

NO FREE RIDE

One downside to connecting to the Internet via a traditional on-line service is slow access speed. You're fighting the limitations of modem bandwidth and the monotasking nature of typical on-line connections. The Pipeline's PinkSlip client/server architecture gives it a big advantage in this area. Also, on-line service fees may seem inordinate when compared with those charged by local Internet service providers for comparable services.

On-line services offer far and away the easiest path to the Internet and lots of hand-holding once you're there, but they have some drawbacks: limited scope of services, restricted access speed, and relatively high cost. Are the trade-offs worth it? Read the reviews that follow and decide for yourself.

The Internet Center

• America Online

BY BRENDON M. MACARAEG

The Internet Center started life in October 1993 with a whimper. It promised a multitude of services—including Usenet newsgroups, Gopher, WAIS, a mailing-list database, FTP, and telnet—but most of these didn't work then, and some—FTP and telnet—aren't delivered yet. Still, it *was* the first commercial on-line service to offer a Windows graphical front end, and this alone has won it great popularity.

Once you have the AOL Windows software installed, getting onto the Internet is a simple point-and-click process. The trade-off for this ease of use, as with most on-line services, is access speed: Expect to watch the Windows hourglass a lot while surfing the Internet with AOL.

EASY READER

Newsgroups remain an AOL strength. The package offers a default selection of groups for those with mainstream tastes, and the Add Newsgroups function lets you add your choice of groups to a personal collection. An icon labeled "Latest Newsgroups" allows you to view and choose among new arrivals from a frequently updated list. AOL's newsreader groups messages by subject and automatically threads related messages by date.

Reading and sending mail via AOL are a snap, and your AOL e-mail address book can manage mailings to multiple recipients. AOL also lets you send and receive unlimited mail without added per-message charges. You can't attach files on Internet mail, however.

You can do Gopher and WAIS searches in AOL, but they can be slow, and they don't always work.

AIDS TO NAVIGATION

AOL helps new users learn how to handle a variety of Internet tasks, from subscribing to mailing lists to performing Gopher and WAIS searches. The service's message boards help members share tips, and Brendan Kehoe's *Zen and the Art of the Internet* is available as a searchable on-line reference.

AOL shines as a place for Internet newcomers to familiarize themselves with e-mail and newsgroups. Those with more sophisticated needs, however, may be better served elsewhere.

▶ **America Online.** The Internet Center, *Vienna, Virginia; 800-827-6364; e-mail, aohotline@aol.com.*

Circle 496 on reader service card

Delphi Internet Services Corp.

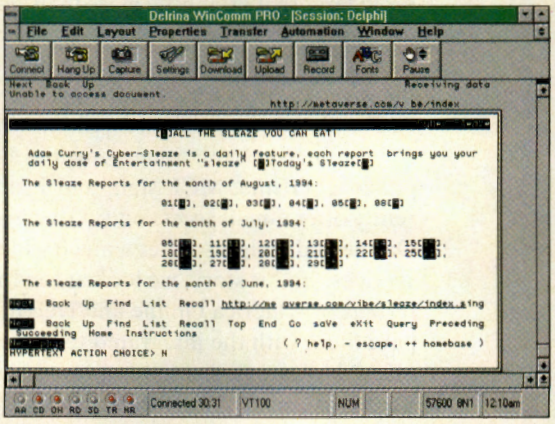
• Delphi

BY ANGELA GUNN

Whatever you may think of its text-based services, Delphi certainly blazed the trail, offering full-on Internet access way back when other services still balked at even a simple mail gateway. The company's plans to introduce a new interface this fall, which will have an iconized main menu and a graphical mail module, indicate that Delphi is ready to meet the GUI world halfway.

Just about anything you'd want from the Internet is available through Delphi: e-mail, FTP, IRC, newsgroups, Gopher, telnet and the World-Wide Web (via Gopher; you'll see text only—no graphics). Delphi also outstrips other on-line services in supporting such useful Internet utilities as finger, PING, and WHOIS.

Furthermore, the service provides plenty of documentation; if you're unsure how to go about using any of Delphi's tools, you'll find instructions a few keystrokes away. Delphi also offers many well-chosen pointers to useful files and



Delphi provides fast, simple Web access through its character-based interface.



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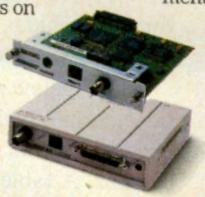

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utilities that document the various tools and provide tips for choosing the right application for whatever you mean to accomplish on the Internet.

For the moment at least, Delphi's tools are all text-based. The newsreader, for instance, is virtually the same one you'll find on many standard Internet public-access services, but it works. Its simple two- or three-letter commands are clear (though since they depend on the application in use, they lack the consistency offered by those found in the other services), and its speed is impressive. In fact, Delphi generally lets you roar; it's astonishing how fast Web sessions move, for instance, when you're not waiting for a GUI to pull itself together. For users intent on serious e-mail usage, Delphi's file-folder system is superior to AOL's and on a par with The Pipeline's.

Its plans to introduce a new graphical interface this fall indicate that Delphi is ready to meet the GUI world halfway.

Though our focus is on the Internet tools just discussed, we should note that Delphi's original on-line service is still alive and well. Plenty of users enjoy Delphi's games and discussion groups and don't ever venture onto the Internet (although Delphi makes a point of integrating Internet access into the regular service to a great extent). Also, unlike many of the larger on-line services, Delphi is engagingly open to member input. Many of the more than 200 special interest groups and forums available on the service itself were suggested (and are run) by members.

The close-knit nature of the comparatively small Delphi community extends to the Internet areas; users having trouble navigating are often advised by friendly passersby, and it's notable that Delphi members have participated on the Internet for years without wreaking the kind of havoc caused by some of AOL's Internet newbies recently.

If you're still wondering if the Internet would be interesting, you can't do much better than Delphi.

▶ **Delphi.** Delphi Internet Services Corp., *Cambridge, Massachusetts; 800-695-4005; e-mail, askdelphi@delphi.com.*

Circle 497 on reader service card

NetCom On-Line Communication Services Inc.

• NetCruiser

BY ANGELA GUNN

Like The Pipeline, NetCom On-Line Communication Services has moved from providing Internet access services to offering a graphical front end for using those services. NetCom is now one of the nation's largest commercial Internet access providers, and its Windows-based NetCruiser offers a fully integrated suite of Internet tools and services.

You won't find a more comprehensive service provider than NetCom. Services offered include FTP; archie, Gopher, Jughead, and Veronica; and IRC, telnet, Usenet newsgroups, WAIS, and World-Wide Web. All of these are accessible from the main screen with one click.

Its software, NetCruiser, needs serious work, however. There's no support for archie, IRC, or WAIS, for instance, and we experienced several system errors. The Gopher interface provides a spiffy map with a number of servers listed for your convenience, but the interface had a bug that rendered it useless during our evaluation.

Moreover, the browsers, though numerous, aren't particularly advanced. For instance, the newsreader doesn't support threading, and the Web browser's hotlists rely on filenames rather than user-defined names. Inexplicably, the program has no horizontal browse bar, which makes for problems when you're viewing files and graphics. And NetCom would do well to imitate The Pipeline by including an off-line mail client and newsreader.

While there are good ideas here, and the GUI makes nice use of icons and other interface elements, NetCruiser has "Version 1.0" written all over it. But by the time you read this, many of the features now missing—such as archie, IRC, and threading by newsgroups—should be available to users who can download the software from NetCom. With the might of NetCom behind it, this service/software combo should soon be competitive with its peers.

▶ **NetCruiser.** NetCom On-Line Communication Services Inc., *San Jose, California; 408-554-8649; e-mail, info@netcom.com.*

Circle 498 on reader service card

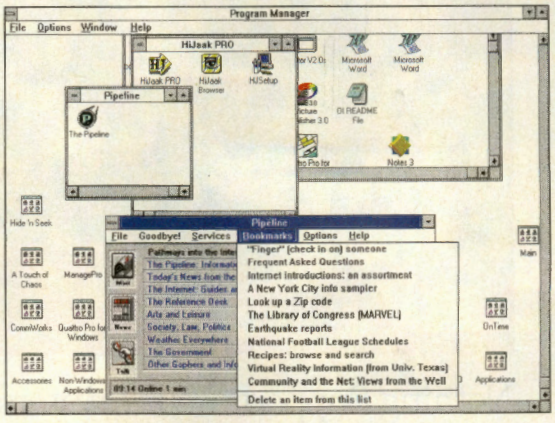
The Pipeline

• The Pipeline for Windows

BY ROBIN RASKIN

The Pipeline for Windows, Version 1.4.2, succeeds in carrying off an unlikely task: It is at once an access service and a complete collection of Internet-access tools. Its back end provides seamless dial-up access, and its front end offers simple point-and-click Windows navigation while clearly interpreting the morass of the Internet.

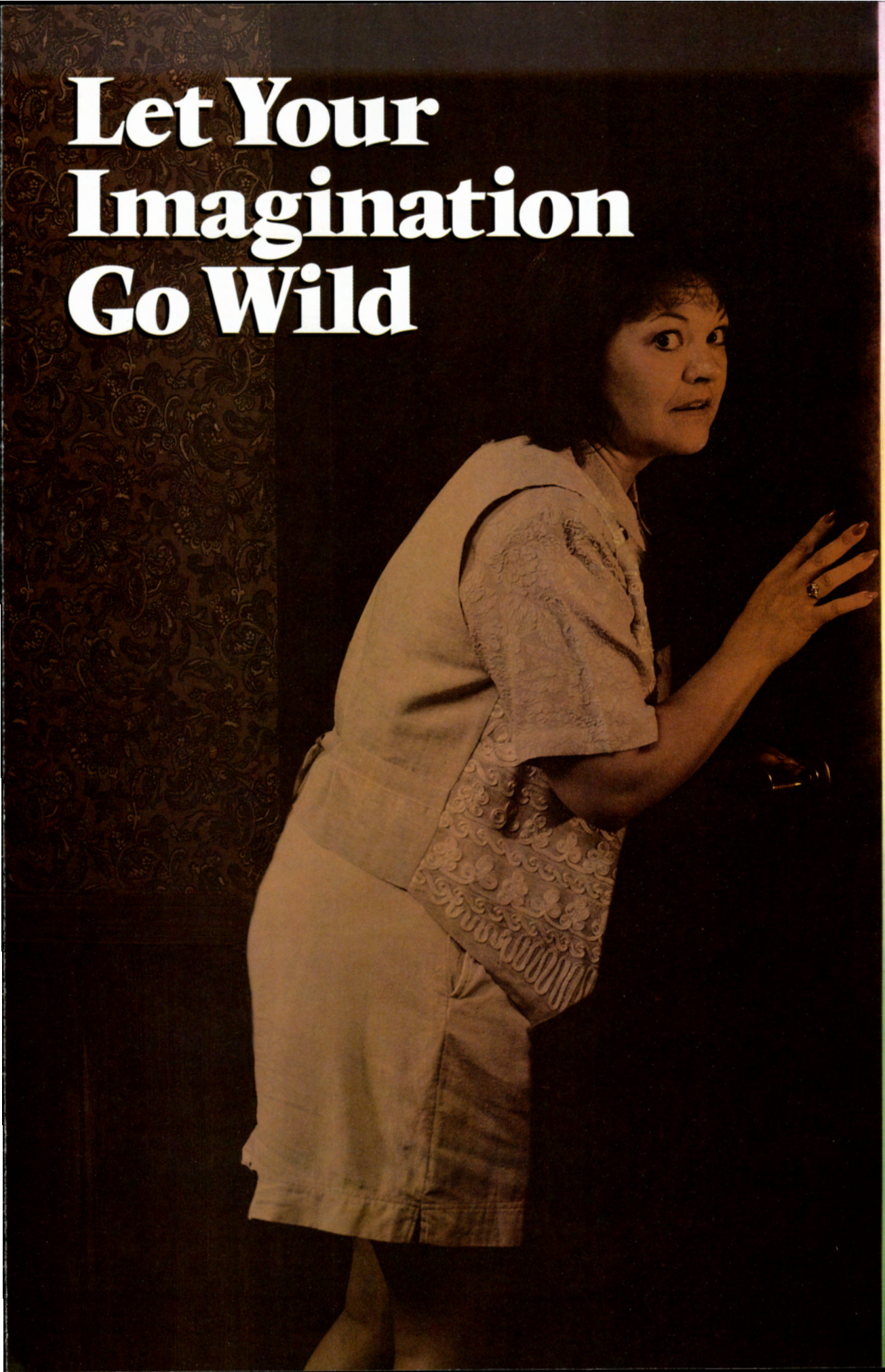
The Pipeline, written in Visual Basic, allows dial-up access without SLIP or PPP; it runs (and runs pretty quickly) over a standard modem connection. Thanks to a technology called PinkSlip—developed by the package's creators—Windows can act like a true multitasking system by prioritizing the transmission of information from the back end to your client. Whereas The Pipeline's service used to be available only via a New York City phone number, the latest version includes a SprintNet connection that makes it affordable for national use.



The Pipeline's bookmarks let you quickly get to your Internet area of interest.

The Pipeline's main menu provides access to mail, real-time chat, newsgroups, and Internet databases through a series of buttons. A table-of-contents–style menu

Let Your Imagination Go Wild

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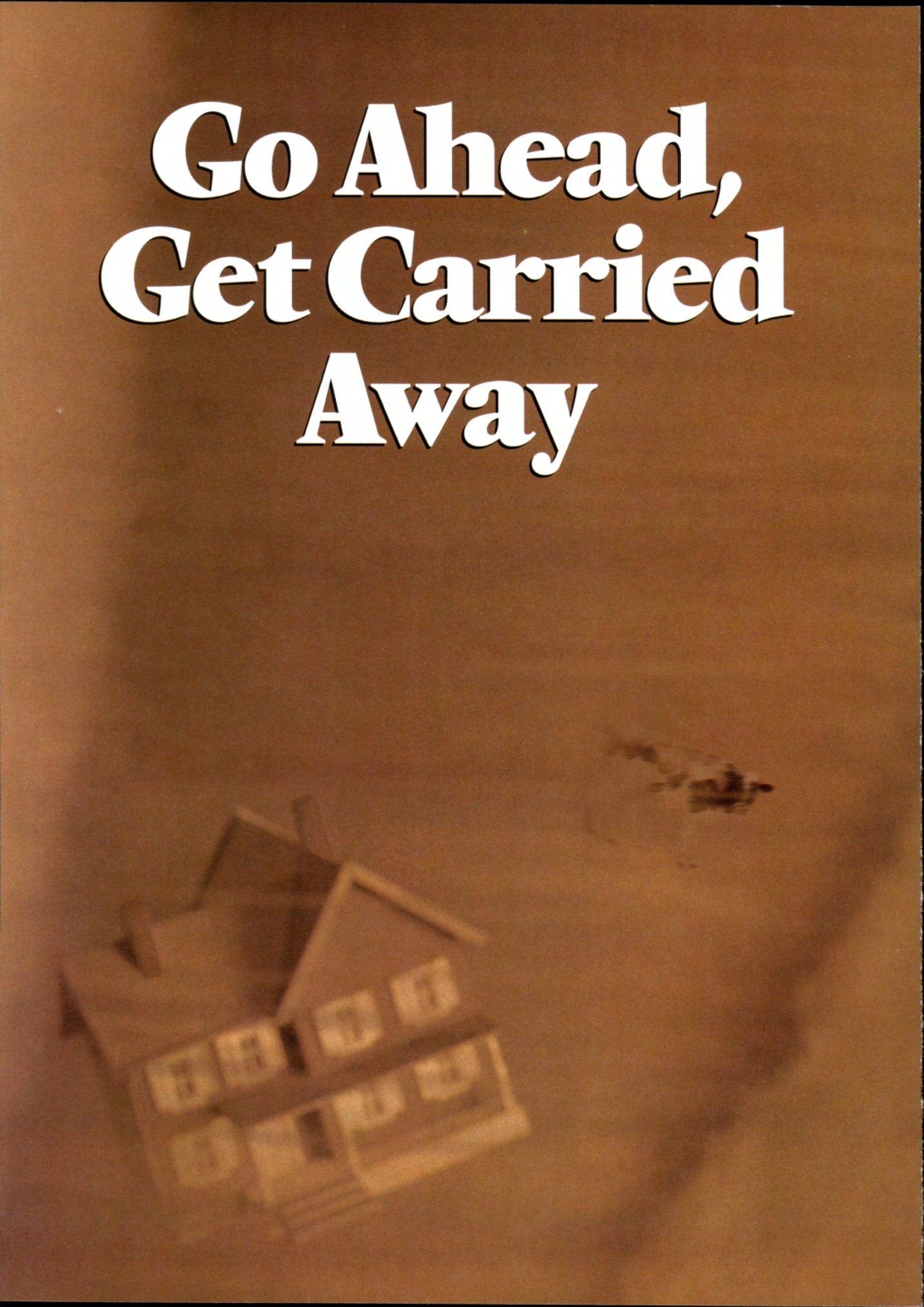

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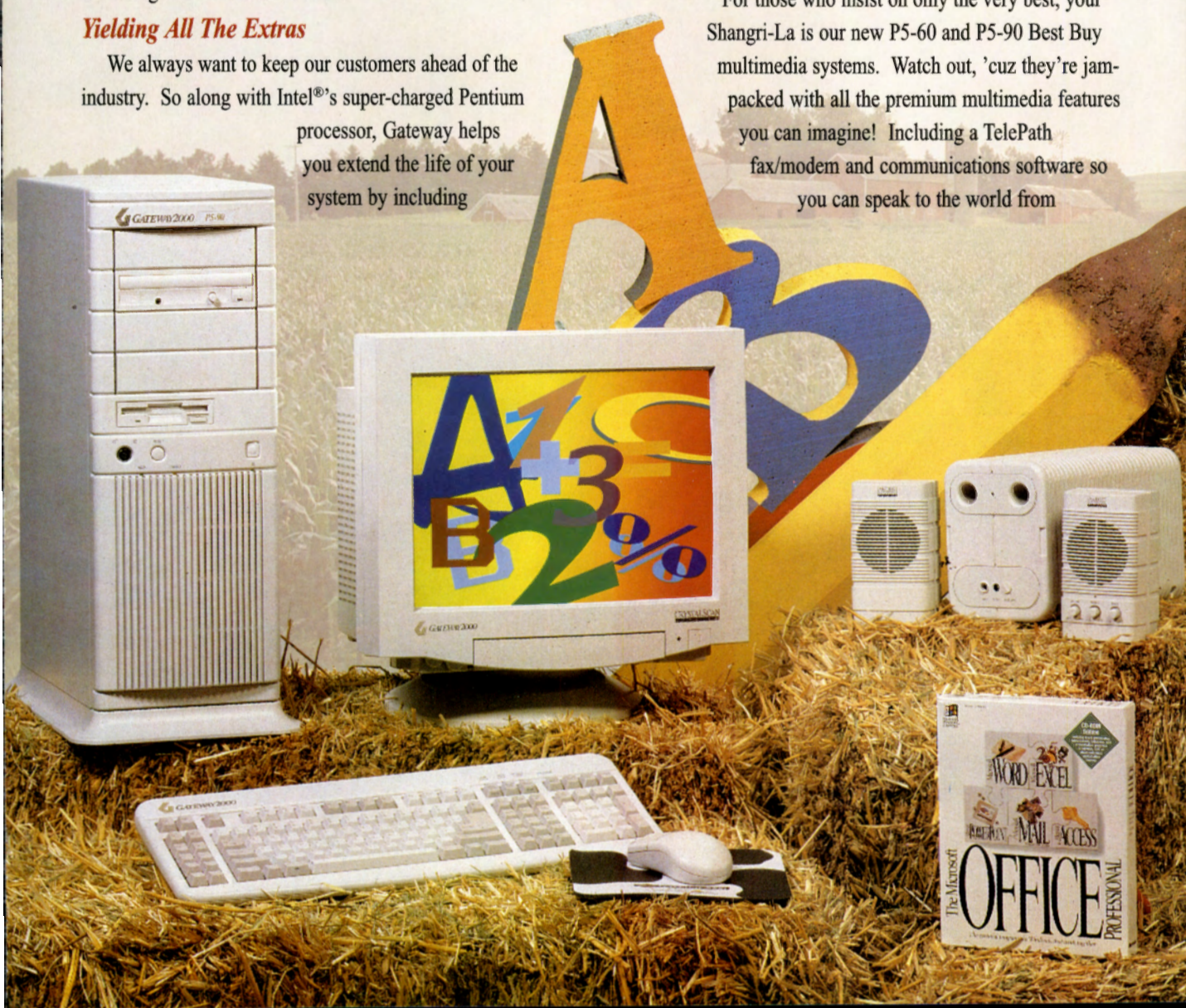


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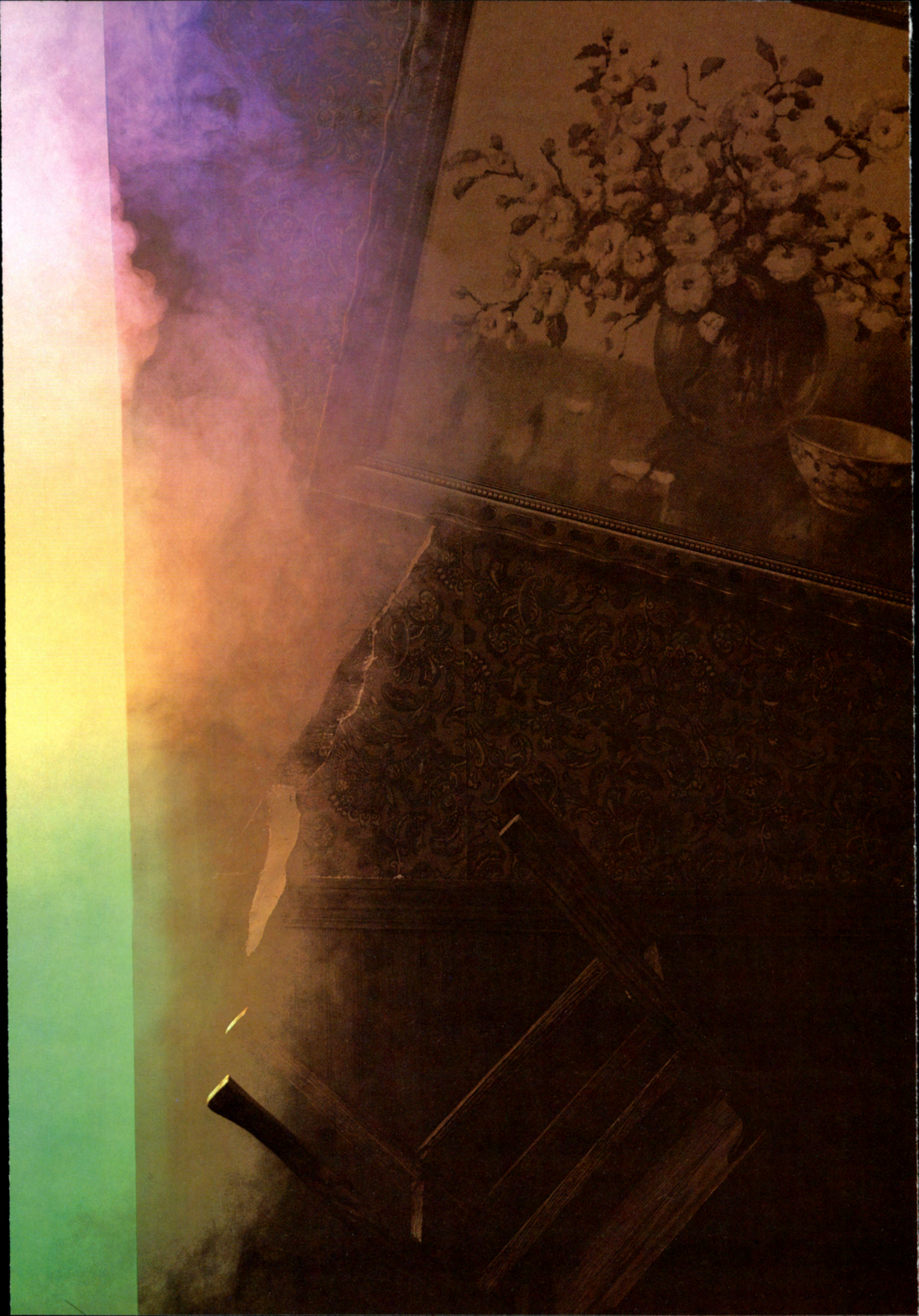

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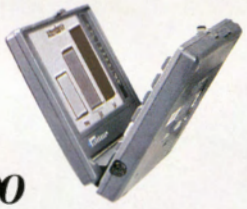

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offers access to topic areas such as Weather, Shopping, and Reference. The Pipeline runs a side-by-side translation of Netspeak terms such as *FTP* and *Gopher,* providing English equivalents such as *get files* and *search for information.* It also answers many questions in the form of FAQ (Frequently Asked Question) files.

While the mail reader is not the most sophisticated, myriad straightforward procedures are built into the top level. These procedures include addressing, inserting files, quoting from a previous message, creating an address book or a mail folder, and even using *mailbots* (Pipelinespeak for mail robots).

To join newsgroups, you simply click on the groups you'd like to join. You can easily create a custom selection of newsgroups, and bookmarks let you quickly tag your favorite places for revisiting.

Searching for information is easy: The archie and FTP menus each offer a direct route to files or archives when you know their names or locations, and Gopher and Veronica searches are simple. The Pipeline also includes value-added services such as Clarinet—a news service that taps such sources as the Associated Press and Reuters.

The Pipeline's main shortcoming today is its lack of full graphical and audio support for the World-Wide Web. You can access the Web through Liunx, but you lose an awful lot of richness in the translation. We tested a beta version of The Pipeline 2.0, which remedies this problem, providing Mosaic-like graphical access to the Web. Other improvements in the new version include the addition of a stock-quote service and an infinitely nested tree design for the service's bookmarks.

Problems remain: The package does not work over a LAN, support searches of multiple folders, or offer drag-and-drop. These are minor blemishes on a true beauty queen, however. The Pipeline is an elegantly conceived program; we've seldom seen a Version 1.*x* program that's as well thought out. Watch as The Pipeline continues to grow; the Internet will be a better place because of this package.

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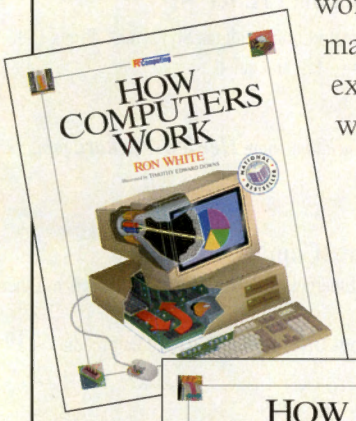

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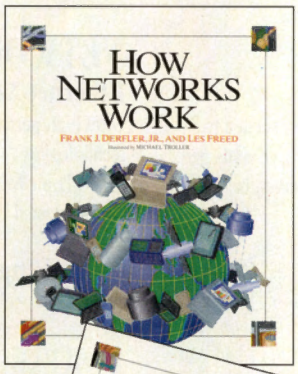

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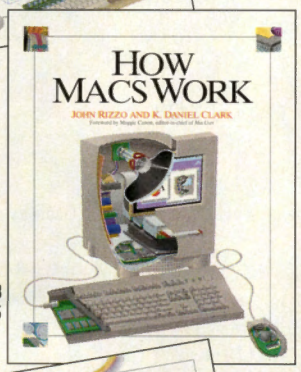

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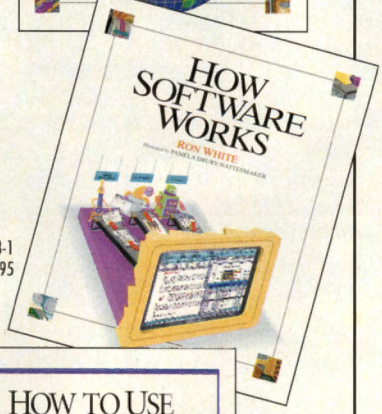

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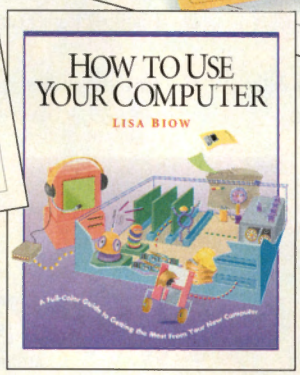

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THE INTERNET

Tools *for* Connecting

If you want the fullest, fastest, and most flexible Internet access possible, you'll need a variety of software tools. The prepackaged collections we review here may be your answer—or you may prefer to design your own kit from tools available free over the Net itself. Either way, the entire Net will be at your command.

By Ted Stevenson

For the time being, at least, *full* Internet access means a dose of the P's: You definitely need to have TCP/IP (the communications "stack" of Transmission Control Protocol and Internet Protocol) running on your PC; you may also have to contend with either SLIP (Serial Line Interface Protocol) or PPP (Point-to-Point Protocol). How difficult is this? Probably not as bad as you think.

True, the tasks of marshalling all the information you need to get the right computers talking to each other, as well as setting up and configuring TCP/IP, are somewhat daunting (if you don't have a LAN administrator to handle this chore for you), but the rewards should justify the effort. With TCP/IP connectivity in place, you can connect either through your LAN (the fastest of all links) or, with the aid of a modem and one of the serial communications protocols (SLIP or PPP) to a public access service provider.

Even a modem connection through a public-access service provider is likely to be much faster than the commercial on-line services discussed in "The Internet: Services for Connecting" because it lets you sit as a full peer on the Net. Both types of connections, however, give you a wide choice of software applications for interacting with the Net. We'll examine many of these applications in the pages that follow.

SUITE IDEAL

We had hoped to find products with a *complete* set of Internet tools. We looked for packages that had the TCP/IP and SLIP/PPP transports necessary for connecting and a Winsock program (which allows any compliant application to access TCP/IP services from Windows). And we felt that the same package should offer a selection of robust, graphical applications for handling the full range of Internet services and resources: e-mail, news, telnet, Gopher, and the World-Wide Web.

Our reviews show that the news is both good and bad. The bad news is that our quest was somewhat unsuccessful. To a large extent, packages that purported to be complete solutions were primarily TCP/IP stacks—corporate wide-area connectivity tools—packaged with a variety of not-so-robust or well-integrated applications that covered only a small part of the Internet spectrum.

With TCP/IP connectivity in place, you can connect through either your LAN or a modem using the SLIP or PPP serial protocol.

BRIGHT FUTURE

The good news is that things are changing. Spry's AIR NFS is a one-stop-shopping solution that combines a full and powerful set of applications—including Spry's own fully licensed version of the fabled Mosaic—with not one but two different TCP/IP stacks. (Spry's tools will also work on top of any stack you may already have running.) And although Ameritech Library Services' WinGopher doesn't have full Internet functionality, it is an impressive example of what a full-blown Internet application can be. It deserves a place in the workbox of anyone who is willing to handpick his or her access tools.

Both these products have built-in con-

Suitability to Task: Internet Access Tools

With demand for Internet access tools mushrooming, we've seen packages designed primarily as TCP/IP stacks move toward becoming Internet front ends by adding applications for managing specific Internet services. For the most part, however, progress in this direction has been slow. We found that most of the products currently provide only basic implementations with middling usability features—not enough to tame the colossal network of networks for the uninitiated.

SUITABILITY TO TASK		
	Power	Ease of Use
TCP/IP implementation	POOR	EXCELLENT
Mail/newsgroups	FAIR	GOOD
FTP/telnet	GOOD	FAIR
Search tools	EXCELLENT	N/A

In evaluating a package's **TCP/IP implementation,** we looked at how the TCP/IP stack is implemented. We look at whether a package will work with both ODI and NDIS drivers and whether it loads in DOS or as drivers in Windows. In addition, we tested the packages with NCSA Mosaic for Windows to check whether they would work with Winsock 1.1–compliant applications. Packages that allowed both direct connections and asynchronous connections (using SLIP or PPP) got higher ratings. If a package required extensive scripting for asynchronous connections but did not include sample scripts, we lowered its ease of use score.

The most important criterion evaluating in ease of use was how well a package shelters users from the complexities of the TCP/IP setup. Most programs do a pretty poor job of taking a novice user through this inherently complex process, but the ones that included worksheets detailing all the information required before the setup got points for usability.

Part one of the **mail/newsgroups** rating gauges a package's ability to mimic both the functionality and ease of use typical of existing Windows e-mail packages. The evaluation also rates a package's address book: whether or not it had folders, whether it implemented automatic reply separators, and whether it allowed users to filter message header information.

We gave good ratings to those able to function as standalone e-mail servers, as well as to the ones that supported a variety of mail protocols. In particular, packages that support MIME (Multipurpose Internet Mail Extensions)—the protocol necessary for sending and receiving sound, graphics, and video files via Internet mail—earned high marks.

In the *newsgroups* category, we rated each package's newsgroup reader. Those readers able to provide automatic access to an NNTP server earned extra points. We looked at a package's ability to access and sort newsgroups, as well as its ability to set up single or multiple newsgroups for easy lookup. The latter capability lets a user avoid having to load all the lists each time he or she logs on. As with the mail modules, we gave points for the ability to include a "signature" at the end of a message.

In the first part of the **FTP/telnet** category, we looked at the number of terminal emulations a package supplies, as well as its ability to remap the keyboard and offer other customization options. Packages with scripting ability got higher scores.

In the *FTP* area, packages providing both server and client capabilities scored higher. We also gave higher ratings to packages that let the user log onto multiple-server operating systems and that provided a generic and default log-on parameter. Among Windows-based packages, we looked for those able to simulate the Windows File Manager interface in their file management offerings, especially by implementing features such as drag-and-drop. We looked for the ability to perform file management tasks, including directory creation and deletion on both the host and remote systems.

Unfortunately, in the area of **search tools,** we had to grant points even if a package simply contained a search tool; that alone constituted a big plus. Search tools that earned a good rating included applets for launching certain file types as they were retrieved. Also a plus was a package's ability to integrate with third-party tools, such as graphics viewers.

Only one of the packages we looked at included a true Web browser, although many vendors say they are planning to include one in their next release. Three packages—ChameleonNFS, Spry's AIR NFS, and WinGopher Complete—did offer Gopher tools; we evaluated these for their user interfaces and their status messages.

nections to their vendors' servers. WinGopher connects to Ameritech Library Services' Gopher server; AIR NFS, to Spry's NNTP/Usenet and Web servers.

STEP UP AND SAVE

For the more independent-minded (and economy-minded), we also look at some of the many Internet tools available free of charge (freeware) or for a modest registration fee (shareware) on the Internet and on many commercial on-line services. Many are still the best available applications of their kind.

Of them, NCSA Mosaic for Windows, is undoubtedly the most famous. This "tool of tools," from the National Center for Supercomputing Applications, gives almost single-handed access to World-Wide Web, Gopher, and FTP servers. It is readily available on-line, as is the beta version of Cello, an even more ambitious application, from the Legal Information Institute at Cornell Law School. Cello natively allows retrievals from the Web, Gopher, FTP, and Usenet News and supports other protocols including WAIS, Hytelnet, and telnet. For a detailed look see the sidebar, "Cello and Mosaic: Freeware at Its Finest." Other useful freeware and shareware apps are profiled in the sidebar "Riding the Internet for Free." Of these, the mail reader Eudora is a standout.

Whether you prefer the all-in-one commercial package solution or the pick-and-choose freeware approach—or some combination of the two—the Internet software you need should be covered in the pages that follow.

Ipswich Inc.

• Acadia/VxD

BY ERIC BERLIN

Although Ipswich's $395 Acadia/VxD, Version 1.0, provides aspiring Net surfers with all the TCP/IP functionality they need, the package offers only some of the expected Windows tools. It has mail, telnet, and FTP, but no Gopher or newsreader.

SECOND GUESSING

Upon installation, Acadia forms a Windows program group containing five icons that give you access to FTP, mail (and mail configuration), and telnet (via VT320 emulation). You can also launch these applications from Acadia's front end, which is essentially a menu bar. From there you can also launch additional telnet emulations, PING, WHOIS, and TFTP (which runs in a DOS window). Although this front end is usable, it is not well designed. Its on-line help does no more than tell you how to get in touch with Ipswich. The commands on the menu bar appear to be listed in a random order; many functions or command variants don't appear on it at all.

A LITTLE BIT OF GOOD

Acadia's mail is basically easy to use, with a button bar controlling most of the functions you'll need. You can search, reply to, or forward messages, and you can create folders for convenient filing (although here folders are called "mailboxes," which is confusing). The Address book, however, is excessively complicated: You can't delete names without the help of an extra utility.

There are many mail-related options that let you, for example, use signature files, alter line lengths in both sent and received mail, and specify how you want to view mailed attachments. You can choose whether to remain continually logged onto your mail server or log on only when you want to check for new messages. Useful as these options are, unfortunately they are all mashed together in one large disorganized window. Also, like Acadia's front end, the mail application lacks any real on-line help.

EASY FTP

Acadia fares considerably better with its FTP program, which is handsome and uncluttered—even intuitive—and also has a real help screen. The application serves as a mini file manager for both your local computer and the remote site. You can create or delete directories and send files in either direction simply by double-clicking. Notepad serves as Acadia FTP's file viewer (although you can specify another), and you can launch executable files directly from within the FTP module.

Only a few telnet protocol options are available on Acadia's front end Access menu. Of these, the VT320 protocol is the most full-featured. It encompasses an attractive phone book that is easier to use than its mail counterpart, buttons for sending and receiving files under Kermit (but not under other common protocols like Xmodem or Zmodem), and extensive customization options.

When you install Acadia, a dialog box guides you through the process of entering all the proper information. Make a mistake, however, and you'll find yourself at a standstill because there is no clear way to correct it. There are some nonobvious ways—involving editing various text files with Notepad—but there's no way to know this short of calling tech support.

But the real drawback with Acadia isn't related to installation. The absence of search tools seriously limits Acadia's usefulness as an Internet research vehicle. These shortcomings provide ample reason to look at other packages.

FACT FILE

Acadia/VxD, Version 1.0

List price: Single user, $395; 5 users, $1,475. **Requires:** 4MB RAM, 6MB hard disk space, Microsoft Windows 3.1 or later. **In short:** Acadia has a good FTP program that can serve as a mini file manager for both your local computer and the remote site, making file management easy. But although Acadia/VxD has all the TCP/IP functionality a user would need, it offers only some of the expected Windows tools. Lack of any kind of a search tool seriously limits Acadia's usefulness as an Internet research vehicle. This shortcoming, combined with the fact that there is no newsreader, is ample reason to look at other packages before turning to Acadia.

Ipswitch Inc., 669 Main St., Wakefield, MA 01880; 617-246-1150; fax, 617-245-2975; e-mail, info@ipswich.com.

SUITABILITY TO TASK

	Power	Ease of Use
TCP/IP implementation	GOOD	FAIR
Mail/newsgroups	FAIR	FAIR
FTP/telnet	FAIR	FAIR
Search tools	N/A	N/A

447 on reader service card

Spry Inc.

EDITORS' CHOICE

AIR NFS

BY ANGELA GUNN

Of all the packages in this roundup, Spry's AIR NFS, Version 3.0, was by far the most complete. At a list price of $449 (sin-

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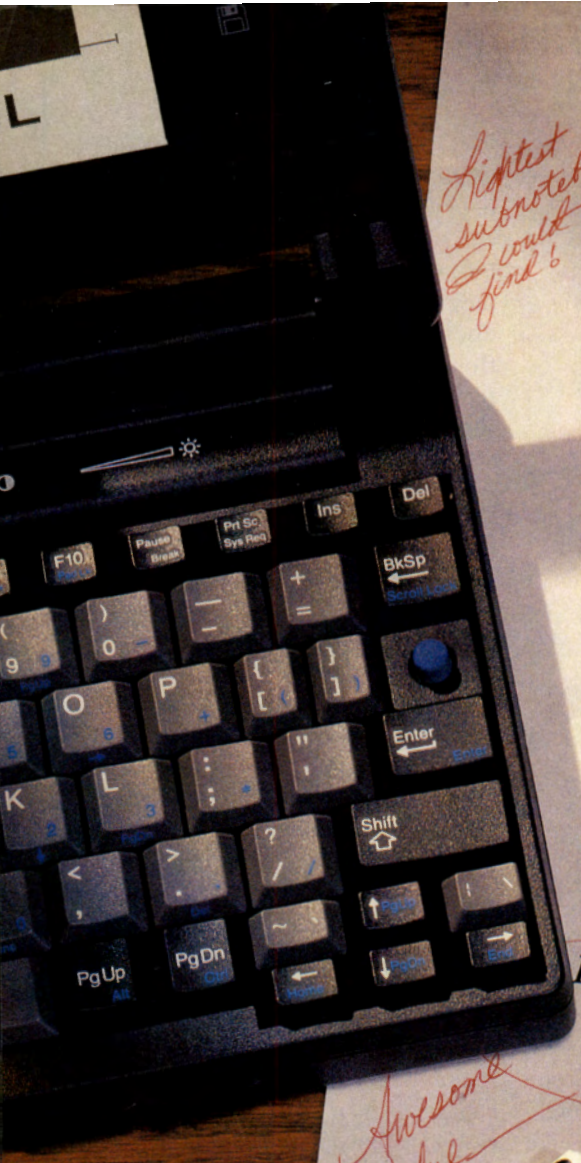

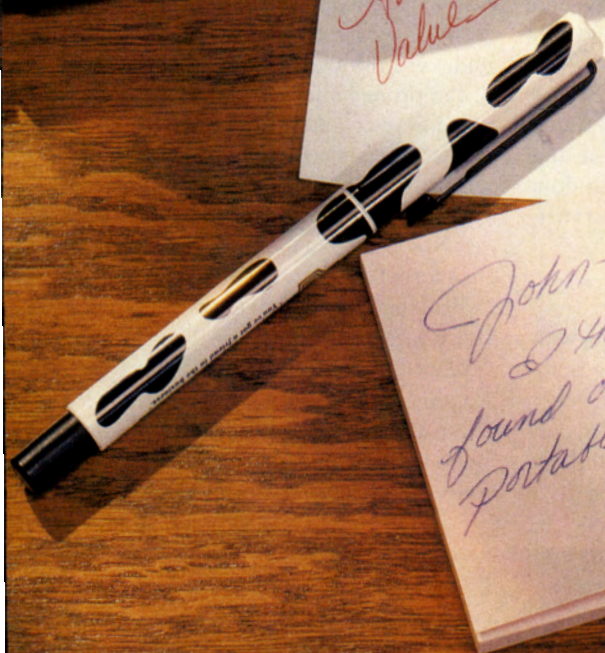



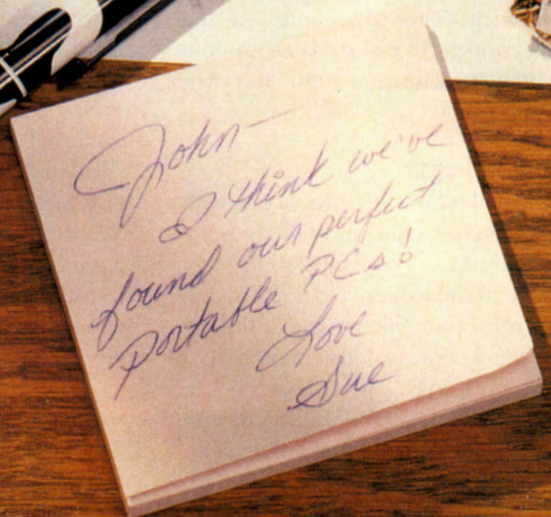

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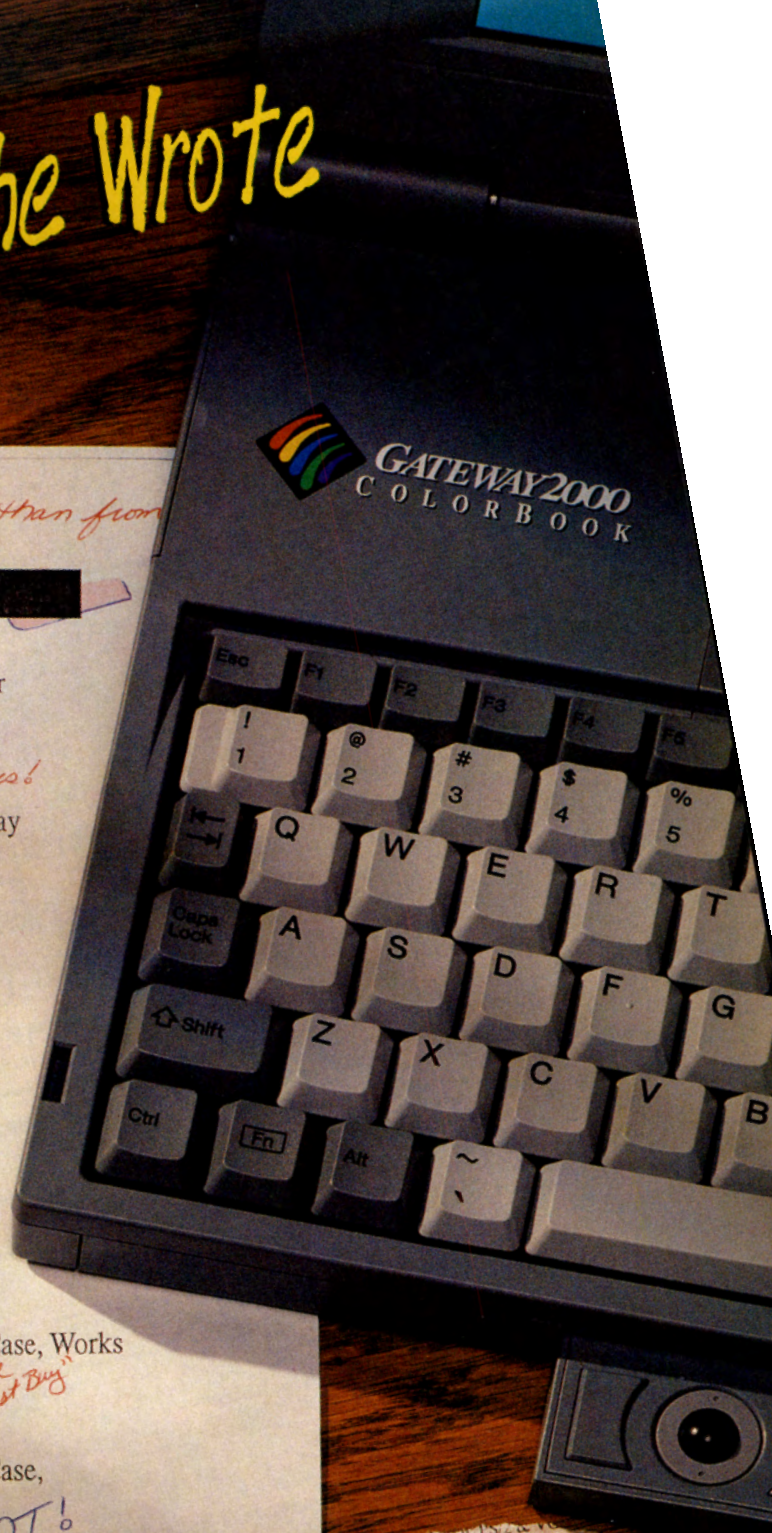

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Mosaic and Cello: *Freeware Gold*

If you have only one Internet tool, it should be a browser. These are the best so far.

By Kevin Reichard

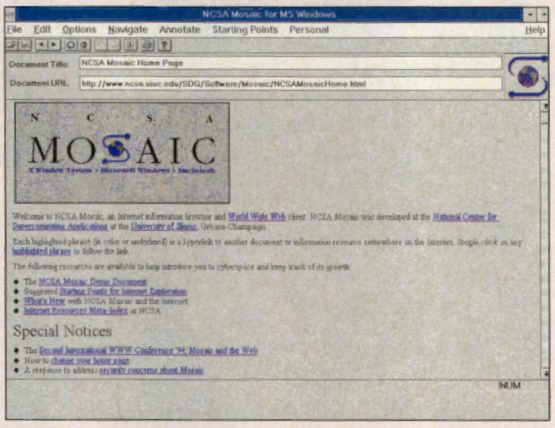
An Internet browser is the closest thing there is to a Swiss Army knife for the Internet. Browsers can grab documents from anywhere on the Net, treating even Gopher servers and Usenet groups as documents. Embedded hyperlinks lead you to related subjects; you can easily get lost in cyberspace following their paths.

The two best freeware Windows browsers are NCSA Mosaic for Windows (from the National Center for Supercomputing Applications) and Cello (from the Legal Information Institute at Cornell Law School). Both work with the Windows WINSOCK.DLL SLIP driver for access to the Internet through a service provider. Even at 14.4 Kbps, performance is acceptable.

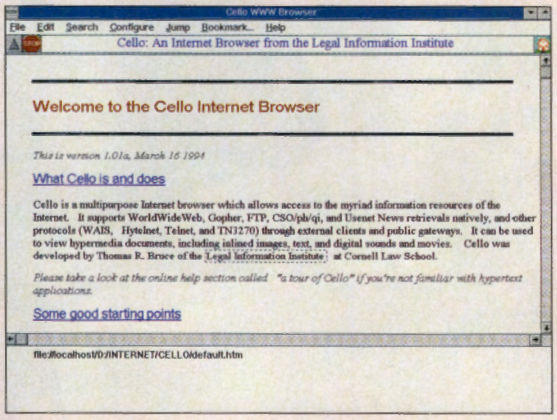
THE ORIGINAL

A snazzy combination of slick design and solid code (two traits not commonly found together in freeware), Mosaic has probably done more to popularize the Internet than any other single piece of software has. Mosaic is also becoming the most widespread Internet browser (it already dominates the Unix Internet world), as vendors like Spry, Quarterdeck, and others base commercial Windows products upon it.

When launched, Mosaic presents you with a highly useful Starting Points document, which contains concise explanations of Mosaic and the many tools available on the World-Wide Web, like directories of Web, Gopher, and FTP servers. (If you're familiar with specific Web servers, you can of course go directly to any of them at any point.) Highlighted phrases serve as hypertext "jump points" to other Web documents. Beginners will like the introductory documents that explain the intricacies of Internet navigation.



The first of a new generation of Internet tools, Mosaic has done more to popularize the Internet than any other tool.



Cello is more than just an Internet browser; it also offers FTP, mail, and telnet capabilities.

Mosaic also works well as a personal archiver of your Internet searches. For example, when you stumble upon a resource that you want to revisit, you can annotate the document either on a document hotlist or by direct placement on a pull-down menu. Arcane hyperlinks can be documented with lengthier explanations.

Beginners should probably stick to Version 1.0 since the most recent 16-bit version (Version 2.0, alpha 2) is considered a work in progress and lacks some basic features, such as help files. Both are available from *ftp.NCSA.uiuc.edu* in the */PC/Mosaic* directory, as is a 32-bit Windows alpha version.

THE NEWCOMER

Cello is an equally ambitious effort in terms of combining access to disparate Internet elements. Version 1.01a (which can be found at *ftp.law.cornell.edu* in the directory */pub/LII/Cello*) comes close to being the ideal single-source Internet tool: It supports native Web, Gopher, FTP, *CSO/ph/qi,* and Usenet News retrievals, as well as external tools for other protocols like WAIS, Hytelnet, and telnet. Cello also supports DDE, so you can link data from the Net to files created by any software application that also supports DDE.

Serious Internet users will probably resort to integrating other tools with Cello, since it lacks some important features (such as the ability to retrieve e-mail or post messages to newsgroups), and some of its other basic services, such as FTP, don't always work the way they should. In reality, Cello is still very much a development effort—not yet quite stable and lacking the visual polish of Mosaic. While it is still very much a work in progress, Cello is worth your attention. But if you want to dive immediately into the Net—no muss, no fuss—Mosaic for Windows may be a better starting point. □

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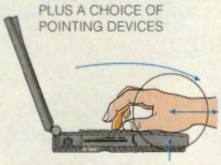

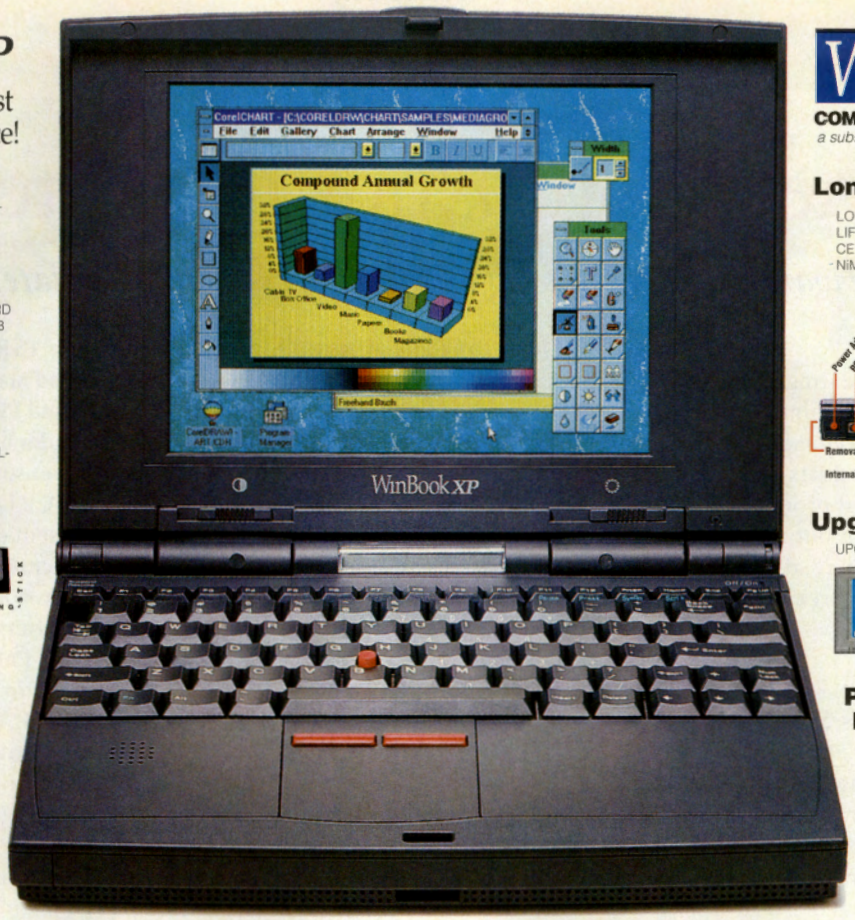

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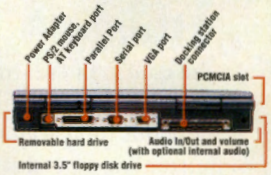

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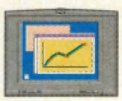

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PC MAGAZINE EDITORS' CHOICE™
August 1994
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CIRCLE 085 ON READER SERVICE CARD

Internet Front Ends to Watch For

Internet software tools are popping up all over. Here are some late poppers.

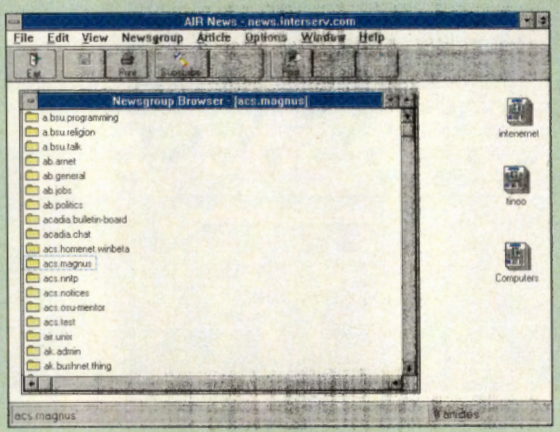
By Angela Gunn

In the course of creating this story, we received constant reminders of how rapidly this field is changing: Several important new products and major upgrades of current products weren't shipping in time for our review, but by the time you read this, many of them will already be on the market.

SPRY YOUNGSTER

As we went to press, Spry (Seattle, Washington; 800-777-9638) was putting the finishing touches on the long-awaited Internet in a Box. More than just a software package, Internet in a Box includes a specially revised edition of Ed Krol's classic *The Whole Internet User's Guide & Catalog* (for a review, see Read Only in this issue), along with AIR NFS 3.0 versions of mail, news, Gopher, telnet, FTP, and Mosaic modules; access to Spry's own news server; and a subscription to *GNN*, the Internet on-line magazine. Expect to see the package both in traditional computer stores and in up-to-date bookstores.

The 3.0 upgrade of Spry's AIR NFS package has seen significant improvement, too. Changes to the newsreader, for example, let you sort messages by several criteria including author, topic, and size.



Internet-in-a-Box's newsreader allows you to build your own personal collections of newsgroups.

FTP PLUS

The new 32-bit PC/TCP OnNet package from FTP Software (North Andover, Massachusetts; 508-685-4000) was among those not quite ready in time for our review. This product uses a Windows VxD instead of the earlier version's TSR drivers, and handles telnet and mail (SMTP, VMAIL, POP2, and POP3). It has an NNTP newsreader and includes FTP client and server support.

PC/TCP OnNet also runs under most major network operating systems, including NetWare, Microsoft LAN Manager, IBM LANserver, Banyan's VINES, DEC Pathworks, Microsoft Windows for Workgroups, and Artisoft's LANtastic. PC/TCP OnNet also provides a significant level of Kerberos security.

ACCESS PACKS

Finally, many users have chosen to get their Internet access through one of the on-line services. Delphi has been particularly aggressive about offering wide-ranging access to the Net; currently the company is bundling its Internav Windows front end as part of the Phoenix Complete Internet Start-Up Kit, from Phoenix Technologies (Chicago, Ilinois; 312-541-0260). Like Internet in a Box, this package is more than just software; it includes guides both to Delphi and to

gle-user NFS product), AIR provides all the tools required for a foray into the folds of Internet space. Applications include mail, telnet, a newsreader, FTP (both server and client), a Gopher client, and the first commercial release of NCSA's GUI Web browser, Mosaic. The package also has a uu (Unix-to-Unix) encoder-decoder and a graphics viewer. AIR offers two TCP/IP options, one licensed from Microsoft and the other from Novell.

AIR NFS supports PPP connections. With one double-click on an icon, you can switch between a direct and a PPP connection. You can also set the package to invoke the dialer automatically when you launch any application.

MODULE FOR MODULE

The applications—Gopher, telnet, mail, FTP, and Mosaic—are well chosen and complete. Particularly impressive is the graphical FTP client, which opens Windows' File Manager along with a File Manager–style view of the remote server. File transfers are as simple as drag-and-drop. By default, the package truncates long filenames at eight characters and warns you when you're in danger of overwriting files already on your machine.

The mail module supports both POP3 and SMTP, as well as the ability to work off-line. Spry has also added nested folders since the last release, which, along with the editor and the mail sorting features, are exceptional parts of this module.

The newsreader is even more successful than the mail module, letting you view messages sorted by thread, subject, size, and date. You can easily subscribe to groups and round up your selections into personalized subgroups. It is also simple to post, follow up on, and quote from messages, and to include signature files. Another useful addition is the ability to filter message and mail headers down to those categories that interest you.

ARBOREAL GOPHER

AIR's Gopher uses a graphical tree interface much like The Pipeline's. Navigation is easy, and you can set up the application to go to a particular site automatically at

the Net itself, as well as 10 free hours on-line—certainly enough for new users to get their toes wet.

TURBULENT MARKET

Why so volatile, this market? In part, because no one knows quite how connections to the Net will be made in a year or so. Where once Microsoft couldn't be convinced to support modems faster that 2,400 bps, the company is now building both TCP/IP and PPP support into Chicago and Windows NT 3.5 and has assigned at least one person to work directly with Internet service providers. Not to be outdone, both Novell and IBM are rumored to be including World-Wide Web browsers in upcoming versions of LAN WorkPlace and OS/2 for Windows.

Mosaic, rapidly becoming the most widespread Internet browser, has caught the fancy of a number of providers. NCSA Mosaic, the original version, has been licensed far and wide to commercial companies, and NCSA continues to develop the program in conjunction with Spyglass (Savoy, Illinois; 217-355-6000).

Expect other, non-Mosaic World-Wide Web browsers to make waves soon. Jim Clark's new company, Mosaic Communications, is a likely source, and it's thought that Novell's WWW browser will not be particularly Mosaic-like. □

startup. You can also automatically associate file types with different applets for viewing images or listening to sound files.

Telnet rarely provides much interface excitement, and AIR's telnet is no exception. Still, it can automatically save the addresses of new sessions to a pick list, and you can customize and launch sessions via their own icons.

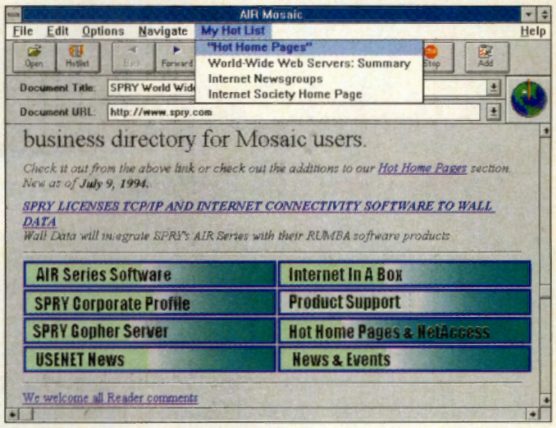
One of the most important inclusions in AIR is AIR Mosaic, a licensed version of the popular Mosaic developed by NCSA. This version is significantly improved over the current 16-bit Windows version (1.0) of shareware Mosaic, though a 32-bit Windows version is expected soon. For one thing, AIR Mosaic lets you print. You can also customize the hotlist and even add it to the menu bar. AIR Mosaic supports what is called *kiosk mode*, in which you lose the top portion of the application and deal directly with the screen options only.

AN OBSTACLE OR TWO

Although Spry has made great strides in usability, the user is still not isolated from the complexities of setting up the TCP/IP portion of the product. But, like many of the products in this roundup, AIR includes a complete worksheet of the information you will need. Once this information is collected, installation should proceed peacefully. The package provides clear directions for plugging in individual items such as the addresses of your workstation, router, and DNS server. You choose which applets to install via a Windows radio-button screen.

During installation, we found that we were unable to recover from mistakes: When we mistyped an IP address, for example, we tried to correct our gaffe by the recommended expedient of opening the appropriate file using an editor and retyping the setting. However, this requires expert knowledge, and the novice might be better off simply reinstalling the package. Spry does provide several handy samples—typical versions of configuration files such as NET.CFG—for troubleshooting the installation process. Users can refer to these—and even cut and paste sections of code from them—when complications arise.

As one of the first of the new generation, AIR is by far the most extensive product we reviewed. Except for the complication in setting up the TCP/IP stack, it was very easy to use. We feel confident in recommending AIR for those ready to make the Internet connection.



The Mosaic tool in Spry's AIR NFS lets you add your own hotlist to the main menu bar.

▶ FACT FILE

AIR NFS, Version 3.0

List price: Single user, $499; 10 users, $2,300. **Requires:** 4MB RAM, 3MB hard disk space (additional 3MB required for the Novell TCP/IP transport and utilities; additional 500K for Microsoft transport), Microsoft Windows 3.1 or later. **In short:** Spry's AIR NFS 3.0 provides the most comprehensive set of Internet access tools of all the packages reviewed here. AIR is easy to use because of its well-designed interface and its automatic connections to Spry's news, Gopher, and Web servers. It also includes AIR Mosaic, the first commercial release of NCSA's GUI Web browser.

Spry Inc., 316 Occidental Ave. South, Seattle, WA 98104; 800-777-9638, 206-447-0300; fax, 206-447-9008; e-mail, info@spry.com.

SUITABILITY TO TASK	Power	Ease of Use
TCP/IP implementation	EXCELLENT	FAIR
Mail/newsgroups	GOOD	GOOD
FTP/telnet	GOOD	GOOD
Search tools	EXCELLENT	EXCELLENT

448 on reader service card

NetManage Inc.

• ChameleonNFS for Windows

BY ERIC BERLIN

NetManage's $495 ChameleonNFS for Windows, Version 4.0, has everything the usability-conscious Internet surfer could want. It includes a TCP/IP stack, a generous selection of Internet applications (Gopher, NFS, client and server FTP, and mail), and buttons galore to make those applications easy to use. Moreover, pop-up dialogs ease installation. In fact, ChameleonNFS has such a polished appearance that its imperfections come as a bit of a surprise.

THE WHOLE SHEBANG

The package's scope is evident in the whopping number of available icons (24). These include FTP, Gopher, mail, and

Riding the Internet for Free

Why buy software when you can have it for the price of a phone call?

By Kevin Reichard

Considering that the Internet grew out of many people's free contributions of time and effort, it should come as no surprise that a number of useful Internet software tools are given away. Browsing on-line, you can easily build your own cost-free suite of Internet tools.

We say *suite* since there's no single freeware package that's likely to address all of your Internet needs. (*Freeware,* by the way, is software given away free of charge. *Shareware* is software for which the developer asks for a registration fee.) You'll typically use one tool to connect, another to grab your Internet mail, and still another to read the postings from Usenet newsgroups.

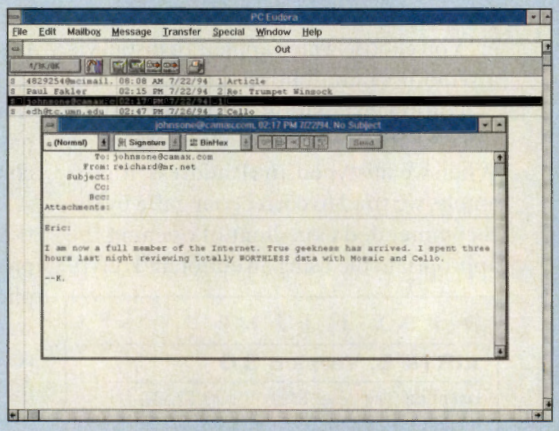
Just about every program we look at here is available on CompuServe or on the Internet itself. (The archives at *ftp.cica.indiana.edu* in the */pub/pc/win3/winsock* directory contain most of the tools listed here. We specify alternate FTP sites where they exist.) All of these tools can be used on direct serial-line connections to the Internet, as they are all Winsock 1.1–compliant. All are freeware—except for Trumpet Winsock, whose developer asks for a $20 registration fee—and all run under Microsoft Windows 3.1.

MAKING THE CONNECTION

One tool that's essential for all users is a SLIP (Serial Line Interface Protocol) manager, which allows you to call an Internet provider's server via a modem and phone line. Trumpet Winsock is one of the most popular shareware SLIP managers; it facilitates the initial connection through dial-up scripts and then continues to manage the connection for other programs.

Trumpet uses the Windows WINSOCK.DLL TCP/IP driver, which then allows other applications to write directly to the DLL. You can find the most recent version of Trumpet (1.0a) at *ftp.utas.edu.au* in the */pc/trumpet/wintrump* directory and on many commercial on-line services.

Once it's up and running, Trumpet is reliable and unobtrusive. Getting it running is challenging, however, even for experienced Internet users. The trick lies in getting Trumpet to match the IP address of the server you're calling. The solution is to parse the correct address from the server's output, but to do this, you need to use a log-on script, and the sample script that's provided simply doesn't work. If you plan on using Trumpet, be prepared to master the obscure and poorly documented scripting language. You'll need to factor in some configuration time before you actually get on the Internet.



Tracking your messages—short and long—is a snap with the top-notch newsreader PC Eudora.

OTHER TOOLS

Beyond the general-purpose browsers is a slew of more specialized Windows freeware tools. Take the ever-popular Gopher programs. WSGopher, Version 1.0 (available on *boombox.micro.umn.edu* in */pub/gopher/windows*), is a useful Gopher implementation that has been configured with most of the popular Gopher servers. It also comes preconfigured for Gopher resources, such as Gopher Jewels and Usenet newsgroups.

Are you looking for an FTP program? WS_FTP (at *ftp.usma.edu* in the */pub/msdos/winsock.files* directory) comes preconfigured for downloading most of the programs listed here.

Live chat over the Internet in the form of Internet Relay Chats (IRCs) has become popular, thanks to coverage in the mainstream press. And despite the general focus of some of that coverage, not all IRCs appeal to prurient interests; at times, IRCs can be fascinating. A good tool for accessing IRCs is WSIRC (found at *cs.bu.edu,* also available in several CompuServe forums).

For Usenet newsgroups, WinVN connects directly to an NNTP server and lets you read and write postings. It's not fancy, but it works quickly and reliably. You can find it at *newstitan.ksc.nasa.gov* in the */pub/win3/winvn* directory.

Finally, two noteworthy Winsock-compliant mail readers are PC Eudora (found at *ftp.qualcomm.com* in */pceudora/windows*) and Pegasus Mail for Windows (available on CompuServe). Both can track sent and received mail and require only a minimal amount of effort on your part. Version 2.0 of Eudora is available commercially for $65 and is arguably the best Internet mail reader. The free version is 1.4, and though it's a few features short, it's still a fine program worth adding to your software collection. □

three different telnet modes. There's also NEWTNews, a Usenet newsreader, but you'll have to find a news server to use it because ChameleonNFS doesn't provide one. NEWTNews is easy to use: Click on the newsgroups you want to subscribe to, and then click on those you want to read. Messages are organized only in order of appearance, however, so following message threads is not as easy as it could be. Also, you can't conduct keyword searches for specific messages in busy newsgroups. Saddled with these limitations, NEWTNews falls short of being a serious research tool.

The setup for mail isn't as easy as the general installation, but once you get all the mailboxes set up via the Postmaster function, mail is simple and efficient. There is support for signature files, and you can save your mail in folders and organize your incoming mail by date, subject, and sender. The simple address book has no place for notes, just addresses. Our one complaint: Outgoing mail must be completed and sent in one sitting; you can't save drafts in a folder for later completion.

The interface to ChameleonNFS's FTP client may appear confusing at first, as it provides no fewer than 18 task buttons, none of which is marked *Send* or *Receive*. But you'll eventually figure out, as we did, that because the FTP program serves as a miniature File Manager (for your own local files and those at the remote site), it's the Copy button that activates file transfers. Alternatively, you can drag and drop file icons to their proper destinations. ChameleonNFS also provides an FTP server, which lets other users log on to your machine. You can monitor your FTP site, grant or deny access, and set up specified users for read-only status, all with a few mouse clicks.

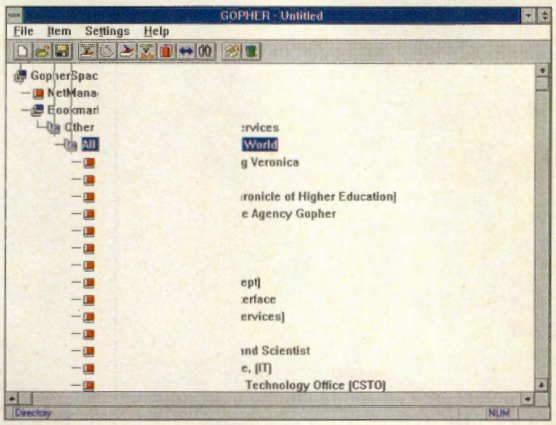
JUST SHORT OF PERFECTION

ChameleonNFS's Gopher program is slanted more toward searching for a particular topic than general Internet surfing. Traveling through the Gopher server is simply a matter of knowing which icon to click on: Little red books indicate branches off the main hierarchy; computer terminals indicate telnet sites; pages indicate viewable text files. The screen is cluttered in its default mode, which duplicates Gopher entries on both sides of a split screen, but you can easily minimize one of the windows to make everything readable. A far more serious problem is revealed when you click on "All the Gopher Servers in the World." You get a gigantic mess of cut-off Gopher entries and unconnected hierarchy lines—a nasty bug activated when the Gopher program is overloaded with information.

You can use telnet in a wide variety of terminal emulation modes, and you can create and alter log-on scripts from within the program. But as with many other aspects of ChameleonNFS, telnet stops short of perfection: You can keep a log of your telnet session, but you can't scroll back in an active session to get the e-mail address that went flying by, for example.

Setup is a mixed bag. Although the package provides friendly dialog boxes that prompt you for information needed during installation, not all of the relevant info is requested. The Default Gateway and the DNS servers are skipped over entirely, making it easy to forget that this info is often critical for a trouble-free connection.

ChameleonNFS (and its sibling dial-up–only product, Internet Chameleon) compensates for its imperfections with some nifty special features. The Diagnostic Center, for example, can capture every TCP/IP packet entering or exiting your computer. You can have NetManage analyze the data, or you can buy the company's NEWTTrace application to do so.



When you try to scan all the Internet's Gopher servers, you will find that ChameleonNFS's interface isn't up to the task.

ChameleonNFS's tools, while not as good as the best in their categories, make up a well-rounded kit for users who need a jump-start to the Internet. The package is worthy of notice not only for its thorough suite, but also for its reasonably successful GUI implementation.

▶ FACT FILE

ChameleonNFS for Windows, Version 4.0

List price: Single user, $495. **Requires:** 6K RAM, Microsoft Windows 3.1 or later. **In short:** ChameleonNFS for Windows has everything the usability-conscious Internet surfer could want, including a slew of icons and a generous selection of Internet applications. Applications include Gopher, NFS, client and server FTP, and mail. While the package has a polished appearance, it is nonetheless plagued by several imperfections. On the whole though, it's a good choice.

NetManage Inc., 10725 N. De Anza Blvd., Cupertino, CA 95014; 408-973-7171; fax, 408-257-6405; e-mail, support@netmanage.com.

SUITABILITY TO TASK	Power	Ease of Use
TCP/IP implementation	GOOD	FAIR
Mail/newsgroups	GOOD	GOOD
FTP/telnet	GOOD	GOOD
Search tools	GOOD	GOOD

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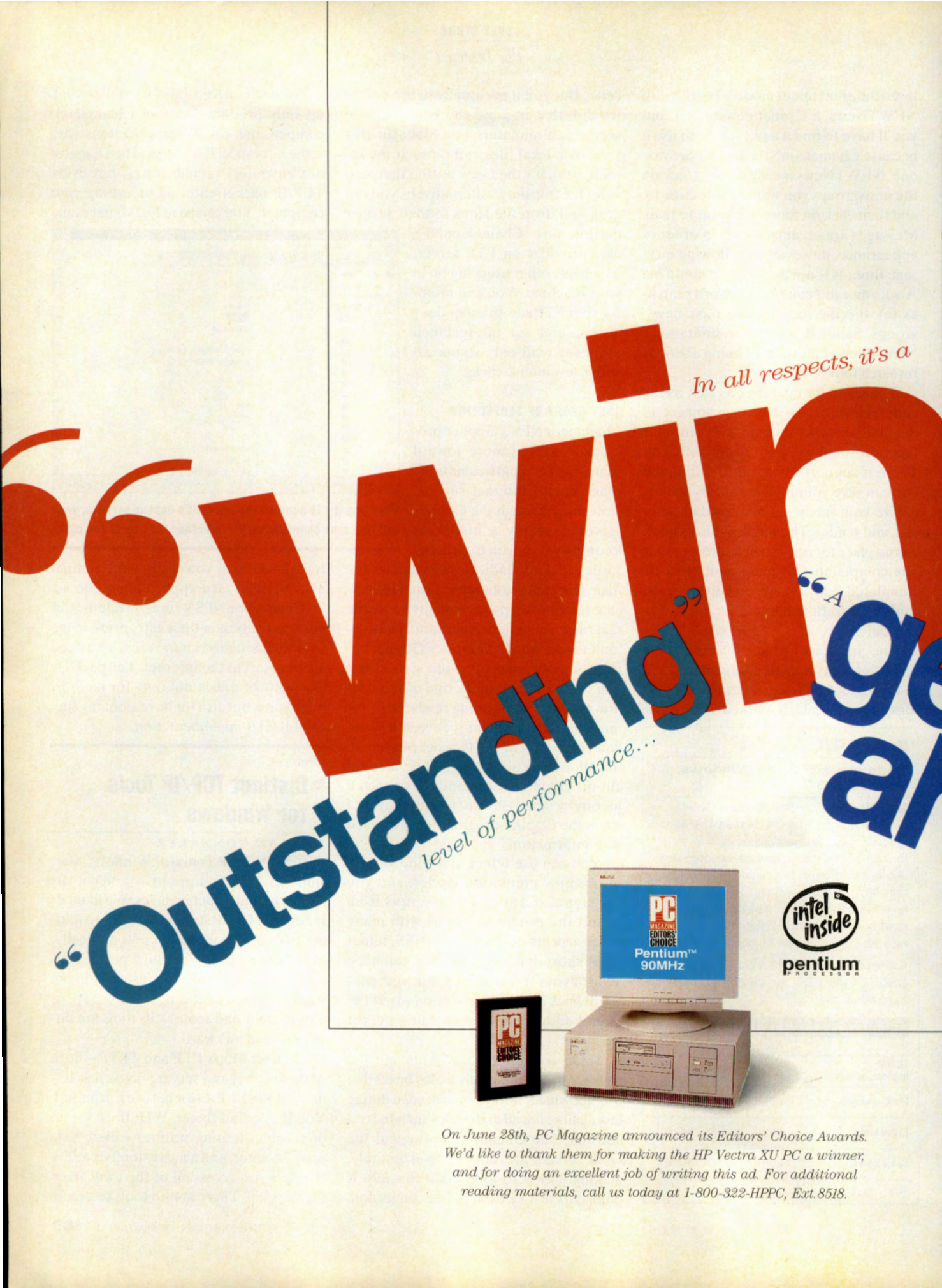
Distinct Corp.

● Distinct TCP/IP Tools for Windows

BY SEAN GONZÁLEZ

Distinct TCP/IP Tools for Windows, Version 3.21 ($395), surprised us with both its strengths and its deficiencies. We liked its seamless TCP/IP stack and ability to initiate a TCP/IP connection automatically, even when used with third-party Winsock-compliant tools. But installation can be difficult and confusing even for experienced users, and some of its tools are unreliable and awkward.

Distinct offers FTP and TFTP—both of them client and server—as well as telnet and LPD/LPR (for network printing). You'll also find finger, WHOIS, a group of troubleshooting utilities called Network Monitor, and a handy toolbar utility that lets you access all of the tools from the desktop. There are no tools to access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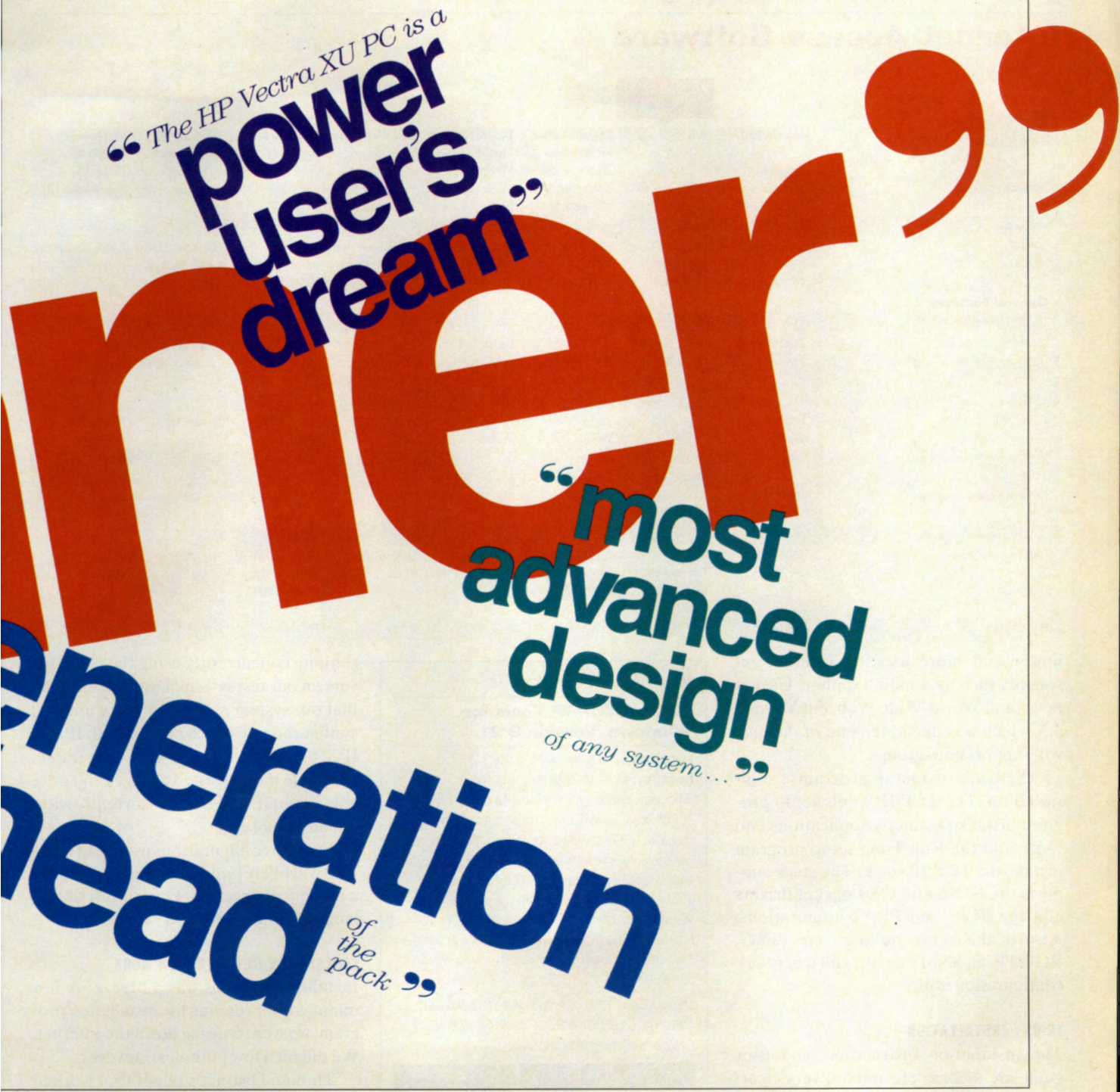

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▶ SUMMARY OF FEATURES

Internet Access Software

PC MAGAZINE EDITORS' CHOICE

Products listed in alphabetical order	Acadia/VxD	AIR NFS	ChameleonNFS for Windows	Distinct TCP/IP Tools for Windows	LAN WorkPlace for DOS	Pathway Access for Windows	SuperTCP/NFS for Windows	WinGopher Complete
List price	Single user, $395; 5 users, $1,475	Single user, $449; 10 users, $2,300	Single user, $495; 5–9 users, $4,440	Single user, $395; 5 users, $1,200	Single user, $395; 10 users, $1,995	Single user, $350; 5 users, $1,995	Single user, $495	Single user, $129
Interface	Windows	Windows	Windows	Windows	Windows	Windows	Windows	Windows
Support	CompuServe, e-mail, fax, toll call, on-line help	BBS, e-mail, fax, toll-free call, on-line help	BBS, e-mail, fax, toll call, on-line help	BBS, e-mail, fax, toll call, on-line help	CompuServe, fax, toll-free call, on-line help	BBS, e-mail, fax, toll call, on-line help	BBS, CompuServe, e-mail, fax, toll call, on-line help	E-mail, fax, toll call, on-line help
General Features								
TCP/IP implementation	VxD	DLL	DLL	DLL	TSR	TSR	VxD	DLL
Connections supported	Direct, SLIP, PPP	Direct, SLIP, PPP	Direct, SLIP, PPP	Direct, SLIP, PPP	Direct	Direct, SLIP, PPP	Direct, SLIP, PPP	Direct, SLIP, PPP
TCP/IP applications included	FTP	FTP, telnet	FTP	FTP, telnet, TFTP	FTP, telnet	FTP	Fax, FTP, NFS, telnet, TFTP	None
TCP/IP utilities included	Finger, PING, WHOIS	Finger, PING, WHOIS	Finger, PING, WHOIS	Finger, PING, WHOIS	Finger, PING, WHOIS	Finger, PING, WHOIS	Finger, PING, WHOIS	Finger, PING, WHOIS
Internet applications included	Mail	Gopher, mail, Mosaic, news	Gopher, mail, news	None	None	Mail, news	Mail, news	Gopher
Server applications included	FTP, NFS, telnet	FTP	FTP, mail, NFS	FTP, TFTP	DNS, FTP	FTP, mail, NFS	Fax, FTP, mail, NFS	None
Servers supported by vendor	None	Gopher, news	Gopher	None	None	None	None	Gopher
Terminals emulated	ANSI, VT102, VT320	NetWare Virtual Terminal, TN3270, VT52, VT100, VT200	ANSI, TTY, TVI950, TVI955, VT52, VT100, VT220	VT100, VT220	TN3270, VT52, VT100	VT100, VT220, VT240, VT320, VT340, TN3270	TN3270, TTY, VT320	VT52, VT100, VT220
Scripting language	FTP, telnet	SLIP, PPP	Telnet	SLIP, PPP	Telnet	FTP, telnet	SLIP, PPP	None

newer and more exciting Internet resources such as e-mail, Gopher, Usenet news, and World-Wide Web, but Version 3.3, which was due at the end of August, will support newsgroups.

There are two setup programs for installation. The TCP/IP Tools setup program installs Distinct's applications and tools, and the Run Time setup program installs the TCP/IP stack. The stack supports the NDIS and ODI packet drivers and the SLIP and PPP configurations. Also in this setup program are PING, BOOTP, an SNMP agent, and a network configuration utility.

TRICKY INSTALLATION

The installation instructions and user guide are incomplete and not very clear. Depending on your system configuration, you may need to contact Distinct Corp. for assistance (fortunately, the company's technical support staff is excellent). According to Distinct, the installation program in Version 3.3 will be more user-friendly.

We were initially unable to get both NetWare and the Distinct TCP/IP stack running concurrently using the ODI drivers on our test system. Distinct observed that our system required a "very unusual configuration," which needed both IP and IPX bound to a single Ethernet frame. We made the suggested changes and were able to run IP and IPX concurrently without any problems.

Dial-up configurations using SLIP and PPP will likely require a script to establish a modem connection. Distinct's scripting language is intuitive and easy to use.

TOOLS: EASY SETUP, ROUGH WORK

Installing the tools was a breeze. A few minutes after running the installation program, we were cruising down the Internet. We did hit a few potholes, however.

Though Distinct's telnet tool worked well, the FTP client tool is nonstandard and confusing, and we found it slow and difficult to use. You need to know what OS and FTP server software are running at the remote site (as well as the version number of the server software). Once running, the FTP client shows remote files and directories in two separate windows. This is a nice feature, but it takes a long

▶ FACT FILE

Distinct TCP/IP Tools for Windows, Version 3.21.

List price: Single user, $395; 5 users, $1,200.
Requires: 4K RAM, 2MB hard disk space, Microsoft Windows 3.1 or later. **In short:** Distinct TCP/IP Tools for Windows has all the tools you need for basic TCP/IP connectivity. It lacks, however, the tools to access today's exciting e-mail, Web, Gopher, and Usenet News Internet resources. If you are already an Internet user and all you want is a good Winsock-compliant stack to run your favorite Internet-access tools, then this product will suit the task. Otherwise, you are better off looking someplace else.

Distinct Corp., 12901 Saratoga Ave., P.O. Box 3410, Saratoga, CA 95070; 408-366-8933; fax, 408-366-0153; e-mail, mkgg@distinct.com.

SUITABILITY TO TASK

	Power	Ease of Use
TCP/IP implementation	GOOD	POOR
Mail/newsgroups	N/A	N/A
FTP/telnet	GOOD	FAIR
Search tools	N/A	N/A

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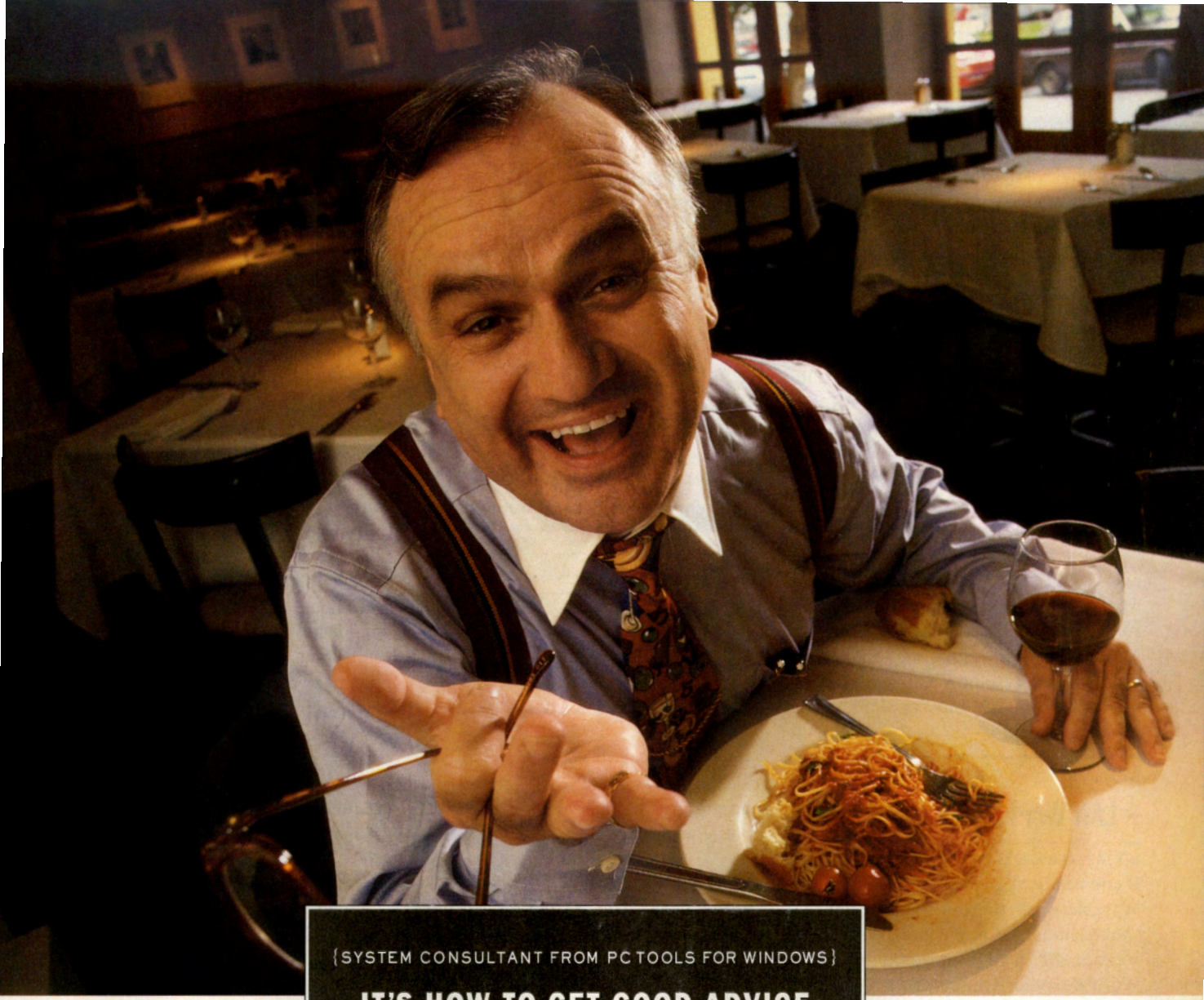

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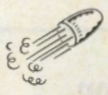

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time to update the display if you are connected to a server that has many files.

If you want to share resources with others, you will appreciate the FTP server and LPD tools. With them we were able to make both drives and printers available to remote Internet systems.

The PING and Network Monitor utilities will prove useful in troubleshooting connectivity problems. For getting information about users on remote hosts, Distinct includes finger and WHOIS. We found that finger worked well and was easy to use, but Distinct documented the identity of the default WHOIS servers only in an addendum, so access to it was difficult at first.

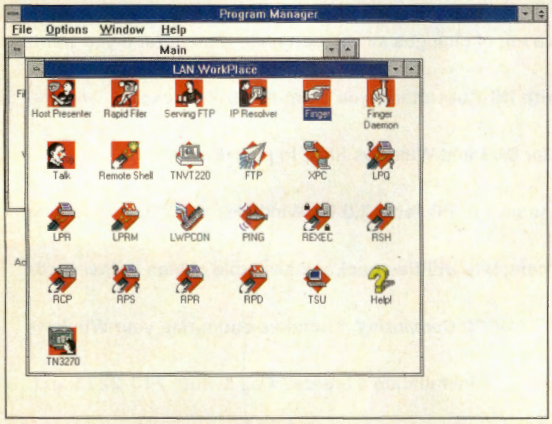
While Distinct has created a reliable and robust stack that makes launching TCP/IP applications simple and effortless, some of its tools need to be revised. If you are looking for the all-in-one product that gives you everything you need to access all of today's Internet resources, this probably isn't it.

Novell Inc.

• LAN Workplace for DOS

BY ANGELA GUNN

If you're not already connected to a NetWare network, there is no particular reason to choose LAN Workplace for DOS, Version 4.2. And even if you are a NetWare devotee, you can probably get a better Internet front end than this $395 package, not to mention one that's more attractive and efficient. LAN Workplace provides TCP/IP connectivity, as well as a few useful utilities and sturdy albeit basic and unexciting Internet client applications (telnet and FTP). Though the package supports Gopher and Web-browsing tools, the package does not include them.



LAN Workplace for DOS provides many Windows icons, but most of them are simply links to DOS applications.

FACT FILE

LAN Workplace for DOS, Version 4.2

List price: Single user, $395; 10 users, $1,995. **Requires:** 512K RAM, 5.5MB hard disk space, Microsoft Windows 3.0 or later. **In short:** LAN Workplace for DOS provides TCP/IP connectivity and some basic Internet tools, but it does not include the more sophisticated tools such as Gopher and a Web browser. Even if you are devoted to NetWare, chances are you can find a more suitable (not to mention more attractive and efficient) Internet front end.

Novell Inc., 122 East 1700 South, Provo, UT 84606-6194; 800-638-9273, 801-429-5588; fax, 801-429-5155; e-mail, ftp@novell.com.

SUITABILITY TO TASK

	Power	Ease of Use
TCP/IP implementation	GOOD	FAIR
Mail/newsgroups	N/A	N/A
FTP/telnet	GOOD	FAIR
Search tools	N/A	N/A

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SEEING RED

Once you're set up, the program adds a program group to Windows and deposits more than a dozen Novell-red icons therein. As you might expect from the company that rules the office connectivity market, most of the package's functions are skewed toward the needs of WAN connectivity.

For instance, you're unlikely to find such a comprehensive collection of remote printing options in any other package on the market. In a similar vein, the package has a decent FTP server and even allows you to set up as a finger server or a DNS.

Casual Internet users, however, may be dissatisfied with LAN Workplace's offerings, which include FTP and telnet, as well as finger, PING, and WHOIS. (Finger lets you find out information about a particular user. Also, some sites on the Internet—certain weather-info places, for instance—are reached mainly by finger. WHOIS lets you check a host to see if it has a user by a particular name. PING allows you to see if another IP address is on-line.) LAN Workplace's telnet and FTP are sturdy—we couldn't crash them—but unremarkable. They're Windows applications only by virtue of the fact that they run in their own windows.

Though many of its components operate under Windows, LAN Workplace must be installed from the DOS prompt. Installation is not too painful, although certain NetWare conventions—using the Esc key rather than the Enter key to choose options and progress through the setup, for instance—will disconcert anyone unaccustomed to the Novell way of doing things.

Like many of the packages we looked at, LAN Workplace includes a useful installation guide that lists the various pieces of information you'll need to collect in order to get started. The program installs all its utilities at start-up; there's no picking and choosing.

BEYOND THE RED HORIZON

Novell knows that changes are necessary to keep up in this volatile market. By the time you read this, LAN Workplace will include a special-offer coupon for Ameritech Library Services' WinGopher, which, if purchased, will simultaneously add Gopher capabilities and the package's first truly graphical component.

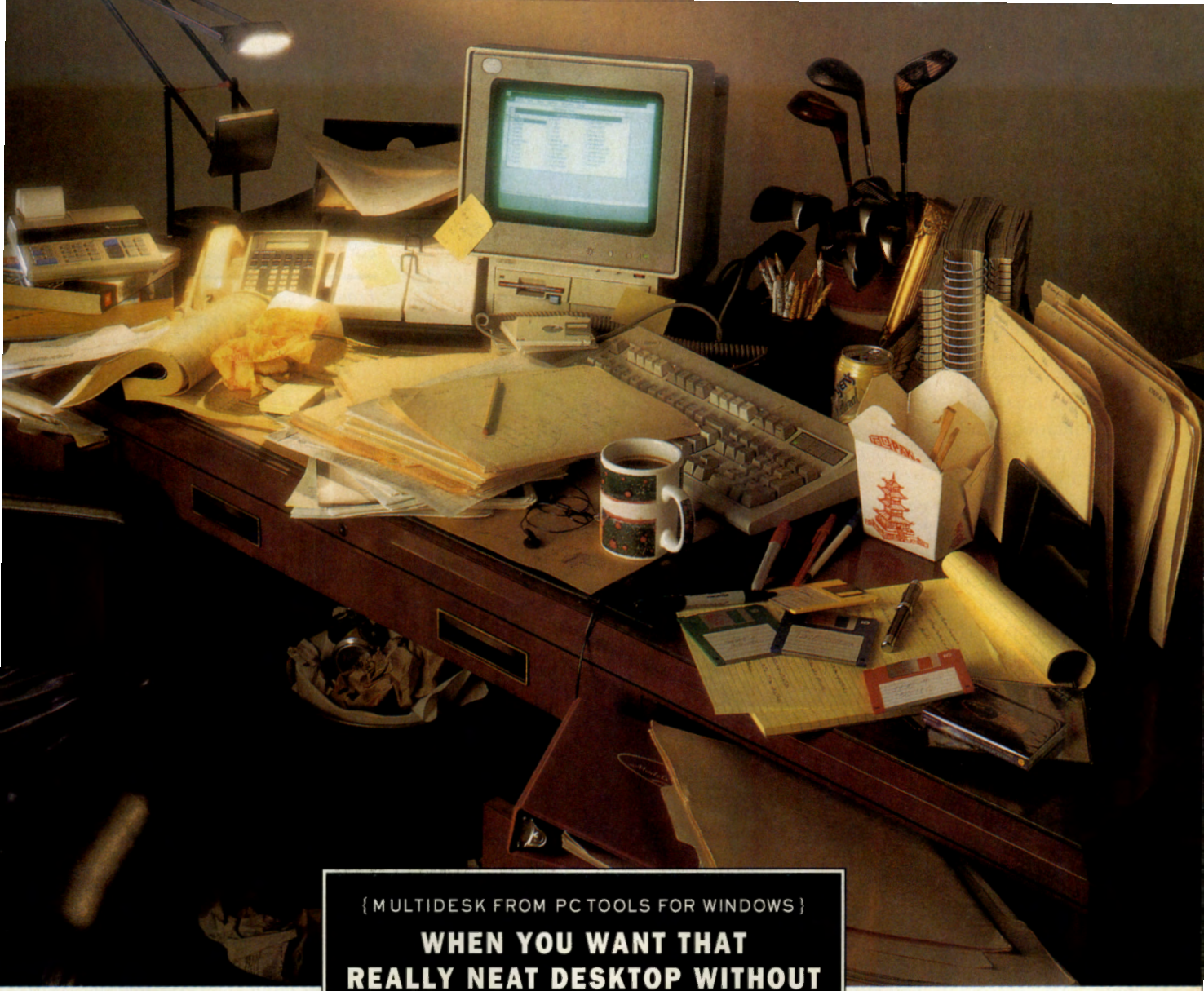
Beyond that, expect to see a mail reader, a Web browser, and perhaps a newsreader in subsequent releases of Novell's sturdy red suite. But if you need those features immediately, there are more comprehensive packages around, any one of which might make a better choice—even if you already run NetWare.

The Wollongong Group Inc.

• Pathway Access for Windows

BY ERIC BERLIN

It's tough not to be intimidated by this $350 TCP/IP package. After all, there are eight manuals representing three programs: Pathway Access for Windows, Version 3.0; its DOS counterpart; and Pathway Runtime, which installs the TCP/IP kernel. But if you're not bowled



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CIRCLE 002 ON READER SERVICE CARD

over by all the documentation—and all the accompanying disks—there are lots of reasons to be pleased.

Pathway hooks you up to mail (which includes a combined mail client and newsreader), two telnet terminal emulations, and an attractive FTP application that lets you transfer files from a remote server by using drag-and-drop. (You can change the transfer mode from ASCII to binary by clicking a button, although it would be ideal if the program automatically identified which mode would be most appropriate.) FTP also allows for scripting, so you can automate regular file transfers. For a final gold star, the package lets you stop an erroneous command before it finishes processing.

FACT FILE

Pathway Access for Windows, Version 3.0

List price: Single user, $350. **Requires:** 640K RAM, 1MB hard disk space, Microsoft Windows 3.1 or later.
In short: Pathway Access for Windows features plenty of applications to play with, such as mail, two telnet protocols, and FTP. Unfortunately, it lacks a Gopher. The package comes with its DOS counterpart, Pathway Access for DOS, and Pathway Runtime, which installs the TCP/IP kernel. Pathway is unremarkable, but it's adequate for aspiring Internet cruisers.

The Wollongong Group Inc., 1129 San Antonio Rd., Palo Alto, CA 94303; 800-872-8649, 800-962-8649; fax, 415-962-0286; e-mail, sales@twg.com.

SUITABILITY TO TASK	Power	Ease of Use
TCP/IP implementation	GOOD	FAIR
Mail/newsgroups	GOOD	FAIR
FTP/telnet	FAIR	FAIR
Search tools	N/A	N/A

452 on reader service card

THE POSTMAN RINGS OCCASIONALLY

Pathway's combined mail/newsreader program is handsome and easy to use, with big buttons for sorting old mail and creating new mail, accessing the address book, and reading Usenet News. A source of confusion here, however, is the Get New Messages command, which was grayed out of the menu bar. You might reasonably take this to mean that you can't get your new messages. It took us a little while to figure out that using the big "Inbox" button is the primary way to poll for new mail.

Pathway mail's newsreader keeps all of the newsgroups you follow in a concise list, so you can read all of them in one session or save some for later. Though subscribing or unsubscribing is simply a matter of clicking on the desired newsgroup, you have to *find* that newsgroup first—among the thousands available. It would be better if the Subscribe Newsgroups command could search across hierarchies (*alt., rec., news.*, and so on) for a given topic; instead, you must go through the hierarchies one at a time, searching for what you want. The only other problem we witnessed with Pathway's newsreader is that while it gives you many options for saving and forwarding recent messages, it has no way to go back to messages written in the past.

Telnetters can choose between using the VT220/230 or the TN3270 emulations. Commands under telnet are few and simple and deal mainly with saving telnet sessions to a file or the Clipboard—although the Script function will let you automate things to some degree. Creating telnet scripts requires a climb up a steep learning curve, though.

Pathway Runtime's TCP/IP kernel is the only part of Pathway that is complicated to set up. This is because of the number of inputs needed from the user. But clear dialog boxes prompt you for the required information: IP address, domain name, and so on. If you make a mistake, you can reconfigure Pathway Runtime simply by running PWSETUP.EXE, which lets you reinstall, uninstall, or adjust an existing configuration. Unfortunately, the odds are that you will make a mistake, especially if you believe the Pathway Runtime manual when it tells you certain information is optional. (The IP address of the DNS server, for instance, is mandatory for most installations.) Pathway Runtime also provides a PING program so that you can test your connection.

It is unfortunate that Pathway does not include a Gopher, and that one or two confusions throughout the applications prevent it from being anyone's ideal package. But Pathway's many virtues exceed its faults, and anyone exploring the possibilities of Internet interfaces would do well to include this package in the comparison.

Frontier Technologies Corp.

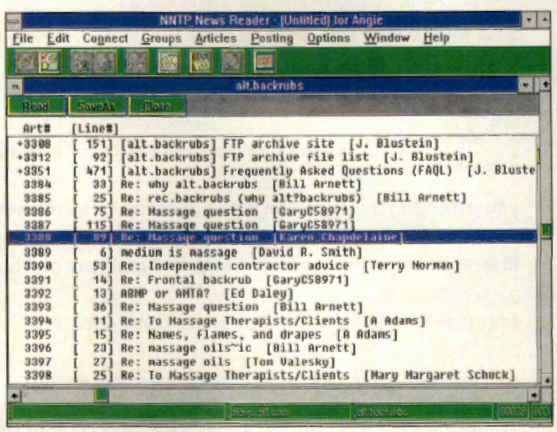
• SuperTCP/NFS for Windows

BY ANGELA HICKMAN

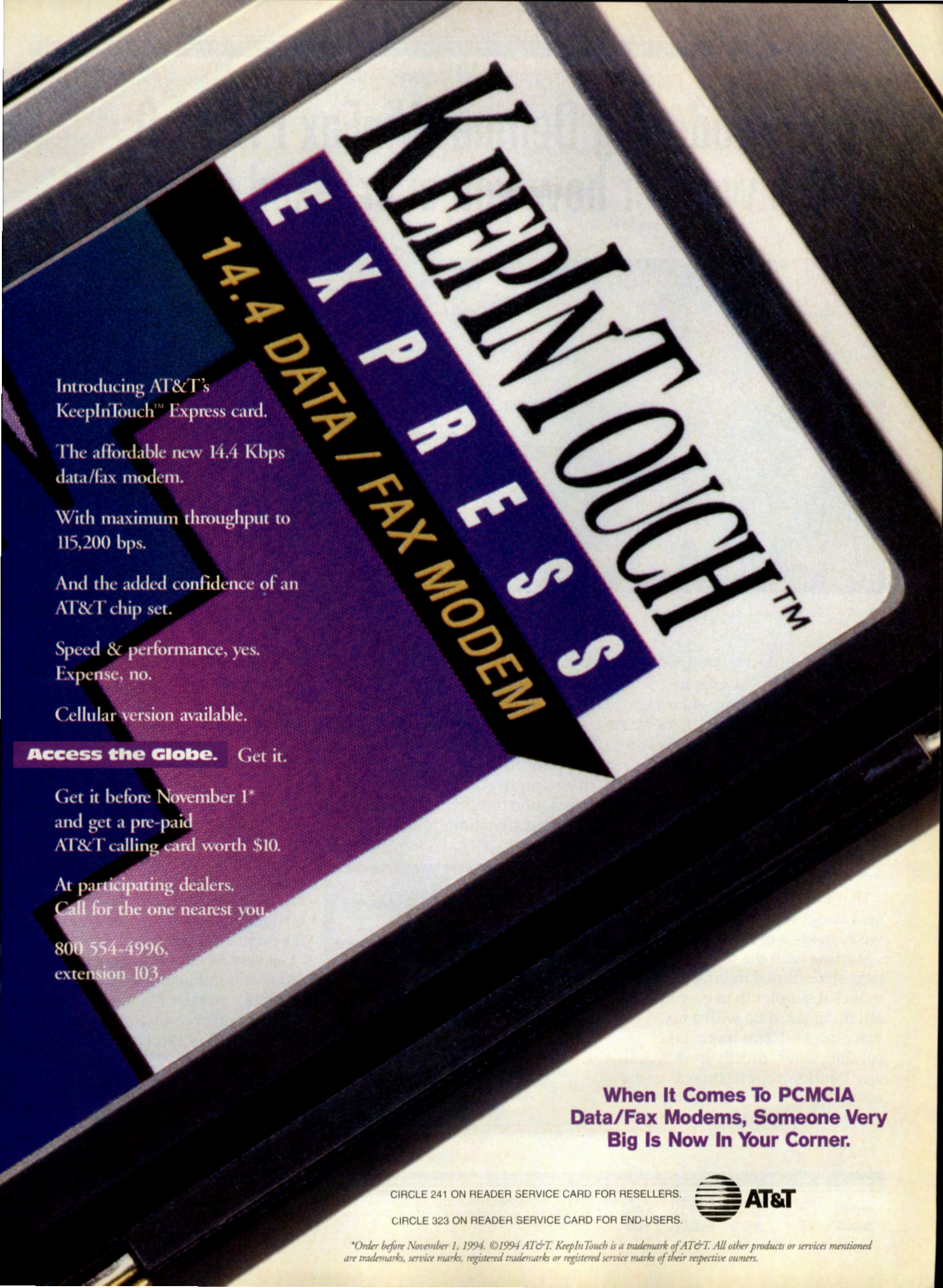
Version 4.0 of Frontier Technologies Corp.'s Super-TCP/NFS for Windows ($495), combines a full-featured TCP/IP implementation with a somewhat quirky but fairly generous set of Internet applications. Of the packages reviewed here, only Spry's AIR NFS 3.0 has more functionality.

In addition to dial-up connections via SLIP and PPP, SuperTCP/NFS will run over any network running TCP/IP, with or without an additional protocol such as IPX (using NDIS or ODI drivers). X.25 support is optional. Internet applications supplied include FTP, TFTP, telnet, an NNTP newsreader, and e-mail—but not search tools such as Gopher, WAIS, or a World-Wide Web browser.

At press time, Frontier had planned the September release of another product, SuperHighway Access, which was to include "Tapistry" (a set of navigational tools for Gopher, WAIS, and the Web), and default installation scripts for several major Internet providers.The scripts will ensure quick and easy access to the Internet via SLIP and PPP dial-up connections. SuperHighway Access will not support direct network connections.



While SuperTCP/NFS's NNTP newsreader is easy to use, messages are posted by date rather than by thread.



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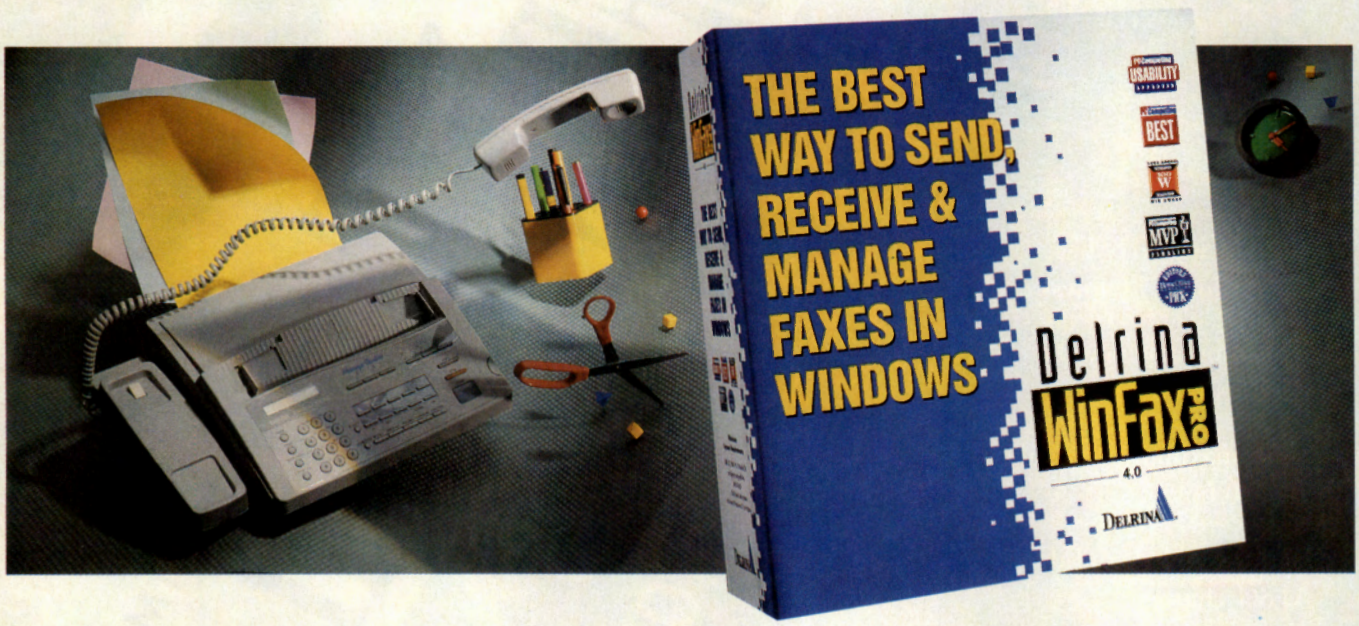

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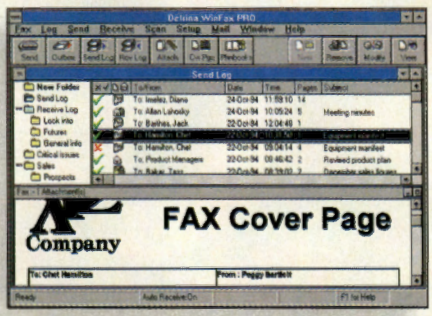

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*Requires Class 1 modem.

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FACT FILE

SuperTCP/NFS for Windows, Version 4.0

List price: Single user, $495. **Requires:** 2MB RAM (8MB recommended), 10MB hard disk space, Microsoft Windows 3.1 or later. **In short:** SuperTCP/NFS for Windows offers a fairly complete set of tools to access and retrieve information, send and receive mail, and join newsgroups, letting users take advantage of all the Internet has to offer. SuperTCP/NFS lacks a search tool such as Gopher or a Web browser, but since it's Winsock-compatible, any third-party tool will fit in well with it.

Frontier Technologies Corp., 10201 N. Port Washington Rd., Mequon, WI 53092; 414-241-4555; fax, 414-241-7084; e-mail, tcptech@FrontierTech.com.

SUITABILITY TO TASK	Power	Ease of Use
TCP/IP implementation	EXCELLENT	FAIR
Mail/newsgroups	EXCELLENT	FAIR
FTP/telnet	GOOD	FAIR
Search tools	N/A	N/A

453 on reader service card

BUTTON BOX

Once SuperTCP/NFS is loaded, getting on the Internet is easy. You access any of the package's applications simply by clicking one of the many colorful icons. Through these icons you can also access SuperTCP/NFS's myriad utilities, which include chat (called Talk), finger, WHOIS, PING, and several terminal emulators, including VT320 and TN3270.

SuperTCP/NFS is one of the few packages in this roundup to provide fax support. And while it lacks a Web browser and similar search tools, the package is Winsock-compliant and thus readily supports third-party tools like Mosaic. Furthermore, as the name indicates, SuperTCP/NFS supports NFS protocols that allow shared access to files and printers across a network. Alternatively, a $395 version of SuperTCP/NFS is available without NFS.

Unfortunately, whereas SuperTCP/NFS is fairly rich in features, many of its applications are unintuitive and shallow. For example, although you can easily subscribe and unsubscribe to any of the thousands of Usenet groups by means of a menu at the top of the screen, messages are posted by date rather than by thread, so you'll have to search high and low to follow a particular discussion.

TEMPERAMENTAL MAIL

Similarly, the e-mail module (which supports SMTP, POP2, POP3, and MIME binary-file attachments) is fundamentally sound but has some idiosyncrasies, both major and minor. The module has no default configuration; you must choose to set it up either as a server or as a client. Furthermore, you must specify one of the aforementioned mail protocols before the module will work.

To make matters worse, SuperTCP/NFS does not alert you to these setup necessities when you launch the application, leaving you to figure out why you're not getting mail functionality. Once you do have SuperTCP/NFS's mail running, you'll have to get along without (minor) conveniences like drag-and-drop.

On the plus side, the mail module supports rules-based management, carbon copies, sorting, a phone book, and signature files. Also, the fact that SuperTCP/NFS can operate as a mail server is quite cool. If you do set it up this way, you'll be able to receive mail directly without having to bother with a remote mailbox.

The graphical FTP application is easy to use, in part because it so closely resembles the appearance and features of the Windows File Manager. With it, you can rename, refresh, or delete ASCII and binary files. And unlike many of the reviewed programs, this package shields you from having to know the file system of the FTP server.

One cannot be completely shielded, however. SuperTCP/NFS does only a mediocre job of sheltering users from its under-the-hood complexities, so getting the package up and running is a challenge. That's especially true for network novices, who will almost certainly need help from tech support or another experienced user. The detailed manual is valuable for its step-by-step guidance, however.

Installation alone should not deter you: SuperTCP/NFS is certainly a competitor in the current bevy of Internet graphical front-end packages. Consider the package a solid performer with a few minor usability quirks. Also, watch for Frontier's SuperHighway Access, which should be available by the time you read this.

VB Power



ISBN: 1-56276-073-4
Price: $34.95

This innovative guide by Dan Appleman turns Visual Basic programmers into power users by illuminating the tools of the Windows Application Program Interface (API). Includes a time-saving disk that contains source code from the examples in the text, plus a specially designed dynamic link library (DLL).

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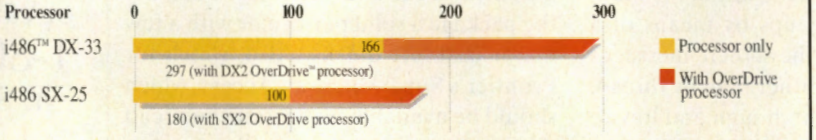

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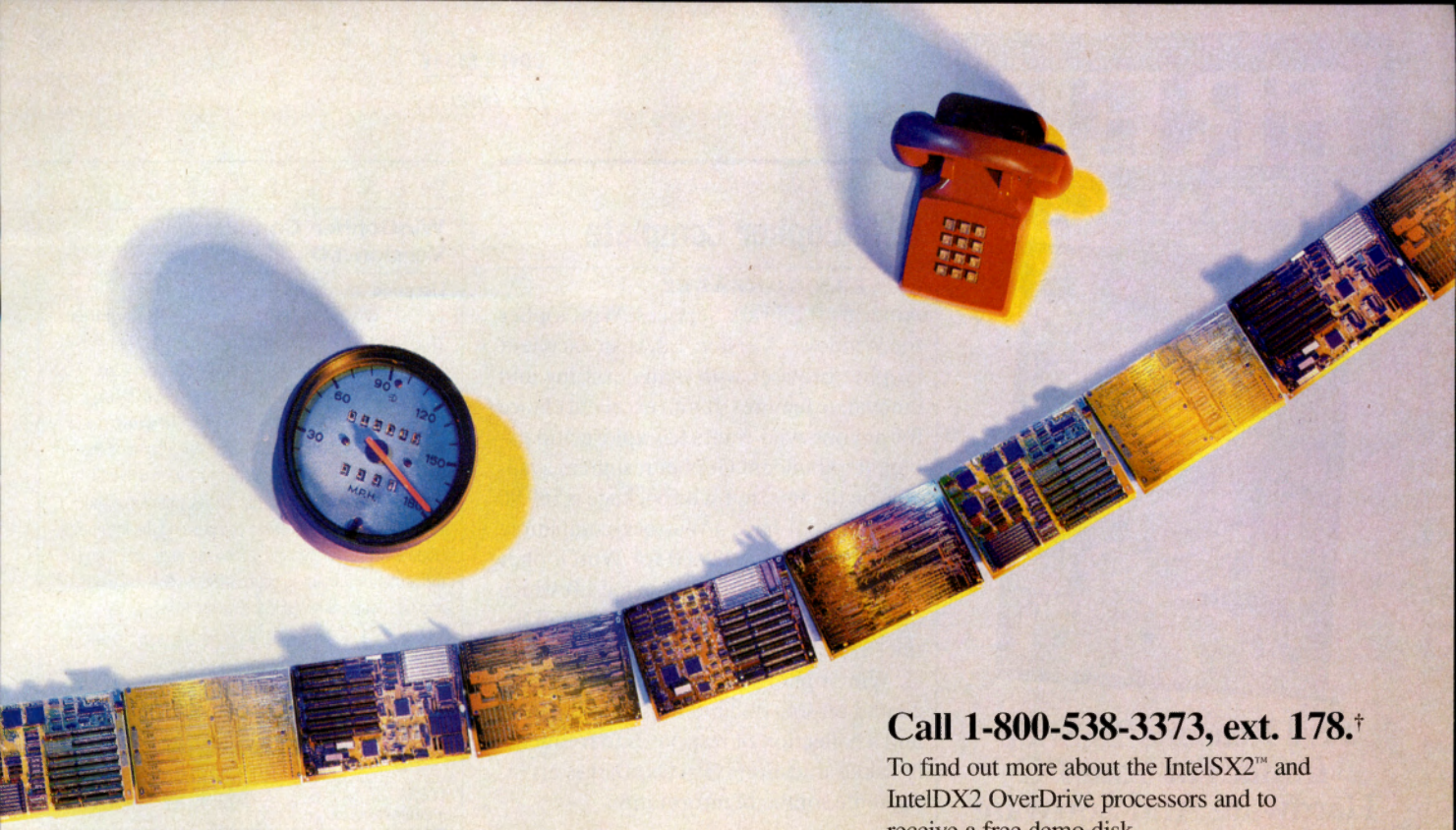

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Ameritech Library Services

• WinGopher Complete

BY SEAN GONZÁLEZ

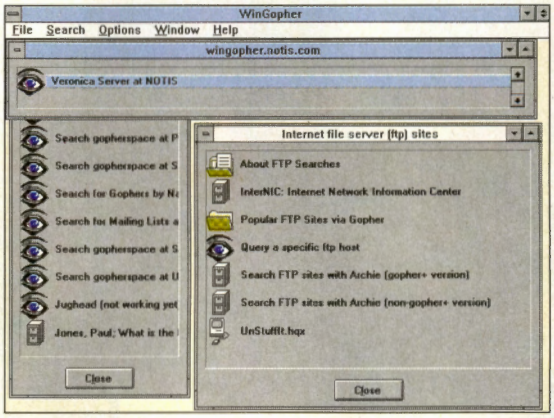
Ameritech Library Services' WinGopher for Windows, Version 1.0, is an excellent Gopher browser with many exciting and innovative features. It's an excellent choice for anyone who wants to explore and exploit the abundant Gopher resources available on the Internet. The package is $69.96 if you already have a Winsock-compatible TCP/IP stack or $129.00 for WinGopher Complete for Windows, Version 1.0, which includes a third-party version of the Distinct TCP/IP stack.

WinGopher ships with excellent printed and on-line documentation, help files, and a collection of responses to frequently asked questions (FAQs) that is an invaluable source of information.

SOUND AND FURRY

WinGopher's sound files and animated Gopher icons make it fun to use. Also, the product is well organized and easy to use, so even novices should be cruising those Gopher servers in no time. WinGopher uses "collections" of Gopher links and items to group Gopher sources and documents by topic. The software comes preconfigured to connect to the company's Gopher server, where you will find a wealth of Gopher links and documents (including a link that allows you to download updated and additional collections).

WinGopher includes document and image viewers and a telnet program (although it has neither a TN3270 emulator nor an AVI player). By default, it uses the Windows .WAV player (*mplayer.exe*) to play sound files. You can easily configure the program to use other "helper" applications.



While WinGopher Complete doesn't offer an FTP module, you can still do file searches and transfers using the Gopher.

TRIVIAL FURSUIT

Installing WinGopher itself is trivial—a snap, in other words. If you purchase the WinGopher Complete version, you have the option of installing the Distinct TCP/IP stack. To configure the Distinct stack, you must run Distinct's interface configuration utility, which supports both direct connect (via ODI, NDIS, and a packet driver) and dial-up (SLIP or PPP) configurations. See the review of Distinct TCP/IP Tools for Windows for further installation details.

Especially considering that this is a 1.0 release, Ameritech Library Services' Gopher browser is very stable, well organized, easy to configure, and fun to use. If you want to access Gopher resources, we strongly recommend adding WinGopher to your toolkit of Internet utilities. □

▶ FACT FILE

WinGopher Complete, Version 1.0

List price: WinGopher Complete: Single user, $129.00; WinGopher: Single user, $69.95. **Requires:** 2MB RAM, 3.5MB hard disk space, DOS 5.0 or later, Microsoft Windows 3.1 or later.(WinGopher also requires a Winsock DLL–compatible TCP/IP stack, a mouse, and a TCP/IP service provider. **In short:** If you are looking for a Gopher browser, WinGopher is the only Gopher browser for you. Packed with collections of handpicked and well-organized Gopher links and items, WinGopher will have you cruising the Internet's Gopher servers in no time. Along the way, you'll enjoy the program's amusing sound effects, colorful icons, and hilarious animated icons.

Ameritech Library Services, 1007 Church St., Evanston, IL 60201-3665; 800-556-6847, 708-866-4924; fax, 708-866-4893; e-mail, wingopher@notis.com.

SUITABILITY TO TASK		
	Power	Ease of Use
TCP/IP implementation	GOOD	POOR
Mail/newsgroups	N/A	N/A
FTP/telnet	FAIR	FAIR
Search tools	GOOD	EXCELLENT

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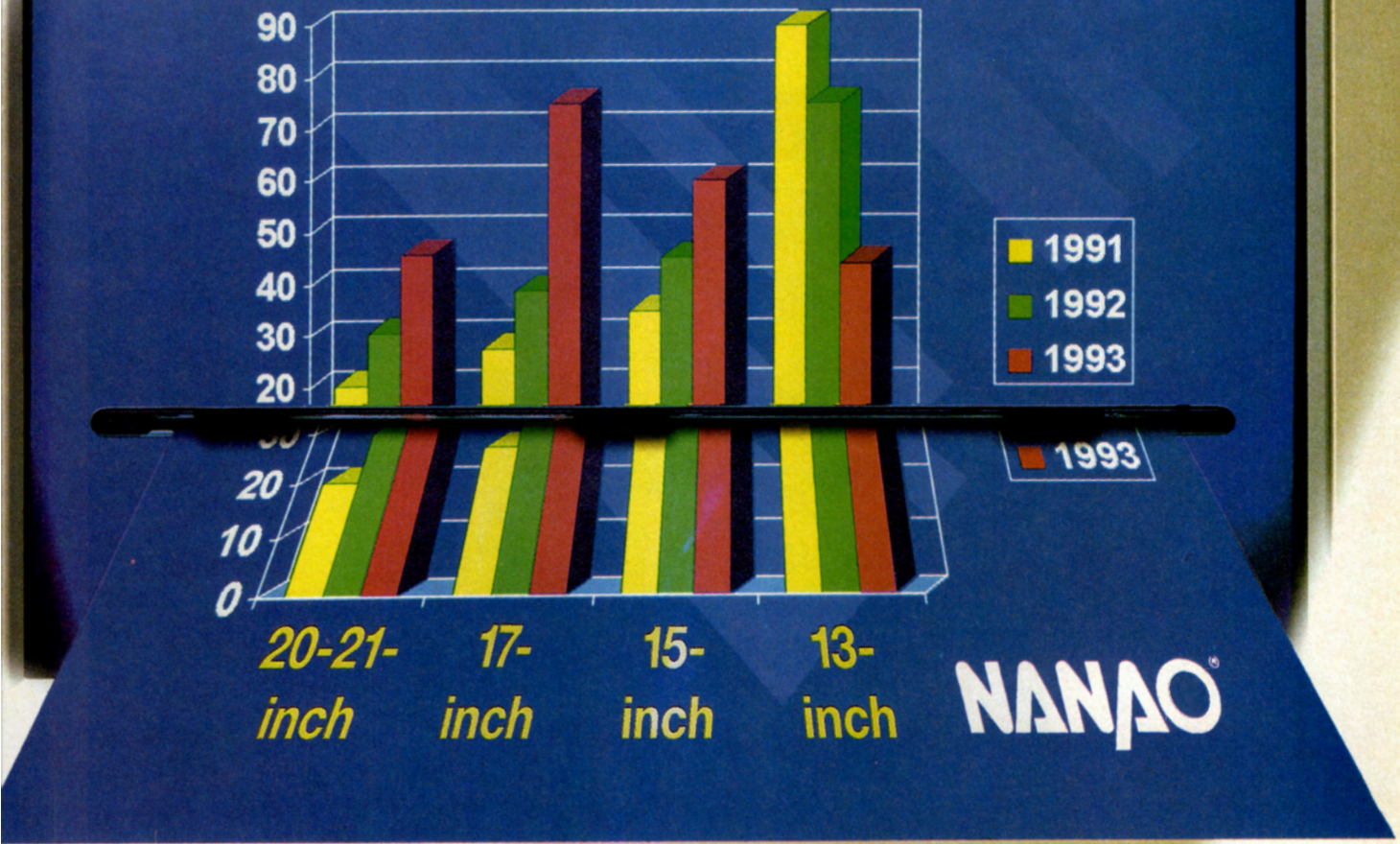



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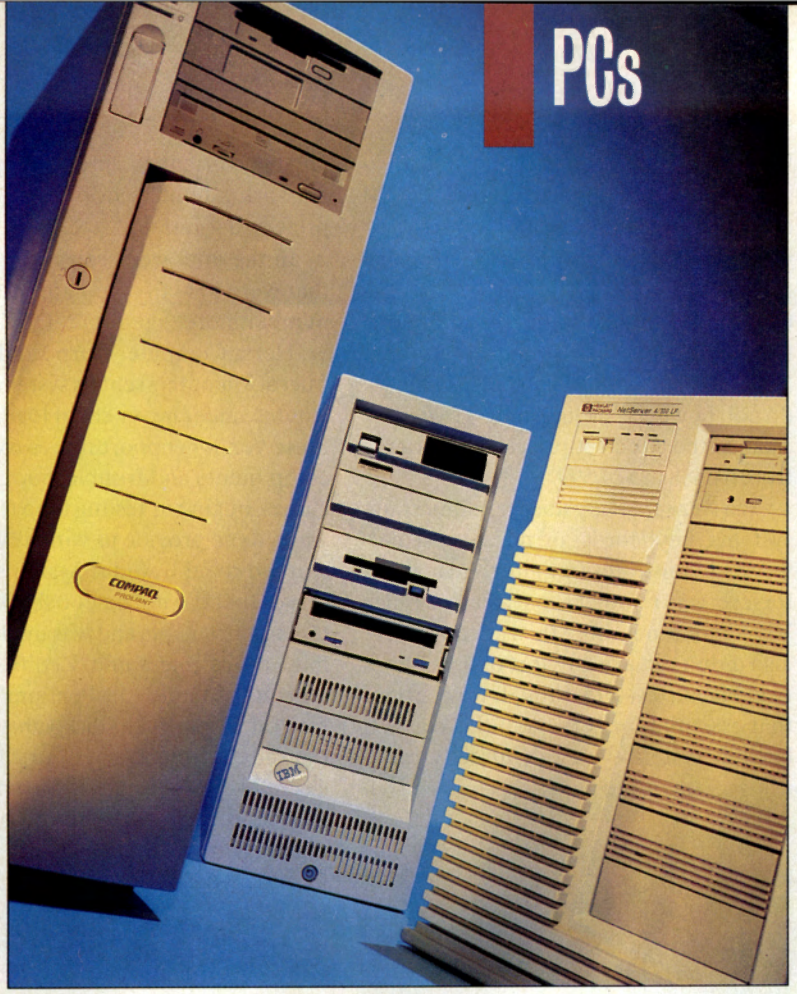

ZD Labs tests 15 file servers running NetWare to see how well they meet the demands of departmental networks. Are they more than just desktops stood on their ends?

FILE SERVERS

Data on Demand

By Jim Seymour

Local area networks have come a long way since we first turned 6-MHz PC ATs on their sides a decade ago and grandly labeled them *file servers*. Like the machines, we have come a long way, too: Our understanding of the role and requirements of LAN servers has grown almost as fast as LANs themselves. We know now, for example, that just any fast machine isn't necessarily a very good server. And we know that the characteristics we find desirable in desktop PCs and those essential in good servers are not always the same.

It's fortunate that we've grown out of our old habits, since we could never meet the demands of today's midsize and large networks by connecting them to the pseudo-servers of those days. Today, PC LANs have taken on much larger, more important roles in business; many companies have begun replacing aging minicomputers and mainframes with these LANs. The servers on those LANs must meet our high expectations for performance, reliability, and expandability.

Clearly, LAN file servers have evolved into a separate product category, so at *PC Magazine* we decided to put this new gen-

IN THIS REVIEW

AcerAltos 7000 197
Axik NetPower Enterprise Server Series-I 209
Compaq ProLiant 1000 486DX2/66 217
Dell PowerEdge SP590 218
DECpc XL Server 566 220
Duracom FilePro 586/66 220
EPS Super Server Goliath P5-66 SSBKP 222
GAIN Vector 90ER 224
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Maintaining Your Data 232

Photography by Scott Peterson

eration of servers to the test. We set our sights on the fat middle of the market: file servers on Ethernet-based Novell NetWare networks of up to 60 PCs. What we learned was that some servers indeed have come a long way while others remain little more than high-end desktops with pretensions of greatness.

REVIEW CRITERIA

Our criteria reflected the computing muscle and flexibility we believe are essential for today's servers. We asked vendors to send us their fast file servers configured with 486DX/50 or better CPUs, 64MB of RAM, and mirrored hard disk storage with 2GB of usable capacity.

We allowed each vendor to supply four network interface cards (NICs) of its choosing, or we installed four Eagle NE3200 NICs. We also requested a 3.5-inch floppy disk drive and a CD-ROM drive to simplify the installation of network software, which is increasingly being delivered on CD-ROMs rather than the traditional 30-plus floppy disks. Finally, we asked vendors to preinstall Novell's NetWare 3.12 with a 100-user license; we do not, however, include the NOS license costs in the cited list prices, which range from $4,588 to $24,599.

We weren't picky about graphics subsystems, keyboards, or mice; most network administrators monitor and manage their servers remotely, and a basic 14-inch VGA monitor is more than adequate. We also didn't require any sort of tape or optical backup system, though we consider that essential for servers in this class. A backup system wouldn't directly influence performance, and we expect most network administrators have their own preferred solutions.

In the end, we received 15 machines that were able to complete testing and a number more that didn't. DTK Computer, Hertz Computer Corp., and National MicroComputers sent us systems that had trouble under heavy client loads; we gave these vendors opportunities to swap out components and troubleshoot their machines, but in our testing time frame none was able to provide us with a system that worked reliably. Sidus Systems sent us a server that did not meet our disk-subsystem requirements and was unable to submit a replacement unit. Zenith Data Systems also submitted a Pentium/90 system for evaluation, but its disk-subsystem configuration did not meet our filter. NEC Technologies, despite its prominence in the marketplace, declined to participate in our roundup.

Just as we were completing our testing, IBM Personal Computer Co. began shipping its first EISA-based file server, the IBM PC Server. We review it in the First Looks section of this issue. IBM was represented here by its Micro Channel–based IBM PS/2 Server 95 Array 566.

Note that we focused on the suitability of the tested machines as file servers only, not as application servers in more demanding client/server environments. The requirements for the two classes of servers are markedly different: Powerful I/O is the key to a good file server, while CPU power plays a much larger role in application servers. (For more on the needs of application servers, see "Application Servers: At Your Service," March 15, 1994.)

DATA PUMPS

We measured performance of these file servers under loads of 1 to 60 clients using our new NetBench, Version 3.0, benchmark tests. Because they are based on extensive profiling of the access patterns of real network applications, these tests provide an indication of how well servers should perform under different client loads in real-world environments. We should emphasize that NetBench clients generate large amounts of network traffic; your network environment may be less demanding. For more information on the

HIGHLIGHTS

File Servers

THE IDEAL FILE SERVER is more than just a desktop PC in a spacious case. It combines solid performance, thoughtful design, expandability, fault tolerance, and management tools. ZD Labs put 15 file servers through their paces on a 60-workstation NetWare LAN using our new network benchmark tests, NetBench, Version 3.0.

FILE-SERVER PERFORMANCE doesn't depend on a fast processor the way application-server performance does. Two of the three fastest machines on our tests used 486DX2/66 processors; coupled with fast network cards and hard disk subsystems, they were able to outpace their Pentium/90-based competitors.

WE TESTED SERVERS in a RAID Level 1 (mirrored) configuration, which duplicates all data onto a second set of hard disks. Many vendors went further, using a second disk controller to provide duplexing. Seven of the tested systems offered hot-swappable hard disks, which let you replace a failed disk on the fly. Three servers came with redundant power supplies.

EISA-BASED SERVERS made up the bulk of the systems we tested, although two relied on ISA instead and took a performance hit as a result. Ten of the systems supported high-speed buses, either VL-Bus or PCI, promising an upgrade path to future networking standards that will require additional bandwidth. Over the next few years, we expect that PCI will replace EISA in file servers.

PRICES OF THE TESTED SYSTEMS ranged from $4,588 to $24,599. A 100-user NetWare license will add about $4,000 to the cost. And don't forget that you'll need a tape backup system and probably an uninterruptible power supply, too.

COMPAQ SETS THE STANDARD for server-management tools. Its SmartStart software automates the server-installation process, and its Insight Manager utilities provide in-depth performance and monitoring tools. A few other vendors, notably HP, provide similar capabilities, but none were as comprehensive and well documented.

new NetBench, see this issue's Lab Notes column, "Testing Your Data Depository with NetBench 3.0."

The primary measure of server speed—the performance characteristic that NetBench actually tests—is total network throughput (the rate at which data is provided to all the workstations on the network). The server with the best throughput on our tests, the HP NetServer 486/LF, provided more than three times the throughput of the slowest performer, the Axik NetPower Enterprise Server Series-I. Other strong performers were the Compaq ProLiant 1000 486DX2/66, the Dell PowerEdge SP590, and the IBM PS/2 Server.

Another indication of a server's scalability is the CPU utilization observed under different loads. Lower CPU utilization is better, because lower utilization equates with more spare processing capacity. A server that saturates the CPU under a limited client load has run out of CPU cycles to support additional users.

As part of our NetBench tests, we used NetWare's STAT.NLM utility to record CPU utilization, and the results showed dramatic differences in performance. The best machines reached CPU utilization of only 60 to 70 percent even under maximum client loads. On the other hand, the Axik NetPower showed 70 percent CPU utilization with only a single network client.

The best CPU utilization was turned in by the Compaq ProLiant, the Dell PowerEdge, the IBM PS/2 Server, the Wyse Series 6000i Model 655, and the ZDS Z-Server EX DP66E. All of these systems kept CPU utilization to no more than 80 percent even with 60 clients.

INSIDE THE SERVERS

The 15 servers were powered by Intel CPUs, from a 66-MHz 486DX2 to a 90-MHz Pentium. One server, the ZDS Z-Server EX DP66E, employed a pair of Pentium/66 processors. Since NetWare does not currently support multiple processors, though, only one was active in our tests.

In an era when even Pentium power no longer commands a premium price, why did we consider processors as modest as 486DX2s in the first place? Take a look at our test results and the answer becomes clear: The machines with the best test results were often not those with the fastest processors. Both the Compaq ProLiant and the HP NetServer, for example, were based on 486DX2/66 CPUs, and the IBM PS/2 Server used a Pentium/66. All three machines outperformed the fastest Pentium/90 servers.

We've said this often, but it bears repeating: The microprocessor is not a primary determinant of overall file-server performance. Memory size and speed, hard disk size and speed, disk-controller design, expansion-bus width and speed, and the number and speed of the network interface cards can all have greater impact.

A fast processor is still a good idea in a file server, especially when you consider the marginal investment that a high-per-

PC MAGAZINE EDITORS' CHOICE

- **Compaq ProLiant 1000 486DX2/66**
- **HP NetServer 486/LF**

A number of the systems we tested exemplified superior engineering that clearly set them apart. Our Editors' Choice winners, the Compaq ProLiant 1000 486DX2/66 and the HP NetServer 486/LF, best fulfilled our vision of what a network file server should be.

The $16,135 Compaq ProLiant was a consistently superior performer that distinguished itself with outstanding server-management capabilities and documentation. Here's a hint at the kind of engineering that went into this system: The cache RAM on the disk controller card has a battery backup so that even a power failure won't result in lost data.

The $19,043 HP NetServer was also a stellar performer. It maintained the highest throughput of any server we tested, though its CPU utilization was relatively high. Still, given that the HP NetServer (like the Compaq ProLiant) uses only a 486DX2/66 processor, its results were especially impressive. The HP NetServer's server-management capabilities are strong, too.

HONORABLE MENTIONS

Two more systems were clear contenders for Editors' Choice awards but didn't quite match the exceptional standards set by Compaq and Hewlett-Packard. These servers earn honorable mentions. The IBM PS/2 Server 95 Array 566 provided the best overall combination of throughput and CPU utilization along with extensive fault tolerance and a very competitive price of $16,700. The IBM PS/2 Server's unequaled design lets you replace most components without requiring any tools.

The Achilles' heel of the IBM PS/2 Server is its reliance on the Micro Channel Architecture. With EISA/PCI combinations gaining momentum and even IBM shipping EISA-based server products, MCA may ultimately prove to be a dead end.

The $17,419 Dell PowerEdge SP590 was a strong performer on our tests and includes amenities such as hot-swappable hard disks and a heat-monitoring board. With a Pentium/90 CPU and both EISA and PCI expansion buses, it should keep pace with the growth of your network.

We're reassured to see that the vendors of these servers in particular understand the demands of today's LAN and network administrators. Many of the other servers we tested felt more like fast desktop systems with disk arrays shoehorned in. They didn't show the same level of performance tuning and engineering that was apparent in the leading machines. This is something we think is important when you're considering spending upwards of $10,000 for a machine to run your LAN.

formance processor demands. A single-minded focus on CPU performance, however, simply doesn't make sense. That's true in spite of the fact that cutting-edge processors typically appear in servers before they become commonplace in desktop machines; this phenomenon is more the result of sharply limited availability and relatively high initial price tags than anything else.

EXPANDABILITY

We asked for machines with 64MB of RAM, because we consider that to be the minimum practical size for a NetWare file server maintaining more than a handful of clients. To boost performance, NetWare relies on huge software disk caches—the bigger the better.

Because your network and file server will likely grow, make sure you include memory expansion as one of your buying criteria. Support for at least 128MB is desirable, and all the machines we tested were capable of accommodating that amount of RAM. Realistically, 256MB is an even more comfortable RAM ceiling. Two of the machines we tested, the GAIN Vector 90ER and the ZDS Z-Server EX DP66E, let you use memory daughterboards to expand RAM to as much as 384MB, which is more than you're ever likely to need.

How memory expansion is handled can be almost as important. A PC with 4 SIMM (single in-line memory module) slots delivered with 4 banks of 16MB SIMMs installed means that when you're ready to upgrade, you must throw out those 16MB SIMMs in favor of higher-density modules. We believe that 8 or more SIMM sockets allow for more cost-effective expandability. The GAIN Vector 90ER had no fewer than 12 SIMM sockets available on its optional memory module (though only 4 SIMM slots were available on its motherboard).

As the traditions of truly mission-critical computing trickle down into the file-server marketplace, we're beginning to see support for welcome features such as ECC (error-checking and correcting) memory rather than simple parity-checking memory. Soft, or transient, memory errors can cause RAM chips to lose a bit of data occasionally; ECC memory employs algorithms that can increase a server's fault tolerance by actually correcting single-bit memory errors rather than just detecting them. Of the servers we tested, those from Dell Computer Corp., EPS Technologies, GAIN Systems, IBM Personal Computer Co., and Zenith Data Systems were equipped with ECC RAM.

RECENT REVIEWS

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40 Pentium/90 systems.

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70 notebook and subnotebook computers.

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July 1994.....*page 111*
Seven visions of the ideal PC.

MASS STORAGE

Perhaps more than anything else, it's the mass-storage subsystem that defines a file server. We left the details of the disk subsystems, including the number of hard disks, to the discretion of individual vendors; we specified only a minimum of 2GB of usable hard disk space after mirroring. We demanded mirroring, also known as RAID (Redundant Array of Inexpensive Disks) Level 1, because we consider some sort of redundancy critical to ensuring data integrity. Although a variety of other solutions are possible, mirroring is a relatively simple and economical way to ensure data integrity for a midsize network. We limited vendors to simple mirroring to provide a consistent basis for performance comparison. (For more information about other forms of RAID, see the sidebar "Data Integrity.")

We ended up with a variety of different approaches to data storage. Simple mirroring requires just two disks (spindles), but the HP NetServer employed six spindles. By dividing data storage among several spindles, vendors can often improve performance, because the hard

Suitability to Task: File Servers

No server managed to achieve an *excellent* rating in every category. The Compaq ProLiant 1000 486DX2/66 and the IBM PS/2 Server 95 Array 566 came closest, with two *good* scores and two *excellent* scores apiece. In many cases, the servers that were extremely strong in one or two areas were lacking in others.

The **expandability/scalability** rating reflects a server's ability to be upgraded with mass-storage devices and additional processing power to handle heavier network loads. Key considerations include number of drive bays, maximum RAM support, power-supply wattage, and number of expansion slots (with an emphasis on local-bus expansion slots). We also consider support for bus-mastering adapters, upgradable flash BIOS, and upgradable CPUs. Units rated *excellent* offer spacious cases, hefty power supplies, and plenty of available expansion slots to ensure room for growth.

The **security/fault-tolerance** rating indicates to what extent a server provides redundant components and implements basic security features. Major factors figuring into this rating include the presence of multiple power supplies, duplexed disk controllers, error-correcting memory, hot-swappable hard disks, temperature sensors, BIOS-based password protection, and case key-locks. Systems receiving *excellent* ratings deliver strong insurance against casual tampering or corrupted data.

The **server management** rating reflects the features a server provides to assist the network manager in keeping the server running optimally. We place a heavy emphasis on the quality of documentation and warranty terms (including on-site service). Other factors include remote-notification and remote-management features, advanced diagnostics, and tools to track memory- and disk-subsystem faults. Servers rated *excellent* provide detailed documentation, comprehensive warranty coverage, and a variety of software server-management tools.

The **performance** rating is a measure of how well a server performed on our NetBench, Version 3.0, tests across a variety of client loads. Servers rated *excellent* marry high throughput with low CPU utilization, providing plenty of performance for today with room for growth tomorrow.

SUITABILITY TO TASK	
Expandability/ Scalability	POOR
Security/Fault tolerance	FAIR
Server management	GOOD
Performance	EXCELLENT

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CIRCLE 246 ON READER SERVICE CARD

Price/Performance Index: *File Servers*

Our price/performance index shows that you can have a system with a low price or a system with high performance and lots of features, but you can't have a system with both.

The HR Mission Critical is in the best position in our index, thanks to its astoundingly low $4,588 price tag. But this is a case where you get what you pay for: The HR Mission Critical performed near the bottom on our tests and offers little to make it appealing as a network server.

The Compaq ProLiant 1000 486DX2/66 garnered the highest performance/features score. A performance leader in this roundup, the Compaq ProLiant's extensive server-management capabilities set it apart from the pack, and its $16,135 price tag is competitive.

Most of the other servers were clustered not far behind these two units. One of them, the Tangent "Just'N Case" Server 100, is well positioned in our index by virtue of its low price—only $9,995. With a combination EISA/PCI architecture, dual 300-watt power supplies, and average performance, it's a strong buy.

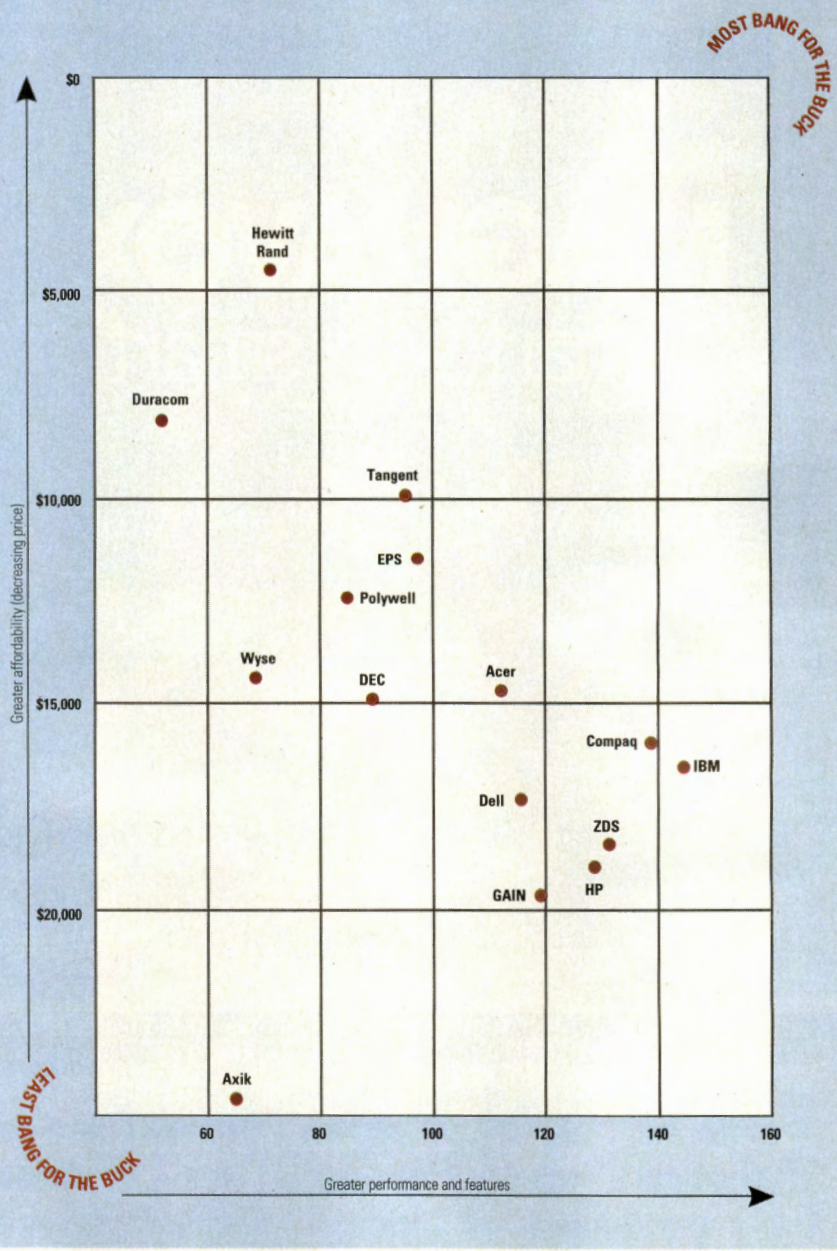
We tested the ZDS Z-Server EX DP66E in a dual-processor configuration ($18,500), but its performance reflects the impact of only a single processor since NetWare currently doesn't support multiple processors. ZDS does not sell a 66-MHz single-processor version of the ZDS Z-Server, but it does sell a $15,124 60-MHz model that we expect would perform nearly as well and provide even more bang for the buck than is reflected here.

In this case, the Editors' Choice and honorable mention winners: theCompaq ProLiant, the HP NetServer 486/LF, and the Dell PowerEdge SP590 and IBM PS/2 Server Array 566, fall in the middle of the test pack. One reason for this is that they stand out, at least in part, because of intangibles—such as design excellence and superior fit and finish—that aren't components of our performance and features evaluation.

The Axik NetPower Enterprise Server Series-I brought up the rear on our price/performance index. Not only did it turn in the worst-performance on our tests, it was also the most expensive machine.

THE DATA POINTS

Performance on our benchmark tests accounts for 55 percent of each performance/features score. Each machine's specific features account for 35 percent, and the company's service and support offerings for another 10 percent. For additional information, look in the Software Library of the Editorial Forum on PC MagNet under 17BANG.XLS.



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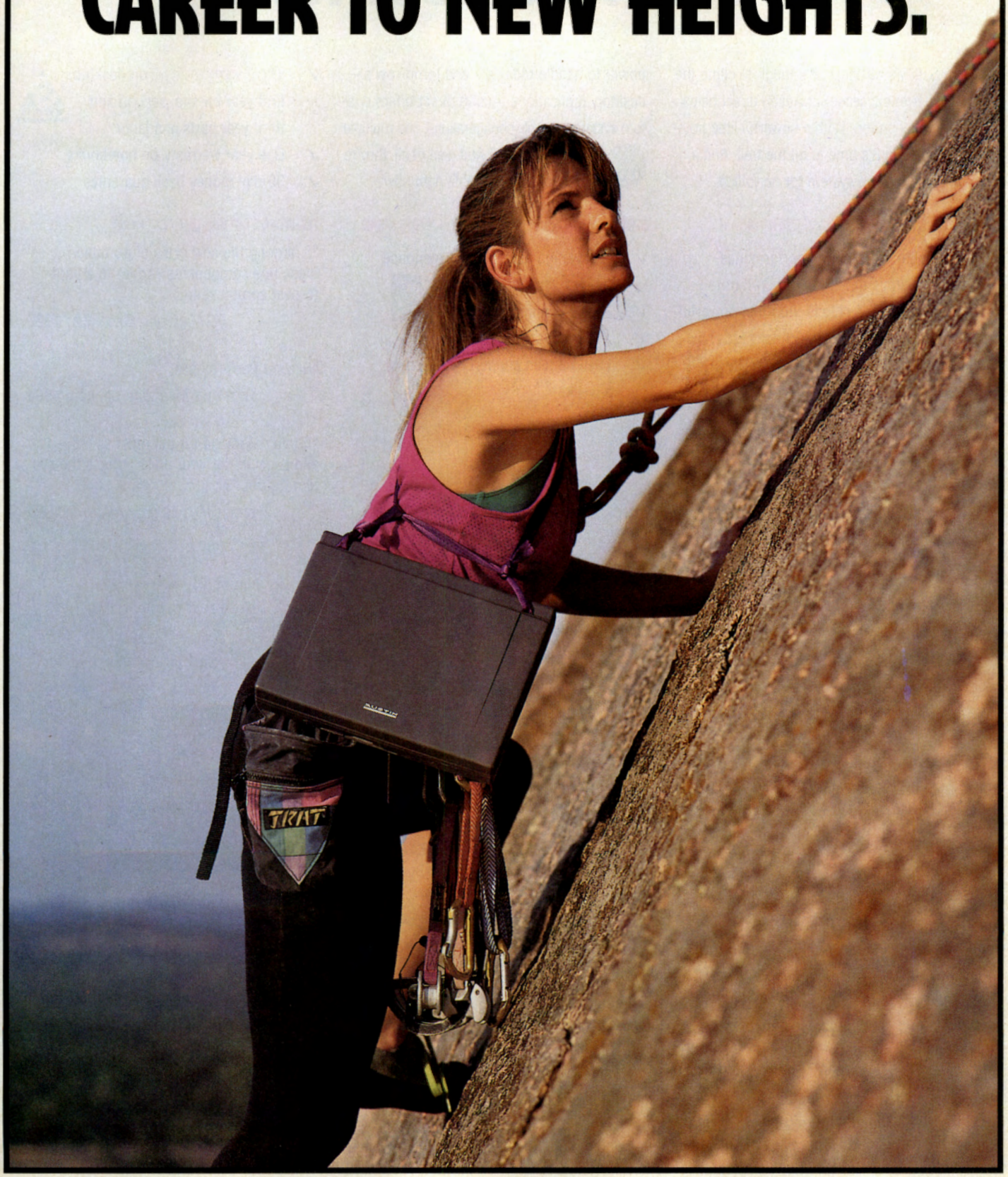

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CIRCLE 012 ON READER SERVICE CARD

disks can seek independently.

Disk subsystems in many of the units we tested supported far more than simple mirroring. The servers from Acer America Corp., Compaq Computer Corp., Dell Computer Corp., Hewlett-Packard Co., IBM Personal Computer Co., Polywell Computers, and Tangent Computer provided support for *hot-swapping*. This allows an administrator or a technician to pull a failed hard disk and replace it with an extra, identical hard disk without having to shut down the server. The disk array–management software detects the presence of the new disk, immediately begins rebuilding it from redundant data stored on other hard disks in the array, and then automatically brings it on-line when the data is fully restored.

Vendors love to show off this capability, pulling out a failed disk while the server continues to chug along. Hot-swapping is more than just for show, however: It prevents lost time and lost revenues for the company—and possibly a lost reputation for the network administrator. Plan on adding $1,000 to $2,500 to the purchase price of a system that supports hot-swapping; this covers an additional 1GB hard disk for that almost inevitable day when a hard disk goes down. The reason the cost for extra storage will be higher than the typical $700 to $1,000 price for a bare 1GB SCSI hard disk is because the packaging that makes these hard disks hot-swappable is proprietary to the server maker. Tangent Computer includes a hot-swappable caddy with its server; you just have to add a hard disk. The GAIN Vector 90ER does not support hot-swapping, but it did ship with a fifth hard disk that can kick in immediately should another hard disk fail.

A further level of redundancy can be provided by duplexing, or using two disk controllers to implement disk mirroring. In a duplexed environment, data integrity is maintained even if a disk controller fails.

DISK INTERFACES

SCSI-2 hard disks are now and will remain the standard in servers despite the advances promised by the Enhanced IDE specification promoted by Western Digital and the Fast ATA specification from Seagate. SCSI-2 supports as many as seven devices chained to a single adapter and lets you extend cables outside the server box; Enhanced IDE is limited to supporting four internal devices. SCSI-2's multitasking nature and command-queuing features also promise better throughput than Enhanced IDE when multiple disk requests are pending—rare on desktops today but common in a server environment. Finally, although the Enhanced IDE specification includes support for so-called ATAPI-compliant tape drives and CD-ROM drives, the variety of SCSI-2 storage solutions is far greater, especially for devices like the magneto-optical drives sometimes used for data archiving.

EISA has been the de facto expansion-bus standard for file servers, but we saw everything from Micro Channel to ISA/PCI combinations.

Our tests showed that machines with caching disk controllers had a slight performance advantage over those that relied only on the server's software caching. But we had trouble with the DPT PM2122/95 controllers installed in the EPS Super Server Goliath P5-66 SSBKP and the Wyse Series 6000i Model 665 machines: We were unable to avoid time-out errors and the resulting SCSI-bus resets by the DPT cards until we changed their default operating-system parameters from NetWare to DOS. That solved the problem but left us (and DPT) puzzled.

The Compaq ProLiant included Compaq's Smart SCSI Array controller with 4MB of mirrored cache that effectively provided 2MB of cache. The card even offered a battery backup, so a power loss won't result in corrupted data. Caching controllers of one kind or another were installed in 8 of the 15 servers.

BUS DESIGNS

EISA has long been the de facto expansion-bus standard for server machines in part because EISA's 32-bit-wide data path offers more bandwidth than the 16-bit ISA bus. In addition, EISA's bus-mastering capabilities let adapters off-load tasks from the CPU to improve overall system performance.

We were surprised, however, to see a wide variety of expansion buses in this roundup. Two machines, the Duracom FilePro 586/66 and the HR Mission Critical, used a combination ISA/PCI design that's more suitable for a desktop system than a server. The systems from Acer America Corp., Axik Computer, and Polywell Computers used an EISA/VL-Bus combination.

The IBM PS/2 Server 95 Array 566 used Big Blue's own Micro Channel Architecture (MCA) bus, which—like EISA—is faster than ISA and supports bus mastering. In fact, the IBM PS/2 Server was the best overall performer in this roundup; it nearly matched the HP NetServer's throughput and achieved better (lower) CPU utilization. MCA, however, doesn't provide the backward-compatibility with ISA that EISA does nor the extremely high performance of PCI. And given IBM's recent move to embrace EISA with its IBM PC Server, we have to question the future of MCA.

Like EISA, PCI can support bus mastering. Furthermore, PCI supports clock speeds as high as 33 MHz, while EISA supports a maximum clock speed of 8.33 MHz. That means PCI is likely to displace EISA, especially as higher-bandwidth network standards such as 100Base-VG take hold. PCI's biggest limitation today is that it supports only three or four slots directly, though soon we'll see systems that provide multiple PCI buses on the same motherboard to offer a

Our Contributors: JIM SEYMOUR is a contributing editor of *PC Magazine*. CAROL A. VENEZIA is a staff editor and WILLIAM P. FLANAGAN is a staff writer at *PC Magazine*. NICK STAM is a technical director (hardware) at PC Magazine Labs. CHUL SUNG KIM is a technical specialist at ZD Labs. JOHN CLYMAN was the associate editor in charge of this story, and RICHARD FISCO and GERARD A. PALMERI were the project leaders.

total of eight or more slots. Today, we think that the combination of EISA and PCI provides the most potent performance and the most solid base for expandability.

MORE THAN COMPONENTS ALONE

Expandability and the ease of expanding memory and disk capacity are important. So are reliability, fault tolerance, and network-management capabilities. Price is obviously a purchase consideration, but before you quibble over a few hundred dollars, consider that the cost of a single episode of unscheduled downtime on a LAN or the loss of important data can easily exceed the cost of any of these servers.

Servers here may not be configured exactly the way you want, but in this pricey league, vendors are happy to customize machines.

Since file servers are designed and built for production environments—often at the core of a business's processes—they must be highly reliable, easily maintained, and quickly upgraded. Because these fully configured machines are intended to run nonstop from the day they're installed until they're removed from service, adequate power supplies and cooling are important.

Machines in this class should have at least one 300-watt power supply. Having two power supplies of that rating or higher is an even better idea, because one power supply can provide backup should the other fail. The EPS Super Server goes even further, with no fewer than three redundant power supplies. EPS Technologies says the computer will operate correctly even if two power supplies go down simultaneously. An alarm sounds if one power supply fails; the alarm changes to a more urgent pitch should a second power supply also fail.

System designers have to do something with all the heat generated in servers stuffed full of drives and memory. Here again, the EPS Super Server leads the pack with its five fans: Two large fans blow air down from the top of the chassis towards the drives, two smaller ones mounted on a card cool the motherboard, and a fifth fan sits atop the Pentium's heat sink.

ROOM TO GROW

The scalability of servers in this league is a large part of the value delivered by superior systems. Before you commit $10,000 or more for a purchase, take the time to ensure that your investment won't be obsolete when your network grows and you need to add another segment or more storage.

Make sure any server you consider has an ample number of expansion slots and drive bays. We consider eight expansion slots to be the minimum for a truly scalable server; with two SCSI interface cards and four or more network interface cards, a six-slot machine fills up fast. Also consider how VL-Bus and PCI slots shared with ISA or EISA slots on the system's motherboard may limit the number of real, accessible slots available. And watch out for motherboard design that block slots with drive cages, processor heat sinks, or other components.

We have yet to find a machine with too many drive bays. Although 8 is about the minimum you should expect to find in this class, 10 to 12 drive bays are even better. This allows for room to grow—adding near–on-line hierarchical storage management (HSM) with high-capacity magnetic or optical disks, for example.

You can always add more drives by daisy-chaining another SCSI interface cable out the back of the server to a separate passive chassis or rack. But why should you have to do that? Linking multiple chassis invites problems with secondary power-system failures, cable failures, and human error. Truly scalable machines allow network administrators to include those devices in the server itself.

Finally, don't forget the importance of server-management tools and extensive documentation. Compaq is the leader in this area; its SmartStart program provides detailed diagnostic tools and comprehensive on-line help. Compaq's manuals also set the standard for other vendors to follow. Dell Computer Corp., Hewlett-Packard Co., and IBM Personal Computer Co. also supplied adequate manuals; those from the remaining vendors were sparse and often oriented more toward novice users than experienced network administrators.

SIGNING THE PURCHASE ORDER

The servers reviewed in the following pages are all packages of more or less sensible compromises; they balance power, scalability, convenience, and price in ways vendors say match their customers' needs. You're likely to find more than one system here that closely fits your network needs; indeed, considering vendors' various configurations and the apparent logic behind them can be a useful reality check for your own estimates. If you don't find a server here configured exactly the way you want, remember that in this pricey league, vendors are happy to build machines custom configured to your specs.

Acer America Corp.

• AcerAltos 7000

Modular is the first word that comes to mind when you look at the $14,773 AcerAltos 7000. Just about every component—from the Pentium/90 processor card to the hot-swappable hard disks—is designed for easy access and quick replacement. This unit, which turned in consistently average performance on our benchmark tests and is housed in a full-size tower case that offers ample expandability, is a file server worth considering if extensive fault-tolerance and remote-management capabilities are not of critical importance to you. Its price is lower than that of many other file servers in this roundup, too.

The plastic that makes up part of the exterior of the AcerAltos hides a well-built interior that can accommodate a total of 12 half-height devices. Four drive bays in our test system were occupied by 1GB Fujitsu hard disks housed in metal trays with plastic handles to facilitate removal. Four more drive bays support removable devices as well but were unoccupied in our test configuration. The remaining four drive bays are externally accessible but don't allow removable components. Two

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ZD Labs Benchmark Tests: File Servers

Our NetBench 3.0 Disk Mix tests show that a server's performance is determined primarily by its disk subsystem and network interface cards; CPU horsepower is rarely the bottleneck.

What the Numbers Mean

The best performers in this roundup maximized network throughput and minimized CPU utilization by using bus-mastering EISA- or Micro Channel–based disk and network interfaces. Throughput, or the rate at which networked workstations can transfer data to and from the server, is the usual measure of server performance. The HP NetServer 486/LF, IBM PS/2 Server 95 Array 566, and Compaq ProLiant 1000 486DX2/66 demonstrated excellent throughput at a variety of client loads, and the Dell PowerEdge SP590 was not far behind. In terms of CPU utilization—a measure of the proportion of a server's processing power required to service workstation requests—IBM and Compaq were the leaders. (Lower CPU utilization represents better performance.) The IBM PS/2 Server, the only server in this roundup that was based on a Micro Channel I/O bus, balanced throughput and CPU utilization best.

What makes these machines winners? The most significant benefits are derived from the way the disks and data are managed by the hard-disk controllers, caches, and network operating system. It's not the hard disks themselves that make the difference, though; in previous tests, we have found that disks of similar capacity, from different vendors, tend to perform almost identically. (For specifics, see "Hefty Storage on a Budget," *PC Magazine*, October 12, 1993.) The efficiency of network interface cards (NICs) affects overall throughput as well; we found that those systems with the best performance used 32-bit NICs designed for advanced buses such as EISA, PCI, and Micro Channel.

Powerful CPUs have some impact on file-server performance too, as reflected by the nominally superior showings made by the Pentium/90-based systems on our tests. Generally speaking, though, the CPU is not the most significant factor influencing performance; two of the three best performers in this roundup, for example, were equipped with DX2/66 processors.

The throughput results produced by the Duracom and Tangent systems exhibited an anomaly: Beyond the 48-workstation load, throughput increased noticeably, which runs counter to what we would have expected. We asked both vendors to assist us and worked with senior engineers at Novell, but we are still unable to provide a definitive explanation. We speculate that the combination of NetWare mirroring and striping with both systems' duplexed PCI disk controllers caused the data to be spread unevenly across the multiple hard disks in each system.

DISK SUBSYSTEMS

NetBench is a major stresser of a server's disk subsystem, which includes the hard disks themselves, disk host adapters, device drivers, physical I/O bus, and NetWare's RAM-based disk cache. NetWare's disk cache comes in handy when specific files are repeatedly accessed by clients, but when NetBench loads the server down with multiple client requests, the cache becomes less effective and the physical disk subsystem is called to task.

The demands on individual hard disks can be reduced by "striping" data across multiple hard disks (or spindles). Using multiple spindles can improve performance on large sequential read or write operations; also, many advanced server disk subsystems can direct individual spindles to operate independently, which enables them to service many small, pending disk data requests concurrently.

The server with the best throughput—the HP NetServer—used a total of six disks. All of the other servers used four. In every machine, half of the hard disks were used for mirroring; that is, half were used for providing a redundant copy of all data. Not surprisingly, every server used high-performance SCSI-2 hard disks.

EISA-based SCSI disk controllers were the most common, appearing in eight of the machines. PCI disk controllers showed up in six servers. IBM's RAID SCSI adapter was MCA-based. In theory, PCI-based adapters should yield better performance than EISA adapters because of PCI's higher throughput. Our test results, however, did not reflect any such performance advantage—except in the case of the HP server, which enjoyed the additional benefit of having more spindles than the others. (We let vendors provide as many spindles as they wished.) That disparity, however, does not necessarily imply that PCI is merely on a par with or inferior to EISA or MCA; other components that affect performance were not identical from machine to machine.

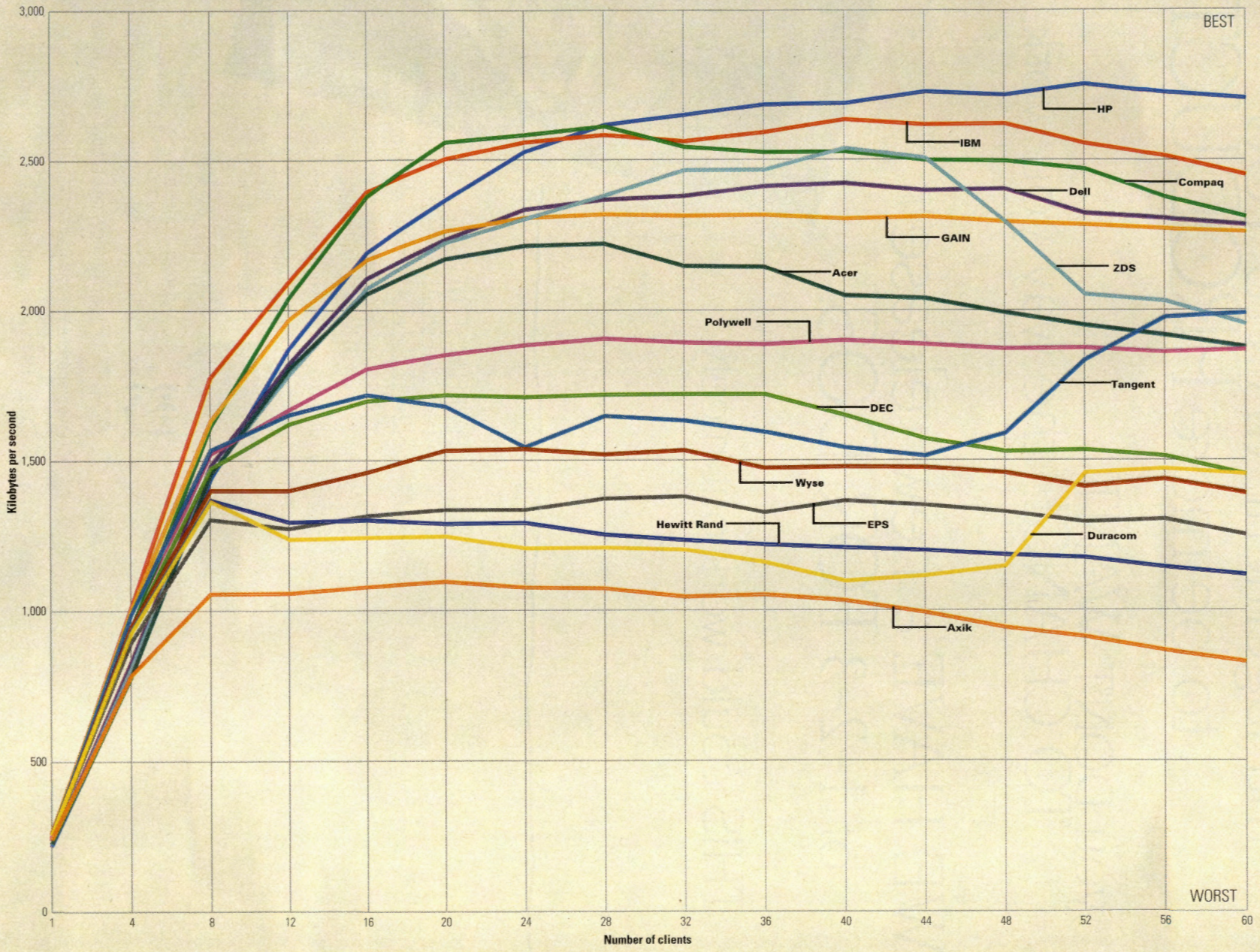
Axik Computer, Duracom Computer Systems, Hewitt-Rand Corp., HP, and Tangent Computer incorporated two disk host adapters and divided drives equally across the adapters. The use of two adapters not only provides increased data throughput but also permits full disk-subsystem duplexing, a more reliable and robust form of mirroring.

Although a number of these systems' host adapters provided hardware disk caches, it is not clear that they provided any performance advantage. We've seen situations in the past where hardware and software cache conflicts have occurred and actually hurt performance. Because of the many factors involved in server performance, the best approach to determining whether host adapter caching helps a particular system is via experimentation with workloads.

NETWORK INTERFACE CARDS

We asked vendors to supply four NICs in the machines (alternatively, we installed four Eagle NE3200 NICs provided by ZD Labs). As we increased client loads, we distributed the network workstations equally across the four Ethernet seg-

TOTAL NETWORK THROUGHPUT



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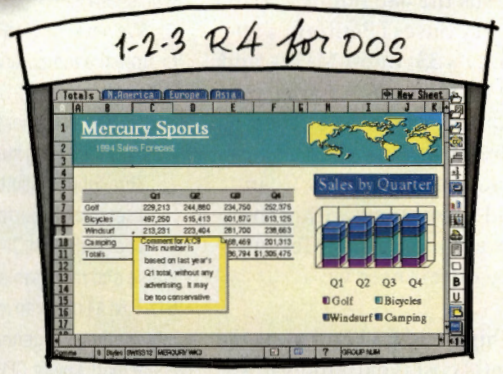

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ments driven by these NICs. Servers that used bus-mastering NICs for fast I/O buses—whether EISA, PCI, or Micro Channel—were consistently stronger performers than those that relied on ISA-based NICs, even if the ISA adapters used DMA controller–assisted bus-mastering capability. Faster buses reduce the time required to transfer data from the adapter to the system, reducing bus-bandwidth requirements. The more advanced successors to ISA also provide much more robust bus-mastering capabilities, which helps to maintain performance even when multiple adapters are vying for the bus.

It is not clear what impact bus-mastering has on CPU utilization. As more data packets are available to be processed, the CPU might be called upon to perform its packet-decoding and other NOS-processing functions, as well as bus-master traffic-control functions, more frequently.

Axik, Duracom, EPS, and Hewitt-Rand all used 3Com 3C509 ISA NICs, but the rest of the vendors chose boards with more advanced bus architectures. It appears that systems using either 3Com 3C579 or 3Com 3C509 NICs suffered from higher CPU utilization than did those with other NICs.

PROCESSOR AND MEMORY SUBSYSTEM

The HP NetServer and the Compaq ProLiant—both based on 486DX2/66 processors—prove that a server does not need an ultra-fast processor to produce top-notch performance if its I/O subsystems are tuned well. But that is to be expected: In most cases, the file server does very little calculating of its own. Most of the time, it simply responds to requests for data. So with efficient bus-mastered disk controllers and NICs, a file-server's CPU operates mostly as a traffic cop directing operations among the various adapters.

In theory, the design of a file server's memory subsystem can affect performance on our tests because of NetWare's software disk caching. When the server attempts to read a block of data and scores a cache hit, its performance will be determined by how quickly it can move the data from the cache. Thus we would expect processors with wider memory buses (Pentium's 64-bit bus versus the 486 family's 32-bit bus, for example) and faster memory buses (Pentium's 60- or 66-MHz bus versus the 486 family's 33- or 50-MHz), and with more sophisticated L2 cache architectures, to perform somewhat better on the whole. And we did in fact observe a nominal performance benefit correlating with these factors. (Because our tests act like applications, though, they cannot isolate the effects of individual subsystems within the server, so we cannot be sure these architectural differences were the cause of the performance differences we observed.)

Still, there are reasons to buy a high-end CPU for your file server. For one thing, the incremental cost is extremely low. If you are planning to spend $10,000 or $20,000 on a file server, it would certainly be worth your while to build in some room to grow.

READING THE CHARTS

The network throughput numbers reported at each client load indicate how much data the server was able to process from the network clients, in kilobytes per second. Our test results reflect the effects of caching on the network workstations, since this caching also affects performance in real-world applications. As a result, it is not possible to determine from the throughput results exactly how much data was actually being transferred across the network cables. In fact, the observed throughput in some cases exceeded the 10-megabit-per-second maximum throughput (achievable in theory) and 3- to 4-Mbps throughput (achievable in practice) of Ethernet.

CPU utilization results indicate how much of the processor's computing capacity was required to service workstation requests. Lower numbers represent better performance, because they indicate that more of the CPU's processing power was available for other tasks. Servers that reached 100 percent CPU utilization with a relatively small number of clients are not well suited to demanding LAN environments.

For detailed information on NetBench 3.0, see the Lab Notes column in this issue.—*Analysis written by Nick Stam*

How We Tested

We tested these file servers running NetWare at ZD Labs in Foster City, California. Our 60-node network there consisted of four Ethernet segments, each of which included ten 486DX/33 PCs and five 386DX/33 PCs from various manufacturers.

We tested each server under 16 different load conditions. We began with one workstation, and then increased to four; thereafter, we added clients in increments of four, reaching a maximum load of 60 clients. The client workstations were evenly distributed across the four Ethernet segments.

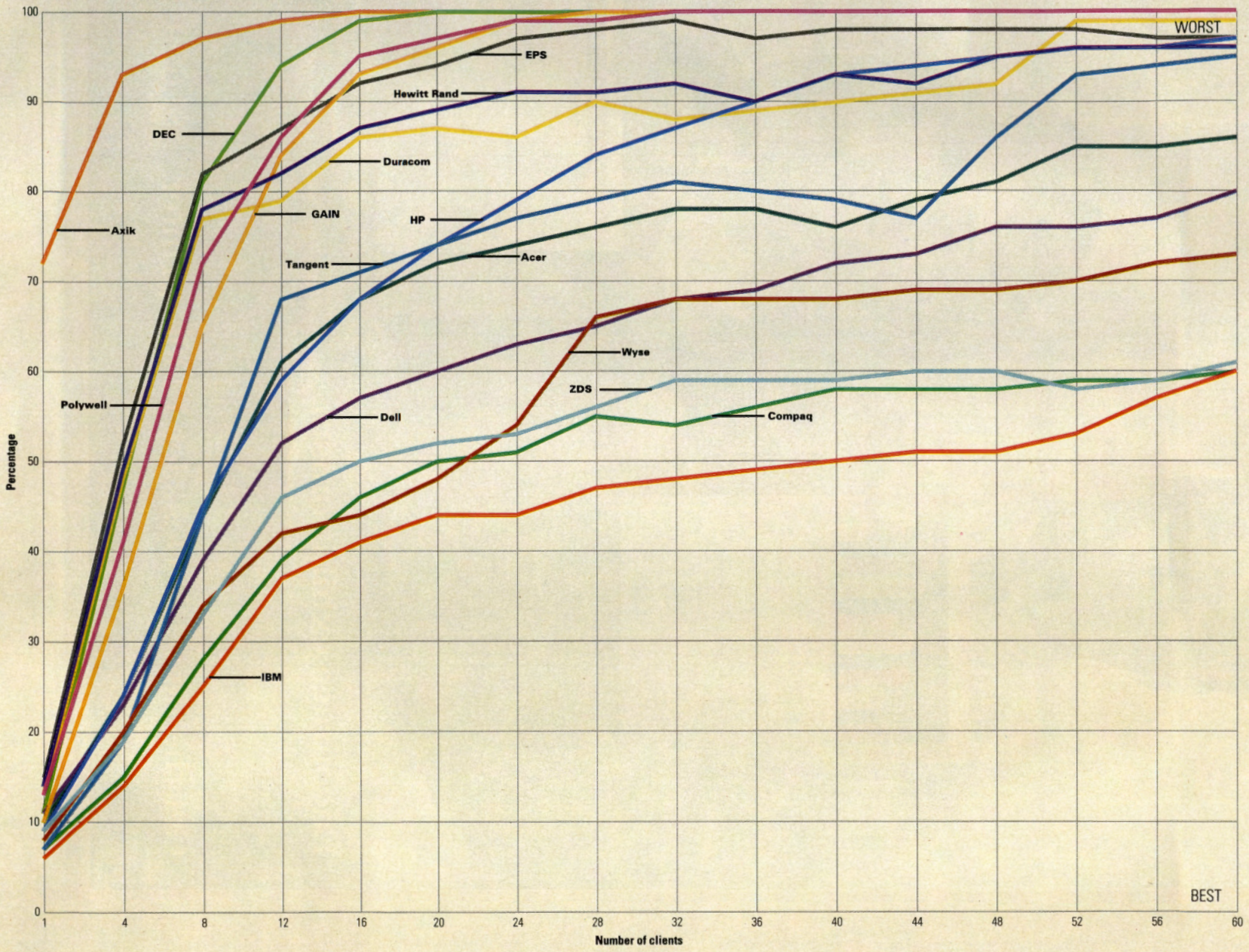
Our throughput results were generated by the **Disk Mix** portion of NetBench, Version 3.0. NetBench's Disk Mix presents application-level read and write requests through NetWare client software that runs on each workstation; the requests then get transported through the physical network to the server. Since during each test multiple workstations are constantly firing requests at the server, results of a test with a number of NetBench nodes might actually represent performance typical of a larger network using less demanding workstations.

We set each NetBench client to use 20MB of hard disk space on the server to store the temporary files that the test uses for reads and writes—a total of 1.2GB of data at the 60-client maximum. NetBench generates read and write requests in a manner that mimics the functioning of real applications, based on extensive profiling studies.

Throughput results are reported in kilobytes per second; higher results represent better performance.

The NetBench Disk Mix runs for 11 minutes at each load level to ensure stable and repeatable results. During the entire run, we use NetWare's STAT.NLM utility to monitor CPU utilization at 1-second intervals. Using this information, we generated the CPU utilization scores for each server at each client load. Lower CPU utilization numbers represent better performance; a 100-percent CPU utilization score indicates that the CPU was completely saturated at that client load. STAT.NLM itself uses a minimal amount of CPU resources and is considered a fixed overhead in all tested servers.

CPU UTILIZATION



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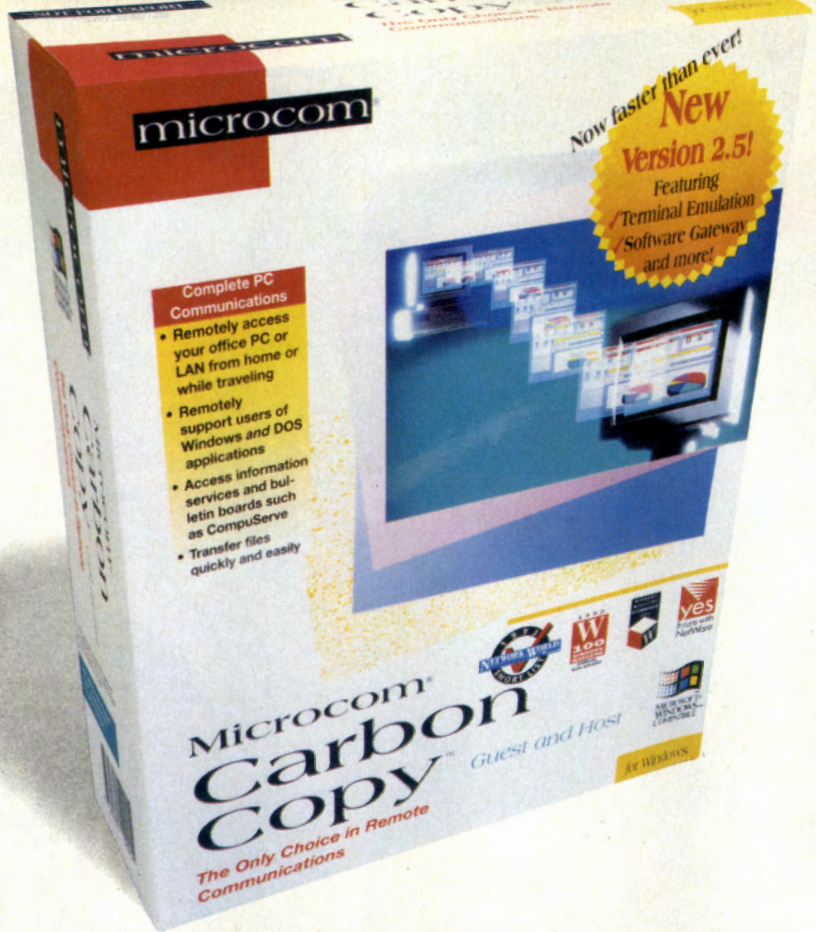

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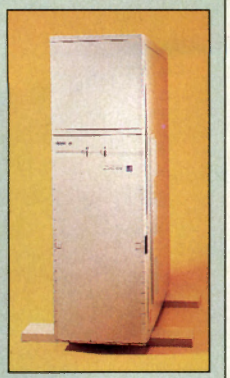
AcerAltos 7000



List price (tested configuration): $14,773. **Processor/memory:** Intel Pentium/90, 64MB RAM, 256K write-back cache. **Data storage:** Four 1GB Fujitsu M2694ES-512 hard disks, Distributed Processing Technology PM2122 EISA SCSI controller card with 16MB cache, Sony CDU-561 CD-ROM drive. **Network cards:** Four Eagle NE3200 EISA. **Power supply:** 350-watt. **In short:** The AcerAltos 7000 offers average performance at an aggressive price. Strengths include 12 externally accessible drive bays and hot-swappable hard disks.

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SUITABILITY TO TASK	
Expandability/ Scalability	EXCELLENT
Security/Fault tolerance	FAIR
Server management	POOR
Performance	GOOD

of them were occupied in our test unit: one by a 3.5-inch floppy disk drive, the other by a Sony CDU-561 CD-ROM drive. A 350-watt power supply provides more than enough power to drive a dozen devices, although you'll need Y connectors to attach more than ten.

The system's motherboard is relatively free of clutter and provides easy access to the system's components. Eight EISA expansion slots, two of them with VL-Bus extensions, are provided; all eight slots support bus mastering. A proprietary slot is provided for the processor card.

One EISA slot was used by a DPT SCSI controller card with 16MB of cache. The hard disk controller supports RAID Level 5 in addition to the RAID Level 1 mirroring that we tested. Four other EISA slots were occupied by the Eagle NE3200 NICs that were provided by our labs but included in the price of the system. (When we acquired the systems, we told vendors that they could supply their preferred network cards or let us install the NE3200s.) Surprisingly, Acer included an S3-based VL-Bus graphics accelerator card—probably overkill given that high-end video is not a critical component of file servers.

The motherboard provides only four SIMM banks (all of which were full in the configuration we tested), but the processor card offers an additional four SIMM banks, allowing for memory expansion up to 256MB. Also provided is a 256K write-back processor cache, expandable to 1MB.

On our NetBench 3.0 Disk Mix tests, the AcerAltos placed squarely in the middle of the test pack. Its network throughput peaked at 28 clients and diminished slightly as more clients were added. On the whole, however, this server's performance was fair: Its throughput, on the average, was about 80 percent that of the HP NetServer 486/LF, which led this test group. This unit's CPU utilization topped 80 percent only after reaching 48 clients—surpassing many of the tested machines, some of which reached 100 percent with the same client load, or a smaller one.

Aside from the hot-swappable drives, the AcerAltos doesn't provide any unusual fault-tolerance features or server-management capabilities. Its manual is years behind the times, too, with discussions of obsolete topics such as interleaving factors and ESDI hard disks. Nevertheless, the server's sensible design, excellent expandability, and moderate performance are all appealing. Acer provides a three-year warranty with this system, which includes parts and labor as well as on-site service.—*William P. Flanagan*

Axik Computer Inc.

• Axik NetPower Enterprise Server Series-I

The Axik NetPower Enterprise Server Series-I, which is powered by a DX4/100 processor, finished last on all of our performance tests. And with a price of $24,599, it is also the most expensive file server in this roundup. Despite the Axik NetPower's well-designed case, which provides easy access to the server's internals, these drawbacks are difficult to overlook.

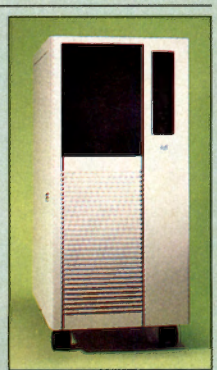
The Axik NetPower's network throughput was consistently lower than that of the other file servers we tested. With moderate to heavy client loads, throughput was only one-third to one-half as high as that demonstrated by the leaders in this roundup. The reason for this is clear: With only a single client, the Axik NetPower's CPU utilization reached 72 percent; with just four clients, CPU utilization was 90 percent.

Under moderate to heavy client loads, the Axik unit maintained throughput only a third to a half as high as that of its competitors.

We suspect this poor showing on our tests was a result of the 3Com 3C509 ISA network interface cards used in the system. Axik originally shipped this server with four 3Com 3C579 EISA-based NICs, but with this configuration we experienced random lost connections among the client workstations. We worked with

▶ FACT FILE

Axik NetPower Enterprise Server Series-I



List price (tested configuration): $24,599. **Processor/memory:** Intel DX4/100, 64MB RAM, 1MB write-back cache. **Data storage:** Four 1.7GB Seagate ST11950N SCSI-2 hard disks, two Adaptec AHA-2740AT TwinChannel EISA SCSI-2 controllers, NEC CDR-510 CD-ROM drive. **Network cards:** Four 3Com 3C509 ISA. **Power supply:** 450-watt. **In short:** With the worst performance and highest price of all units in this lineup, in addition to a poorly integrated motherboard, the Axik NetPower Enterprise Server Series-I has little appeal.

Axik Computer Inc., 268 Santa Ana Ct., Sunnyvale, CA 94086; 800-234-2945, 408-735-1234; fax, 408-735-1437.

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SUITABILITY TO TASK	
Expandability/ Scalability	GOOD
Security/Fault tolerance	POOR
Server management	POOR
Performance	POOR

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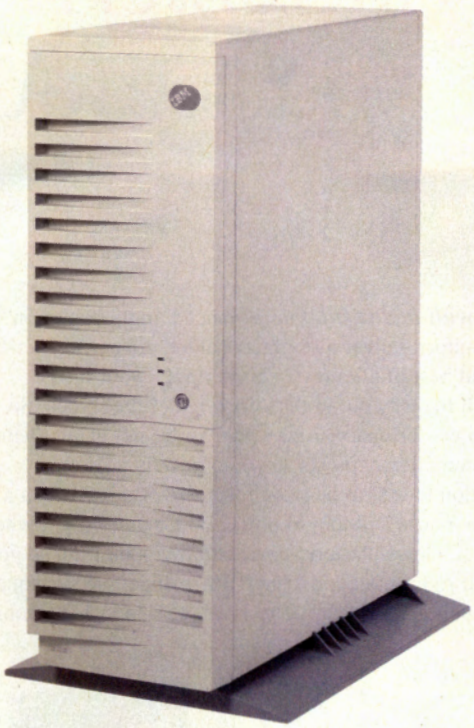

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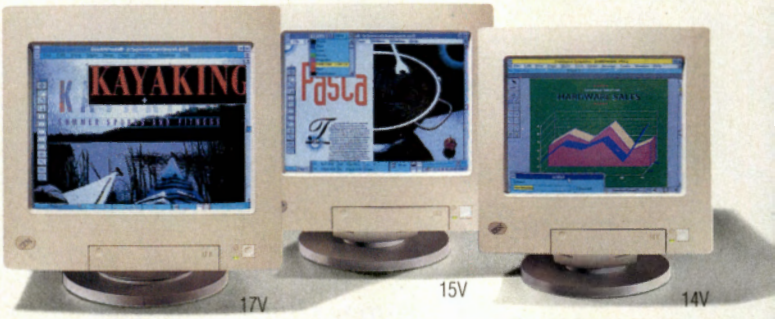

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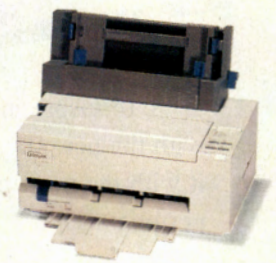

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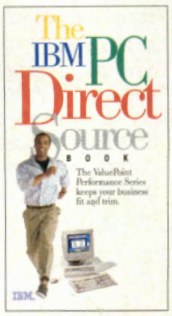

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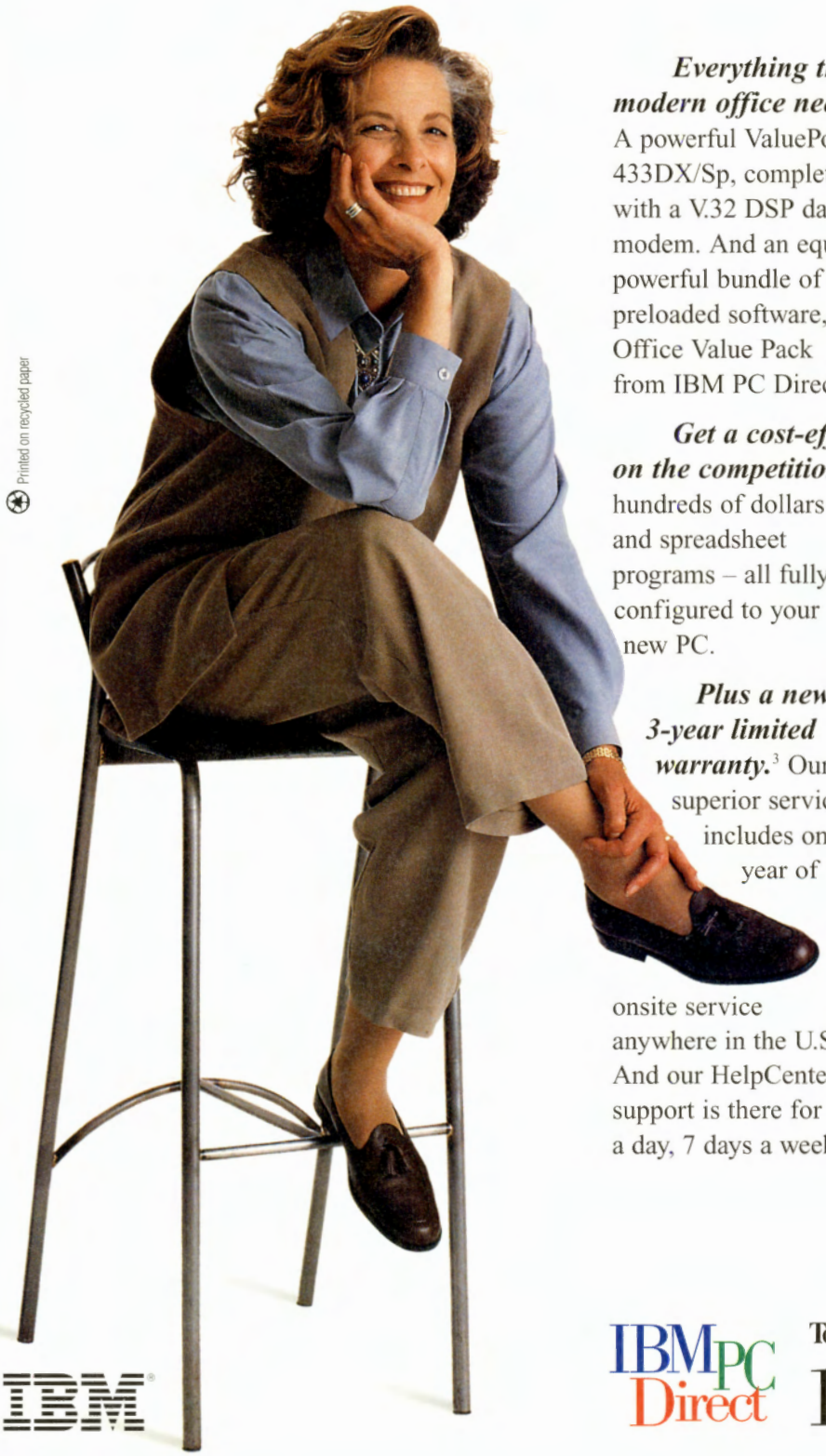



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Axik but were unable to resolve the problem. After consultation with the company, we removed the network cards and replaced them with the 3Com 3C509 cards.

The Axik NetPower shipped with two Adaptec TwinChannel EISA SCSI-2 host adapters, each of which controlled two 1.7GB Seagate hard disks. This arrangement provided substantially more storage space than we required (our minimum test requirement was 2GB), and it also provided superior fault tolerance. But the Axik NetPower does not allow you to hot-swap failed hard disks.

One of the Axik NetPower's greatest assets is its high-quality tower case. Aside from being 3 to 4 inches wider than most cases in this server roundup, it provides easy access to the system's nine 5.25-inch half-height drive bays and eight full-length EISA slots (two of which have VL-Bus extensions). A lack of integration on the motherboard, however, meant that all eight expansion slots were occupied in our test configuration. (A graphics card and a serial/parallel I/O card used two of the slots.)

The case's lockable front panel is hinged, and both side panels slide off easily, so changing hard disks is a snap. The tower case also includes a sliding door that protects both the power switch and the reset button from accidental contact. Below the power switch are separate in-use lights for up to five hard disks. And because of the large, locking wheels on the bottom of its case, the Axik NetPower server is easy to move around.

This server can accommodate 128MB of RAM in its four SIMM slots (two of which were filled in our test system). The system's write-back external processor cache is 1MB; however, any performance benefits derived from this larger cache were not apparent on our tests.

A 450-watt power supply provides connectors for up to nine separate devices. In addition to the fan in the power supply, there are two large fans that blow cool air toward the expansion slots, while a fan mounted on top of a heat sink cools this unit's DX4/100 processor.

Axik includes a one-year parts-and-labor warranty with this unit; on-site service is also included for the first year. But the Axik NetPower's relatively high price, extremely poor performance, and only moderate expansion capability make this server difficult to recommend in the configuration that we tested. —*Chul Sung Kim*

Compaq Computer Corp.

EDITORS' CHOICE

Compaq ProLiant 1000 486DX2/66

A perfect fit for businesses of almost any size, the Compaq ProLiant 1000 486DX2/66 may be the best-designed file server we tested in this roundup. The Compaq ProLiant, priced at $16,135, offers exceptional performance, superb design, and server - management capabilities that are second to none. If you're looking for a network server that won't force you to compromise, the Compaq ProLiant fills the bill.

The Compaq ProLiant offers exceptional performance and may be the best-designed file server we tested in this roundup.

On our benchmark tests, only the HP NetServer 486/LF and the IBM PS/2 Server 95 Array 566 maintained higher network throughput levels than the Compaq ProLiant. This file server's throughput increased rapidly until reaching the 28-client load; thereafter, throughput declined gradually as the number of workstations was increased.

The Compaq ProLiant's CPU utilization, which never exceeded 60 percent, was second only to that of the IBM PS/2 Server. These results are particularly impressive given that the Compaq ProLiant used the lowest-performing processor of any of the systems we tested: a 486DX2/66. The HP NetServer, which also used the DX2/66 processor, demonstrated slightly higher throughput than the Compaq ProLiant but evidenced far higher CPU utilization as well.

If you're concerned about the CPU someday becoming a bottleneck and want to support a multiprocessor-capable version of NetWare (when it's available), Compaq also sells the Compaq ProLiant 2000 and the Compaq ProLiant 4000 servers, which can support two and four processors respectively.

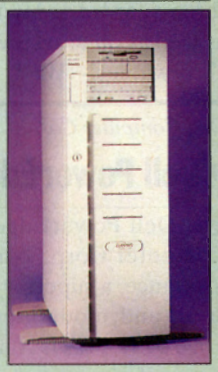
The Compaq ProLiant is one of the few EISA-based systems in this roundup that does not also support PCI or VL-Bus architecture. Seven EISA slots are provided, none of which are blocked by poorly located motherboard components. Our test server used an EISA-based Smart SCSI disk controller that, in addition to mirroring, supports RAID Levels 4, 5, and 10.

The 4MB of RAM cache on the disk controller is mirrored for fault tolerance (effectively providing 2MB) and even has a battery backup so that pending disk writes won't be lost if the power fails.

Four more EISA expansion slots were used by the Compaq NetFlex-2 Ethernet network interface cards, leaving two slots free in the tested configuration. All four SIMM sockets were filled with non-error-

FACT FILE

Compaq ProLiant 1000 486DX2/66



List price (tested configuration): $16,135. **Processor/memory:** Intel 486DX2/66, 64MB RAM, 256K write-back cache. **Data storage:** Four 1.05GB Compaq Pluggable SCSI-2 hard disks, Compaq Smart SCSI Array controller with 4MB mirrored cache, Compaq CDU-561-31 CD-ROM drive. **Network cards:** Four Compaq NetFlex-2 EISA. **Power supply:** 300-watt. **In short:** The Compaq ProLiant proves that you don't need a superfast processor to be a performance leader. This server, which offers excellent design and superior server management capabilities, is a clear winner.

Compaq Computer Corp., P.O. Box 692000, M120208, Houston, TX 77269-2000; 800-345-1518; fax, 713-378-1442.

458 on reader service card

SUITABILITY TO TASK	
Expandability/ Scalability	GOOD
Security/Fault tolerance	GOOD
Server management	EXCELLENT
Performance	EXCELLENT

correcting memory in our test unit. System memory is upgradable to 128MB; processor cache, on the other hand, is fixed at 256K.

The Compaq ProLiant includes five drive bays that allow for hot-swapping. In our test configuration, four of these bays were occupied by four 1.05GB hard disks. Of three additional externally accessible bays, two were occupied—one by the floppy disk drive, the other by a CD-ROM drive.

The server-management features that this server provides are comprehensive. Compaq's SmartStart system provides complete automation of server installation and utilities to perform ongoing hardware-maintenance and server-monitoring tasks. A thermal monitoring board in the system detects overheating conditions before they become problematic. Additionally, Compaq's Insight Manager utilities provide in-depth server performance-monitoring tools. No other server that we tested had such extensive management capabilities; nor did any have documentation that approached the quality and comprehensiveness of the Compaq ProLiant's.

This server is a well-built, well-designed system that is also a strong performer. Combine this with Compaq's three-year warranty for parts and labor, as well as on-site service, and you have a clear winner.—*WPF*

Dell Computer Corp.

• Dell PowerEdge SP590

The Dell PowerEdge SP590, from Dell Computer Corp., combines strong performance, a superior level of fault tolerance, and moderate expandability. Its price of $17,419 is competitive with other top-performing systems in this roundup as well.

The Dell PowerEdge provides six EISA slots and two PCI slots via a riser card that plugs into the system's 90-MHz Pentium motherboard. One of these slots is a shared EISA/PCI slot, allowing a maximum of seven expansion cards to be used at one time.

The motherboard's backplane design allows expansion cards to be loaded from the top of the system into the riser board. Although this design is convenient for many tasks, it does make memory upgrades difficult, because the location of the SIMM banks dictates that either the system be tipped on its side to access them or the motherboard be disconnected (via four screws) from the riser board; then various cables must be unplugged. This should not be a major problem, however, since memory upgrades are likely to occur far less frequently than expansion-card swaps.

This system's case houses eight drive bays. Four 1GB SCSI-2 hard disks, accessible via a lockable front-panel door, were connected in our test system to a Dell SCSI Array (DSA) controller card that supports hot-swapping. The DSA card provides twin SCSI channels and can support as many as 14 SCSI devices.

The Dell PowerEdge provides a good balance of price, performance, design, and support that few others matched.

Two of the remaining drive bays in our test system were occupied by the triple-speed NEC CDR-510 CD-ROM drive and the combination 1.44MB/1.2MB floppy disk drive; the other two drive bays were empty. The floppy disk drive used the motherboard's integrated controller, which is able to support up to three devices at a time. Four of the unit's six EISA expansion slots were occupied by Eagle NE3200 EISA-based network interface cards.

The Dell PowerEdge was closely grouped with the best performers in this roundup. It easily outpaced the Acer-Altos 7000 and the GAIN Vector 90ER—the other two servers in this roundup that used 90-MHz Pentium processors. The Dell PowerEdge's network throughput climbed steadily as the client load increased, until the load reached 40 workstations, at which point the server's performance began to level off.

This unit's low CPU utilization was also impressive. Even with the maximum of 60 client workstations, CPU utilization only reached 80 percent. Only the HP NetServer 486/LF, IBM PS/2 Server 95 Array 566, and Compaq ProLiant 1000 486DX2/66 turned in better overall performance results.

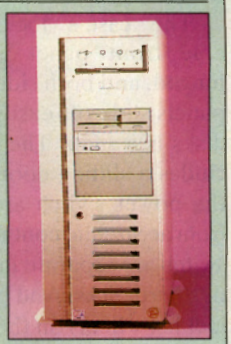
Three strategically placed fans are installed in the system to provide cooling. Two of these fans control airflow to and from the expansion cards; the other fan directs airflow toward the drive bays. Dell also installed a thermal monitoring board that checks for fan failures, power-supply defects, and processor overheating problems, any of which it will report on the monitor while sounding an alarm.

The documentation that Dell provides for the Dell PowerEdge is exceptional; it contains manuals for the system as a whole as well as manuals for various components, including the SCSI array controller card and the CD-ROM drive.

The Dell PowerEdge is a solid performer—a well-built server that is backed by a comprehensive three-year parts-and-labor warranty with one year of on-site service included. Few of the other systems in this roundup can provide better balances of price, performance, design, and support.—*WPF*

FACT FILE

Dell PowerEdge SP590



List price (tested configuration): $17,419. **Processor/memory:** Intel Pentium/90, 64MB RAM, 256K write-back cache. **Data storage:** Four 1GB DEC DSP3107L SCSI-2 hard disks, Dell SCSI Array controller with 1.5MB cache, NEC CDR-510 CD-ROM drive. **Network cards:** Four Eagle NE3200 EISA. **Power supply:** 300-watt. **In short:** The Dell PowerEdge, one of the leading performers on our benchmark tests, offers solid engineering at a competitive price.

Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759-7299; 800-613-3355, 512-338-4400; fax, 800-727-8320.

459 on reader service card

SUITABILITY TO TASK	
Expandability/ Scalability	GOOD
Security/Fault tolerance	GOOD
Server management	FAIR
Performance	GOOD

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- Steve Bass, *PC WORLD*
"Hot Picks for the Home Office" article, June 1994.

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CIRCLE 162 ON READER SERVICE CARD

Digital Equipment Corp.

• DECpc XL Server 566

Room to expand, functional design, and good performance are three of the things that you might look for in a file server. Digital Equipment Corp.'s 66-MHz Pentium-based DECpc XL Server 566 meets two of these three criteria. Its weak spot was performance; the $14,900 DECpc XL simply did not match the impressive results of similarly priced competitors.

Not quite a full-size tower and not small enough to be categorized as a minitower, the DECpc XL is not as spacious as some units in this roundup. There are nine drive bays in the system, one of them specifically for the 3.5-inch floppy disk drive. Above this are two bays; one contained the CD-ROM drive, and the other was empty. Under the floppy disk drive are six more drive bays, four of which were filled with 1GB Digital SCSI-2 hard disks connected to a Mylex DAC960 EISA RAID controller with 4MB of cache. The Mylex controller supports RAID Levels 1 and 5.

The hard disks can easily be removed by pressing tabs on their sides. Unlike many other systems in this roundup, however, the DECpc XL does not have externally accessible hard disks, and hot-swapping of hard disks is not supported. The system's 300-watt power supply provides ten power connectors, enough to service each drive bay without relying on Y connectors.

The motherboard is highly integrated, including video, hard disk, and I/O controllers as well as five EISA slots and three PCI slots. After four 3Com 3C579 EISA-based network interface cards and the Mylex EISA-based disk controller were installed for testing, two PCI slots were still available.

The DECpc XL Server 566 also had 64MB of memory with 256K of write-back cache. System memory is expandable to a total of 256MB. The processor cache, however, is fixed at the standard 256K.

One proprietary expansion slot held the unit's processor card. The processor itself is seated in a standard socket on this daughterboard; upgrades are facilitated by replacement of this card. The unit is upgradable to a higher-powered Pentium processor or to a Digital Alpha AXP processor by swapping the daughterboard and upgrading the system's flash BIOS. Since the new higher-performance Pentium and Alpha processors both require 3.3 volts to operate, the processor daughterboard accommodates either voltage, and the power supply has regulators to supply both voltages.

On our benchmark tests, the DECpc XL Server 566 couldn't keep pace with the majority of systems in this roundup. The unit generally provided poor network throughput. At its peak of 36 users, the system never matched the throughput some other systems achieved with fewer users. Its throughput was also significantly lower than the GAIN Vector 90ER's, which used the same Mylex disk controller card. One possible explanation for this discrepancy is that the GAIN Vector's Mylex controller card had 16MB of cache, while the Mylex controller card Digital chose only had 4MB of cache.

The DECpc XL also fell short on CPU utilization. The server reached 99 percent CPU utilization at only 16 clients.

The DECpc XL Server 566 might work well as file server for a small, undemanding network that is not growing quickly. But given the fact that the DECpc XL's price is roughly comparable with the top performers in this roundup (namely the HP NetServer 486/LF, the Compaq ProLiant 1000 486DX2/66, and the IBM PS/2 Server 95 Array 566), its lackluster performance may not be justifiable.

The DECpc XL also does not include any local or remote system-management features. The system's warranty, though, is competitive: three years on parts and labor with on-site service included. —*WPF*

▶ FACT FILE

DECpc XL Server 566



List price (tested configuration): $14,990. **Processor/-memory:** Intel Pentium/66, 64MB RAM, 256K write-back cache **Data storage:** Four 1GB Digital RZ26-L SCSI-2 hard disks, Mylex DAC960 EISA RAID controller with 4MB cache, Toshiba XM-4101-TA CD-ROM drive. **Network cards:** Four 3COM 3C579 EISA. **Power supply:** 300-watt. **In short:** The DECpc XL Server 566 is an average system; it did not excel in performance and comes up short in expandability and fault tolerance.

Digital Equipment Corp., 146 Main St., Maynard, MA 01754; 800-722-9332; fax, 800-524-5694.

460 on reader service card

SUITABILITY TO TASK	
Expandability/ Scalability	EXCELLENT
Security/Fault tolerance	POOR
Server management	POOR
Performance	FAIR

Duracom Computer Systems

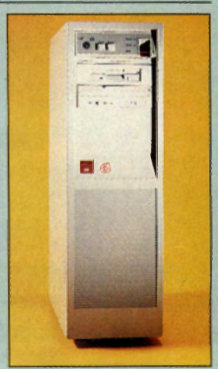
• Duracom FilePro 586/66

Duracom Computer Systems' Duracom FilePro 586/66 was not a strong performer on our benchmark tests. But with a price tag of just $8,199, it is one of the least expensive servers in this roundup.

The chief liabilities of this 66-MHz Pentium server are limited expandability and an uninspired case design. The Duracom FilePro does provide duplexing with a pair of PCI-based NexStor SCSI-2 host adapters. The server does not, however, support hot-swapping of its hard disks.

▶ FACT FILE

Duracom FilePro 586/66



List price (tested configuration): $8,199. **Processor/memory:** Intel Pentium/66, 64MB RAM, 256K write-back cache. **Data storage:** Four 1GB Micropolis 4110 SCSI-2 hard disks, two NexStor NXT-93 PCI controllers, Plextor DM-3028 CD-ROM drive. **Network cards:** Four 3Com 3C509 ISA. **Power supply:** 250-watt. **In short:** The Duracom FilePro 586/66, one of two PCI- and ISA-based servers in our roundup, turned in unimpressive performance results and permitted limited expandability.

Duracom Computer Systems, 1425 Greenway Dr., #650, Irving, TX 75038; 800-551-9000, 214-518-1200; fax, 214-518-1090.

461 on reader service card

SUITABILITY TO TASK	
Expandability/ Scalability	FAIR
Security/Fault tolerance	POOR
Server management	POOR
Performance	FAIR

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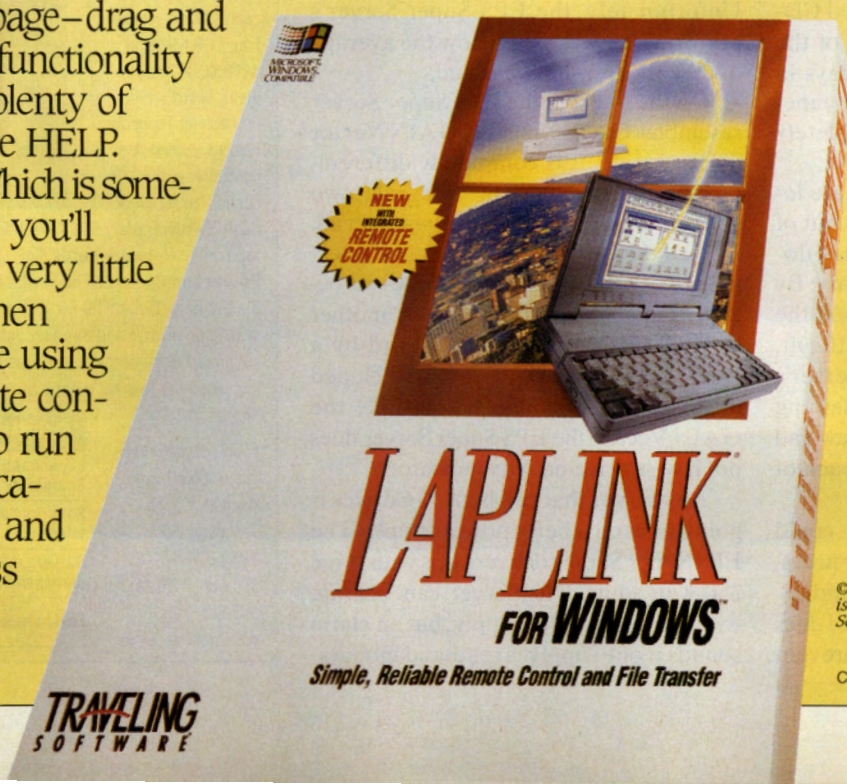

TRAVELING SOFTWARE

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CIRCLE 088 ON READER SERVICE CARD

The Duracom FilePro's motherboard has both ISA and PCI expansion slots—a rare design in the world of servers. With five ISA and three PCI slots (one of the PCI slots shares a space with an ISA slot), the system's expansion capability is barely adequate. The lack of an integrated graphics controller further exacerbates the expansion limitations. Duracom FilePro's one parallel port, one PS/2 mouse port, and two serial ports are built into the motherboard; otherwise, it would be impossible to retain these ports and still have space left for the four 3Com 3C509 ISA network interface cards and the two SCSI-2 adapters.

The Duracom FilePro had two dual PCI disk controllers, each of which was connected to a pair of Micropolis 4110 1GB hard disks to provide full duplexing. Despite this, the server's performance was unimpressive. The machine's network throughput was consistently below average, reaching only about half that turned in by the fastest servers in this roundup.

The Duracom FilePro's CPU utilization was poor as well, topping 80 percent at only 16 clients—bad news if you have a growing network. This poor showing is likely the result of the Duracom FilePro's 3Com 3C509 ISA network interface cards, which could not exploit bus mastering to reduce the processor's workload.

The system's four hard disks, 3.5-inch floppy disk drive, and double-speed CD-ROM drive occupied all but one of the Duracom FilePro's seven drive bays in our tested configuration. Add a tape-backup unit, and you will be completely out of bays and slots.

Three drive bays in this server are located in a hinged cage that swings out of the chassis, making the installation of drives into these bays exceptionally easy. By contrast, gaining access to two of the other drive bays is much more difficult, requiring you to open both of the server's side panels. This operation is something of a chore, since you have to unscrew and remove the plastic cover on the back of the server first.

The Duracom FilePro's case could stand improvement in a few other areas, too. It has only one drive-activity indicator for all the installed hard disks and does not offer a protective cover to prevent tripping the power switch or reset button accidentally. Also, it is a minor inconvenience that the various ports on the back of the machine are not labeled.

The Duracom FilePro accommodates a maximum of 128MB of system memory in four SIMM slots. The system came with 256K of external processor cache. The system's primary fan is supplemented by a small fan mounted on the Pentium/66 processor's heat sink.

The Duracom FilePro 586/66's low price and duplexed hard-disk subsystem are certainly appealing, but sluggish performance and limited expandability make this server best suited for smaller networks that are not likely to grow much.

Duracom Computer Systems backs this unit with a one-year parts-and-labor warranty, with the first year of on-site service included.—*CSK*

EPS Technologies Inc.

• EPS Super Server Goliath P5-66 SSBKP

A case the size of a small refrigerator, 16 half-height drive bays, and three redundant power supplies are just some of the features included with EPS Technologies' aptly named Super Server Goliath P5-66 SSBKP.

This machine's strengths lie in its impressive expandability and fault tolerance. At $11,525, the price is right, too. Unfortunately, the EPS Super Server's performance was well below the average of the other servers we tested.

On the outside, the EPS Super Server resembles GAIN Systems' GAIN Vector 90ER. Inside, it is completely different. Opening the side panel reveals two columns of internal drive bays—12 in all. Behind the front panel are 4 more externally accessible bays; one of these was occupied by a 3.5-inch floppy drive, another by a CD-ROM drive, and a third by a DAT tape drive. All drives are included in the standard configuration. Like the GAIN Vector, the EPS Super Server does not have a drive-activity indicator.

Any server that can house 16 drives is going to need a hefty power supply. The EPS Super Server delivers this with three 250-watt units. The server can operate with only one power supply, but an alarm sounds if one supply is rendered inoperative and then changes to a more urgent pitch if a second power supply fails.

There is no shortage of cooling power in this box, either. In addition to a fan in each power supply, two large fans at the top of the chassis force air toward the hard disks, while two smaller fans mounted on an expansion card blow air over the motherboard. EPS Technologies puts a fan on top of the Pentium's heat sink as well.

Six SIMM slots permit up to 192MB of memory. The Pentium's on-board caches are complemented by 512K of L2 processor cache. There are five EISA and three PCI slots; one of the PCI slots is shared. Two of the EISA slots cannot accommodate full-length expansion cards because of the positioning of the CPU fan. Graphics and I/O controllers are not integrated onto the motherboard, so two slots were taken by an Orchid PCI Kelvin II card and a serial/parallel adapter. In our test machine, a RAID controller and four Ethernet adapters filled all the EISA slots, leaving nothing open.

▶ FACT FILE

EPS Super Server Goliath P5-66 SSBKP



List price (tested configuration): $11,525. **Processor/memory:** Intel Pentium/66, 64MB RAM, 512K write-back cache. **Data storage:** Four 1GB Micropolis 4110 SCSI-2 hard disks, Distributed Processing Technology PM2122/95 EISA controller with 8MB cache, Texel DM-3028 CD-ROM drive, WangDAT DAT 4000DI-4N SCSI-2 tape drive. **Network cards:** Four 3Com 3C509 ISA. **Power supply:** Three 250-watt. **In short:** The EPS Super Server Goliath P5-66 SSBKP offers an impressive 16 drive bays and three redundant power supplies, but its performance was below average and its server-management features are limited.

EPS Technologies Inc., 10069 Dakota Avenue, P.O. Box 278, Jefferson, SD 57038-0278; 800-447-0921, 605-966-5586; fax, 605-966-5482.

462 on reader service card

SUITABILITY TO TASK	
Expandability/ Scalability	EXCELLENT
Security/Fault tolerance	GOOD
Server management	POOR
Performance	FAIR



Paul - Manager/Parent :

"I needed a performance boost for my PC. It took a long time for my charts and presentations to appear on the screen. The colors were flat and limited. And my son's games ran slowly. But, I wasn't ready to buy a whole new system.

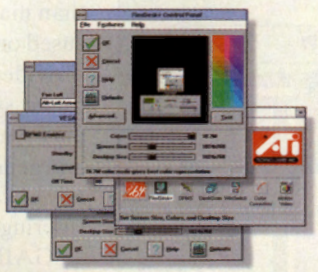
"Fortunately, I got great advice. For *just $299****, I got ATI's GRAPHICS XPRESSION. It revived my whole system.

"My friend had one. Windows snapped open quickly. Charts popped up on his screen. The *blazing speed*, 37M Winmarks*, was incredible. He said it offered *best value for price/performance.* And the improvement in color graphics and detail were most impressive.



WinSwitch changes color and resolution without leaving Windows

"Then, he showed me the features. WinSwitch allowed him to switch between true color mode or high resolution mode without exiting Windows. And ATI's FlexDesk+ software gave him *total control* over color, desktop size, resolution and even motion video acceleration.



FlexDesk+ easy control of desktop settings

"Finally, he told me it was the only affordable 64-bit accelerator for my ISA system. I rushed out to buy one. *Installation was easy.* There were no switches to set and the software guided me through the installation process. And I was amazed, it even came with a complete set of drivers for Windows, Windows NT, OS/2, CAD and DOS.

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The EPS Super Server came equipped with four 3.5-inch Micropolis 1GB SCSI-2 hard disks attached to a DPT RAID controller with an 8MB cache. The potency of this hardware combination was stunted by the four ISA network cards that EPS Technologies chose to install. The server's network throughput leveled off at only eight clients, at which point CPU utilization had already reached more than 80 percent. As the workload increased and CPU utilization climbed to nearly 100 percent, the EPS Super Server was able to sustain only about half the throughput of the leaders in this roundup. Similar bottlenecks were apparent in the other systems that used ISA-based network interface cards.

One particularly weak spot of the EPS Super Server is documentation. We were not provided with a manual for the system itself; we received only a collection of component manuals that were not even specific to servers.

EPS Technologies' offers a three-year parts and a one-year labor warranty for the EPS Super Server, with the first year of on-site service included. If you are more interested in extensive expandability than performance, the EPS Super Server Goliath P5-66 SSBKP deserves your consideration.—*CSK*

GAIN Systems Inc.

• GAIN Vector 90ER

The first word that should come to mind when you look at the GAIN Vector 90ER, from Gain Systems, is *big*. It features substantial memory and disk capacity, above-average performance, and a cavernous case that leaves plenty of room for growth. Its price tag is also big; at $19,726, it is comparable with the prices of the leading machines from Compaq, Dell, Hewlett-Packard, and IBM. The GAIN Vector's weakness is that it does not provide the same level of management features that help to justify the prices charged by the competition.

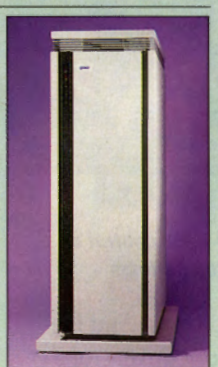
The GAIN Vector uses a highly flexible motherboard/daughterboard configuration. The 90-MHz Pentium CPU and external processor cache reside on one daughterboard, so upgrading to a faster processor is as easy as swapping a card. An optional error-checking and correcting (ECC) memory board, which GAIN Systems shipped in the tested server, holds up to 12 memory modules. Four SIMM slots are located on the motherboard. Because RAM was on the memory board in the tested unit, all four SIMMs slots were empty. In all, you can install a whopping 384MB of memory in the GAIN Vector.

Built-in video, parallel, serial, and floppy disk drive ports let you make the most of the GAIN Vector's eight EISA expansion slots. If both the optional memory board and the Mylex RAID controller are installed, however, one EISA slot is blocked. Even loaded up with four 3Com Ethernet adapters, however, the GAIN Vector still left us two usable EISA slots—more than most.

The GAIN Vector's large, sturdy case is similar to that found in the EPS Super Server Goliath P5-66 SSBKP. It is exceptionally roomy, facilitating easy access to any internal component. The hinged front panel is lockable, the side panels are easy to remove, and the ports are clearly labeled. A pair of redundant power supplies provide an added measure of dependability. Two large fans above the main cluster of drive bays keep air moving.

▶ FACT FILE

GAIN Vector 90ER



List price (tested configuration): $19,726.
Processor/memory: Intel Pentium/90, 64MB RAM, 512KB write-back cache. **Data storage:** Five 1.75GB Seagate ST-12450W hard disks, Mylex DAC960 EISA controller with 16MB cache, Toshiba XM-3401B CD-ROM drive. **Network cards:** Four 3Com 3C579-TP EISA. **Power supply:** Two 250-watt. **In short:** The GAIN Vector 90 ER offers excellent expandability, strong fault tolerance, and mostly above-average performance.

GAIN Systems Inc., 6025-D Unity Dr., Norcross, GA 30071; 800-849-4246, 404-446-2026; fax, 404-446-2028.

463 on reader service card

SUITABILITY TO TASK	
Expandability/ Scalability	EXCELLENT
Security/Fault tolerance	EXCELLENT
Server management	POOR
Performance	GOOD

With a total of 12 drive bays, the GAIN Vector offers plenty of room for growth. Three of the bays are found behind the front panel; one of these was occupied by a 3.5-inch floppy disk drive and another by a double-speed CD-ROM drive. The remaining 9 bays, each suitable for a 3.5-inch half-height mechanism, are at the top of the chassis so that installed drives lie on their side. GAIN Systems provides enough power connectors for all 12 bays.

The unit we tested was equipped with five Seagate 1.75GB Wide SCSI-2 hard disks. Only four of the hard disks were actually active; the fifth was provided as a hot spare that goes on-line automatically if one of the other hard disks fails. (This is particularly useful since the hard disks are not hot-swappable.) Disk I/O was handled by a Mylex dual-channel RAID controller with 16MB of cache. This potent storage configuration allowed the GAIN Vector to post above-average throughput, coming in just behind the leaders. The server's CPU utilization was not as competitive, though: It topped 80 percent at only the 12-client workload and reached 100 percent at 28 clients.

GAIN Systems' documentation for the GAIN Vector was more voluminous than many vendors', but it was not as focused on server-related issues as was that provided with some of the other well-tuned systems we tested. The system's massive expandability, fault tolerance, and generally solid performance, however, make the GAIN Vector worth considering.

GAIN Systems offers a one-year parts-and-labor warranty, with the first-year of on-site service included.—*CSK*

Hewitt Rand Corp.

• HR Mission Critical

Despite the serious-sounding name, Hewitt Rand's HR Mission Critical is basically just a PC stood on its side. The HR Mission Critical has fault tolerance no better than most of the servers we tested. Even though the server is extremely inexpensive at $4,588, it doesn't provide the performance, reliability, scalability, or management features to support even a moderately sized network; managers of truly mission-critical applications would

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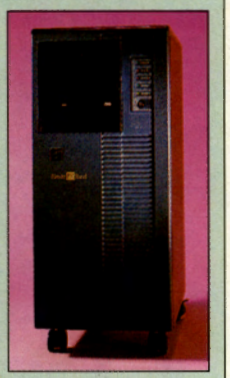
CIRCLE 067 ON READER SERVICE CARD

▶ FACT FILE

HR Mission Critical



List price (tested configuration): $4,588. **Processor/memory:** Intel Pentium/66, 64MB RAM, 256K write-through cache. **Data storage:** Two 1.8GB Quantum ProDrive 1800S SCSI-2 hard disks, two 1.4GB Quantum Empire SCSI-2 hard disks, two NexStor NXT-93 PCI controllers, Toshiba XM-3401B CD-ROM drive. **Network cards:** Four 3COM 3C509 ISA. **Power supply:** 300-watt. **In short:** The HR Mission Critical server is extremely inexpensive, but its ISA/PCI design limited its performance.

Hewitt Rand Corp., 8661 154 Ave. NE, Redmond, WA 98073-0718; 800-869-7074, 206-869-5555; fax, 206-869-5151.

464 on reader service card

SUITABILITY TO TASK	
Expandability/ Scalability	FAIR
Security/Fault tolerance	POOR
Server management	POOR
Performance	FAIR

be better off turning to another server.

The HR Mission Critical uses a 66-MHz Pentium processor, but the system's ISA/PCI motherboard is a limiting factor in its design. The 16-bit ISA bus cannot match the throughput possible with the 32-bit EISA buses used by most of the servers we tested, nor does ISA provide the robust bus-mastering capabilities that many network interface cards rely on to reduce CPU overhead.

The system has a total of five ISA slots and three PCI slots; one of the PCI slots is shared. Hewitt Rand filled the other two PCI slots with a pair of NexStor NXT-93 disk controllers, relegating the four 3Com 3C509 network interface cards to the slow ISA slots. The impact of this decision was evident in the HR Mission Critical's performance: Only the Axik NetPower Enterprise Server Series-I turned in worse throughput results.

The HR Mission Critical's throughput peaked with only 8 workstations and then declined gradually as loads increased. Under heavier loads, the HR Mission Critical maintained only about half the throughput of the leaders in this roundup. The server's CPU utilization was similarly poor, topping 80 percent at the 12-client workload and increasing from there.

For a system that calls itself Mission Critical, the Hewitt Rand server employs few strategies to enhance fault tolerance. The unit's case provides eight drive bays, but none of the hard disks is hot-swappable. There is only a single power supply and no heat monitoring or remote-notification capability. The extent of the system's redundancy does not go beyond its RAID Level 1 mirroring (which we required of all the servers in this roundup) and duplexed disk controllers.

The HR Mission Critical's expandability comes up short, too. Hewitt Rand equipped the system with four Quantum hard disks; two of them were 1.4GB models and the other two were 1.8GB models. Because the 1.8GB hard disks are taller than half-height bays permit, the disk array required a total of six drive bays. The only other drive bays in the system were filled by the floppy disk drive and the CD-ROM drive.

Since video support is not provided on the motherboard, Hewitt Rand provided an ATI Mach 64–based graphics card—overkill for a network server. This used up the last available expansion slot. The processor cache is fixed at 256K, and memory expansion is limited to 128MB. The four SIMM sockets on the motherboard were filled with 16MB SIMMs to meet our 64MB RAM requirement.

The HR Mission Critical's 300-watt power supply is sufficient for the expandability provided in the case. Wires from the power supply were not tied down as they were in many of the other servers we tested; this resulted in an overly cluttered interior.

Sometimes it is worth sacrificing features to save some money; if you do not need high performance in a server, you might be willing to settle for an inexpensive yet functional machine. But with its limited expandability and a design that takes more from desktop PCs than the server world, the HR Mission Critical server does not even fill that niche.

The HR Mission Critical server comes with a two-year parts-and-labor warranty. On-site service is not included but is available for $39 for the first year.—*WPF*

Hewlett-Packard Co.

EDITORS' CHOICE

HP NetServer 486/LF

The first thing you will notice about the $19,043 HP NetServer 486/LF, from Hewlett-Packard, is its advanced design. But that won't be all that impresses you. The HP NetServer's throughput was the highest of any tested server, and its server-management capabilities were far more extensive than those of the other units in this roundup.

In its design, the HP NetServer shows the same attention to detail that we've come to expect from Hewlett-Packard. To simplify access to internal components, the unit's parts are segregated into two areas. On one side of the case is the motherboard, with seven EISA and two PCI slots. We filled four of the EISA slots with Eagle NE3200 network interface cards (an option we offered the vendors in lieu of providing their preferred network interface cards); both PCI slots were occupied by Adaptec AHA2940 PCI SCSI-2 disk controllers. The motherboard has integrated I/O and graphics, leaving three

▶ FACT FILE

HP NetServer 486/LF



List price (tested configuration): $19,043. **Processor/memory:** Intel 486DX2/66, 64MB RAM, 256K write-through cache. **Data storage:** Four 535MB HP D2075B SCSI-2 hard disks, two 1GB HP D2076B SCSI-2 hard disks, two Adaptec AHA2940 PCI SCSI-2 controllers, Toshiba XM-4101TA CD-ROM drive. **Network cards:** Four Novell/Eagle NE3200 EISA. **Power supply:** 350-watt. **In short:** The HP NetServer 486/LF was one of the best performers in this roundup and is an excellent value.

Hewlett-Packard Co., 3000 Hanover St., Palo Alto, CA 94304; 800-752-0900, 303-635-1000; fax, 208-344-4809

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SUITABILITY TO TASK	
Expandability/ Scalability	GOOD
Security/Fault tolerance	GOOD
Server management	EXCELLENT
Performance	GOOD



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DECATHLON



PERFORMANCE Decathlon can run with the best of them. With a choice of Fast SCSI-2 or Fast ATA-2 interfaces, you get up to 16.6 MB/second in data throughput performance. Along with its quick 12 millisecond average seek and 4,500 rpm spindle speed, the Decathlon provides you the capability to keep pace with even the most demanding applications—including advanced multimedia.

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CAPACITY So how high does it go? Decathlon packs 545 MB in its compact configuration. And with a two-year warranty and 40,000 contact start-stop cycle reliability, you can be sure this drive is a reliable winner.

If your new system calls for the kind of efficient drive that excels in every area, Decathlon is it. Call Seagate at 408-438-8111 for more information.

Seagate

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EISA slots open. There is a proprietary CPU slot for an upgradable CPU card that contains the system's six SIMM slots.

The other side of the system holds the HP NetServer's nine drive bays. Six of these bays were filled with a duplexed hard disk array made up of two 1GB hard disks and four 535MB hard disks, all made by Hewlett-Packard. Each drive bay also has its own separate drive-indicator light.

On our tests, the HP NetServer 486/LF maintained the best throughput in the group. The results show that while a few systems posted better numbers with fewer workstations, the HP NetServer really displayed its strength with a larger number of workstations. At 24 workstations, this unit begins to show its dominance over the other systems. At 52 workstations, the system reaches a peak and then levels off with throughput numbers that were still well above average. At 60 workstations, the HP NetServer posted a throughput that was more than three times that of the Axik NetPower Enterprise Server Series-I, the slowest performer in this roundup.

On CPU utilization, the HP NetServer 486/LF was not among the top performers of this roundup, but it remained competitive. At its peak throughput of 52 workstations, this server was using 96 percent of its processor's resources. Other top performers on this test (such as the Compaq ProLiant 1000 486DX2/66 and IBM PS/2 Server 95 Array 566) reached only 60 percent CPU utilization at the maximum client load of 60 workstations.

The NetServer 486/LF also comes with an excellent set of server-management tools: HP NetServer Assistant 2.0 (a customizable software toolset that includes HP Open View for Windows 7.1) and HP Support Assistant. HP NetServer Assistant features remote management capabilities, automatic server restart, and alarms to notify you of changes in the server's status and of SCSI controller and disk problems. It also monitors the status of ECC memory and HP disk arrays.

HP Support Assistant is a CD-ROM–based information system that provides technical and product information not only for HP NetServers but also for HP Vectras, HP LaserJet printers, and other HP networking and accessory products. A year's subscription costs $395.

SUMMARY OF FEATURES CONTINUES

File Servers

List price (tested configuration) We report prices for the file servers configured as we tested them. These prices do not include the price of 100-user NetWare 3.12, however, because not all of the participating vendors have reseller licenses. To estimate the price of a server with NetWare, add approximately $4,000.

Processor All of the tested units were sent to us with one processor, except the ZDS Z-Server EX DP66E, which came to us with two Pentium/66 processors. But because NetWare can recognize only one processor, the ZDS Z-Server behaved as a single-processor machine during testing. Several other systems here support more than one CPU.

Processor location We list the socket type as well as the location of the processor. Some vendors put the processor on a card, as opposed to on the motherboard, to facilitate upgrades.

External RAM cache We list the range of external RAM cache that each server can support. For systems that come with a set amount of RAM cache that is not upgradable, we report that amount of external RAM cache.

Installable system RAM indicates the range of system memory that each server supports. Some of the tested file servers use memory cards in addition to motherboard-mounted memory to reach the maximum level of supported RAM.

RAM supports error correction Error-correcting RAM can actually correct single-bit errors; standard parity RAM can only detect them.

Bus architecture (primary, secondary) refers to the bus that connects the I/O slots to the CPU. Twelve of the reviewed servers use EISA as the primary architecture. Two use ISA, and one uses MCA. Some also include additional proprietary architectures to accommodate memory cards, extra processors, and other special-purpose cards.

We count **ISA, EISA,** and **MCA slots,** as well as **VL-Bus, PCI, and proprietary local-bus slots,** as follows: Any ISA or EISA slot with a VL-Bus extension is counted only as a VL-Bus slot. Shared ISA/PCI or EISA/PCI slots, however, are counted in both categories.

Number of bus-mastering slots indicates how many of a server's expansion-bus slots support bus mastering, which lets bus-mastering cards control their own read/write operations and thereby free the CPU to handle other tasks. Although most expansion buses support bus mastering, some systems impose a limit on the number of slots that can take advantage of this performance-enhancing feature.

RAID levels supported by disk controller Depending on the configuration, or level, of the RAID (Redundant Array of Inexpensive Disks), different combinations of data-security and data-speed features can be built into the hard disk subsystem. Some of these features include disk mirroring, parity checking, and data striping. The RAID implementation can be handled by hardware, software, or both.

If the **tested configuration supports hot-swapping,** you can replace a failed drive without shutting down the server.

Other compatible operating systems We asked each vendor to list all operating systems that run on its server. You should check further with the vendor for information on specific version numbers or operating systems not mentioned.

Power supplies (and number of connectors) We list the wattage of each power supply and the total number of connectors. The number of connectors determines how many devices the server can power without requiring Y connectors. A secondary (or redundant) power supply allows a server to keep running if the primary power supply fails.

Redundant components indicates which subsystems have backup components. This means that if one component fails, another one can continue to support the system without interruption of service. We indicate whether a server's **disk controller, power supply,** and **processor** are redundant.

A server featuring **local/remote system-management notification** will alert the network administrator when special conditions or problems occur, either at the server's console or remotely via an optional modem link.

"The IBM PS/2 Server 95 Array belongs on every system manager's short list."

Julian Evans
PC Magazine™
UK Edition
December '93



PC MAGAZINE UK EDITORS' CHOICE™

IBM PS/2 Server 95 Array
December '93

The IBM Server 95 with RAID-5

Full RAID-5 protection at RAID-0 performance levels—an impressive combination. This is a primary reason Mr. Evans urges "short listing" the IBM PS/2® Server 95 Array. An urging, we might add, that is based on extensive tests and expert comparisons against the competition.

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SUMMARY OF FEATURES

File Servers

PC MAGAZINE EDITORS' CHOICE

In alphabetical order by company ■ = YES □ = NO	AcerAltos 7000	Axik NetPower Enterprise Server Series-I	Compaq ProLiant 1000 486DX2/66	Dell PowerEdge SP590	DECpc XL Server 566	Duracom FilePro 586/66	EPS Super Server Goliath P5-66 SSBKP	GAIN Vector 90ER
List price (tested configuration)	$14,773	$24,599	$16,135	$17,419	$14,990	$8,199	$11,525	$19,726
Processor and Memory								
Processor	Intel Pentium/90	Intel DX4/100	Intel 486DX2/66	Intel Pentium/90	Intel Pentium/66	Intel Pentium/66	Intel Pentium/66	Intel Pentium/90
Processor location	ZIF socket on processor card	ZIF socket on motherboard	Standard socket on motherboard	Standard socket on processor card	Socket on processor card	ZIF socket on motherboard	ZIF socket on motherboard	Standard socket on motherboard
Maximum number of CPUs supported	1	1	1	1	1	1	1	2
External RAM cache	256K–1MB	256K–1MB	256K	256K	256K	128K–256K	256K–512K	512K
Installable system RAM	16MB–256MB	1MB–128MB	16MB–128MB	8MB–192MB	8MB–256MB	2MB–128MB	8MB–192MB	16MB–384MB
RAM supports error correction	□	□	□	■	□	□	■	■
Expansion Buses								
Bus architecture (primary, secondary)	EISA, VL-Bus	EISA, VL-Bus	EISA	EISA, PCI	EISA, PCI	ISA, PCI	EISA, PCI	EISA
ISA, EISA, MCA slots	0, 6, 0	0, 6, 0	0, 7, 0	0, 6, 0	0, 5, 0	5, 0, 0	0, 5, 0	0, 8, 0
VL-Bus, PCI, proprietary local-bus slots	2, 0, 0	2, 0, 0	0, 0, 0	0, 2, 0	0, 3, 0	0, 3, 0	0, 3, 0	0, 0, 0
Other proprietary slots	1 CPU	None	None	1 CPU	1 CPU	None	None	1 CPU, 1 RAM
Number of bus-mastering slots	8	6	7	8	8	3	6	6
Disk Subsystem								
Number and capacity of installed hard disks	Four 1GB	Four 1.7GB	Four 1.05GB	Four 1GB	Four 1GB	Four 1GB	Four 1GB	Five 1.75GB
Mirroring implementation	Hardware	Software	Hardware, software	Hardware, software	Hardware	Software	Hardware	Hardware
Disk controller hardware cache	16MB	None	4MB	1.5MB	4MB	None	8MB	16MB
RAID levels supported by disk controller	1, 5	1	1, 4, 5, 10	1, 4, 5, 10	1, 5	1	1, 5	1, 5, 6
Tested configuration supports hot-swapping	■	□	■	■	□	□	□	□*
Drive bays in provided case	12	9	8	8	9	7	16	12
Operating-System Support								
Compatible with DOS, NetWare, and Unix	■	■	■	■	■	■	■	■
Other compatible operating systems	Altos/SCO Unix, Microsoft Windows NT, OS/2, SCO Unix	Microsoft Windows NT, Microsoft Windows NTAS	Microsoft Windows NT, Microsoft Windows NTAS, OS/2, SCO Open Server, SCO Unix, VINES	Coactive Connector, LANtastic, Microsoft Windows NT, Microsoft Windows NTAS, NeXTStep, OS/2, SCO Unix, Solaris, VINES	Microsoft Windows NT, Microsoft Windows NTAS, NeXTStep, OS/2, Pathworks, SCO Unix, UnixWare, VINES	Microsoft Windows NT, OS/2, SCO Unix, Solaris, UnixWare	Microsoft Windows NT, SCO Unix, SCO Xenix GT, VINES	Microsoft Windows NT, Microsoft Windows NTAS, OS/2, SCO Unix Open Desktop and Multiprocessor Extension, SecureWare Trusted Unix,VINES
Management and Fault Tolerance								
Power supplies (and number of connectors)	One 350W (10)	One 450W (9)	One 300W (8)	One 300W (8)	One 300W (10)	One 250W (7)	Three 250W (20)	Two 250W (15)
Redundant components:								
Disk controller	□	■	□	□	□	■	□	□
Power supply	□	□	□	□	□	□	■	■
Processor	□	□	□	□	□	□	□	□
Local/remote system-management notification	□□	□□	■■	■□	□□	■■	■□	■□
Temperature sensor	□	□	■	■	■	□	□	□
Service and Support								
Warranty	3 years	1 year	3 years	3 years	3 years	1 year	3 years parts, 1 year labor	1 year
On-site service	Included (3 years)	Included (1 year)	Included (3 years)	Included (1 year)	Included (3 years)	Included (1 year)	Included (1 year)	Included (1 year)

* This system includes a hot-spare hard disk.

The HP NetServer's strong performance makes it easy to recommend. The HP NetServer is still easier to recommend on the basis of its design, also one of the best in this roundup. This combination makes the HP NetServer the system to look for if you need a high-end PCI-based server to manage a busy, growing business.—*WPF*

IBM Personal Computer Co.

● IBM PS/2 Server 95 Array 566

At a time when EISA is the de facto standard for expansion buses in servers and high-speed local buses are quickly becoming ubiquitous, the IBM PS/2 Server 95 Array 566 seems something of an anachronism. But ignoring this machine just because it uses a Micro Channel expansion bus would be a mistake.

The IBM PS/2 Server was the best overall performer on our benchmark tests, and it also features an instant-teardown design that makes maintenance a snap. At $16,700, the system is priced very

ENDS

	PC MAGAZINE EDITORS' CHOICE					
HR Mission Critical	**HP NetServer 486/LF**	**IBM PS/2 Server 95 Array 566**	**Poly RAID-586EV**	**Tangent "Just'N Case" Server 100**	**Wyse Series 6000i Model 665**	**ZDS Z-Server EX DP66E**
$4,588	$19,043	$16,700	$12,500	$9,995	$14,459	$18,500
Intel Pentium/66	Intel 486DX2/66	Intel Pentium/66	Intel Pentium/66	Intel Pentium/66	Intel Pentium/60	Two Intel Pentium/66s
ZIF socket on motherboard	ZIF socket on processor card	Standard socket on processor card	ZIF socket on motherboard	ZIF socket on motherboard	ZIF socket on motherboard	Standard sockets on processor card
1	1	1	1	1	1	2
256K	256K	256K	256K–512K	256K–512K	256K	256K
1MB–128MB	8MB–136MB	16MB–256MB	8MB–128MB	2MB–192MB	16MB–192MB	4MB–384MB
☐	☐	■	☐	☐	☐	■
ISA, PCI	EISA, PCI	MCA	EISA, VL-Bus	EISA, PCI	EISA	EISA
5, 0, 0	0, 7, 0	0, 0, 8	0, 6, 0	0, 4, 0	0, 7, 0	0, 8, 0
0, 3, 0	0, 2, 0	0, 0, 0	2, 0, 0	0, 4, 0	0, 0, 0	0, 0, 0
None	1 CPU	1 CPU	None	None	None	1 CPU, 1 RAM
4	7	8	8	8	7	8
Two 1.8GB, two 1.4GB	Four 535MB, two 1GB	Four 1GB	Five 1.2GB, one 80MB	Four 1GB	Four 1GB	Four 1GB
Hardware, software	Hardware, software	Hardware	Hardware	Software	Hardware	Hardware, software
None	None	4MB	4MB	None	16MB	None
1, 5	1, 5, 6	1, 5	1, 3, 5	1	1, 5	1, 5, 6
☐	■	■	■*	■	☐	☐
8	9	9	8	8	6	11
■	■	■	■	■	■	■
Microsoft Windows NT, OS/2, SCO Unix, UnixWare, VINES	Microsoft Windows NT, OS/2, VINES	LanServer, Microsoft Windows NT, OS/2, VINES	Microsoft Windows NT, OS/2, SCO Unix	LanServer, Microsoft Windows NT, OS/2, SCO Open Desktop, SCO Unix	Microsoft Windows NT, OS/2, SCO Unix, Solaris, UnixWare, VINES	Microsoft Windows NT, Microsoft Windows NTAS, OS/2, SCO Open Server Enterprise, SCO Open Server Network, SCO Unix, Solaris, VINES
One 300W (5)	One 350W (9)	One 400W (7)	One 300W (8)	Two 300W (14)	One 325W (6)	One 384W (11)
■	■	☐	☐	■	☐	☐
☐	☐	☐	☐	■	☐	☐
☐	☐	☐	☐	☐	☐	☐
☐☐	■■	■■	■■	☐☐	☐☐	☐☐
☐	☐	■	☐	☐	☐	☐
2 years	3 years	3 years	2 years parts, 5 years labor	2 years	1 year	3 years
$39 (1 year)	Included (3 years)	Included (3 years)	$175 (1 year)	$495 (1 year)	Included (1 year)	Included (3 years)

competitively with other high-performing servers in this roundup.

Depending on how you look at it, the Micro Channel expansion bus can be either an asset or a liability. The MCA-based disk controllers and network interface cards that IBM selected helped the system achieve outstanding results on our benchmark tests; its throughput scores were second by a hair to those of the HP NetServer 486/LF, while its CPU utilization scores were substantially better than those of the HP NetServer. When the HP NetServer had just topped 80 percent CPU utilization with a 28-client workload, the IBM PS/2 Server led the pack at only 47 percent CPU utilization. Under the full 60-client workload, when the HP NetServer had peaked at 97 percent CPU utilization, the IBM PS/2 Server was still humming away at a mere 60 percent CPU utilization.

The downside of Micro Channel is that it doesn't offer the growth path that the more commonly implemented EISA/PCI combination does. Micro Channel is less widely supported than EISA and doesn't provide the additional bandwidth of a high-speed local bus such as PCI. Micro Channel's throughput is adequate for the 10-Mbps Ethernet implementations that predominate today; as 100-Mbps standards reach implementation over the coming years, though, not having PCI support may limit your options.

The IBM PS/2 Server has other unique features besides its expansion bus. No tools are required to tear down the system; thumbscrews let you remove the cover and flip out the power supply, and plastic grips on expansion cards make them effortless to remove. A pair of levers lets you pop out the system's Pentium/66 processor card for easy replacement or upgrades. All eight SIMM banks in the tested machine were filled with error-correcting 8MB SIMMs to enhance fault tolerance.

Of the eight Micro Channel slots on

▶ FACT FILE

IBM PS/2 Server 95 Array 566



List price (tested configuration): $16,700. **Processor/memory:** Intel Pentium/66, 64MB RAM, 256K write-back cache. **Data storage:** Four 1GB IBM 0662S12 SCSI-2 hard disks, IBM RAID SCSI controller with 4MB cache, IBM 32G2958 CD-ROM drive. **Network cards:** Four IBM EtherStreamer MC 32 Micro Channel Ethernet. **Power supply:** 400-watt. **In short:** The IBM PS/2 Server 95 Array 566 was the best overall performer in this roundup, and its design makes maintenance easy. Reliance on IBM's Micro Channel architecture may hinder future upgrade options.

IBM Personal Computer Co., Route 100, Somers, NY 10589; 800-772-2227; fax, 800-426-4182.

466 on reader service card

SUITABILITY TO TASK	
Expandability/Scalability	GOOD
Security/Fault tolerance	EXCELLENT
Server management	GOOD
Performance	EXCELLENT

Maintaining Your Data

By Carol A. Venezia

As a network administrator, you can't ignore the importance of data integrity. Network downtime doesn't just mean unhappy users; for many companies, data loss can mean lost revenues. A 1991 Gallup poll of the Fortune 1000 determined that each time a network goes down it costs a company, on average, $5,000 in lost productivity.

So how can a LAN-dependent business protect itself in the event of a failure? Companies do have differing needs, and thus their methods of network maintenance will be different. But by adopting a two-tiered approach to data integrity—through data redundancy and system backups—a company can protect itself if disaster strikes.

DISK MIRRORING

A simple and fairly cost-effective method of data storage for midsize networks is *mirroring*. A mirrored disk subsystem connects two disk drives to one controller. All data that is written to the first disk drive is copied to the second disk drive, thus establishing an on-line backup: If one disk fails, the second disk contains an exact duplicate of the information, so nothing is lost.

Mirroring is relatively inexpensive because it can be implemented through software. Under NetWare, multiple physical disks can be attached to one host adapter. Data can then be mirrored by defining partitions of equal size on two physical disks and then telling NetWare that you want to mirror these partitions.

ADDITIONAL REDUNDANCY

Mirroring does have its limitations. In a mirrored array, the host adapter acts as a single failure point; if the adapter dies, the entire array will crash.

One way to solve this problem is through *duplexing*. A duplexed disk array uses two or more host adapters. Each adapter controls one or more disk drives, so if one adapter fails, the array continues to function. For example, a duplexed array may be set up using two disk controllers, with two drives connected to each controller. If the first disk of one array is mirrored to the first disk of the second array, then a backup exists if the first disk controller fails.

Both mirroring and duplexing can be expensive if you are storing large volumes of data. Because all data is duplicated, you must pay for twice as much disk storage as you'll actually use.

RAID SUBSYSTEMS

Other approaches to data redundancy may be appropriate for larger networks. The most common are different varieties of RAID. Three different RAID levels are in common usage. RAID Level 1 is mirroring, as described above. RAID Level 3 stripes data byte by byte across all drives and stores parity information on a dedicated drive. In a RAID Level 5 configuration, data is striped by sectors across all drives in the array, and parity information is interleaved with the data, so a dedicated parity drive is unnecessary. RAID 3 and RAID 5 systems require that you buy only about 20 percent more disk space than you actually need for storage.

Many RAID subsystems support *hot-swapping* (changing a failed drive while still on-line) or *hot-sparing* (keeping a spare disk on-line, which is ready to go if one drive fails). This means that if a disk fails, the system will continue to run as data rebuilds are done in the background. But fault tolerance will not be reestablished until the failed drive is rebuilt. The downside of these solutions is cost: A standalone external RAID subsystem can cost upwards of $20,000.

BACK IT UP!

No matter how redundant your disk subsystem is, data loss is always possible. That is why you should also back up your server on a regular basis. Two types of storage systems widely used today are tape and optical.

Tape storage systems come in different varieties; two of the most popular are QIC (quarter-inch cartridge) and DAT (digital audio tape). QIC tapes are available in two formats: the full-size DC6000, about the size of a paperback book, and the minicartridge DC2000, which fits in 3.5-inch drives. QIC tapes can hold about 250MB of compressed data per tape, at a cost of about $15 each. DATs are faster than QIC tapes, and they allow for up to 8GB of uncompressed storage per tape for a cost of about $40 each.

Another storage method is magneto-optical (MO), which is now the most widely used rewritable optical solution. MO storage has a distinct advantage over tape storage: It allows for random access, whereas tape storage allows for only sequential access. Thus, recovering a file from an MO disk is much quicker than from a DAT. The drawback to MO, however, is cost: one 650MB MO disk costs about $100.

WHICH IS RIGHT FOR YOU?

We asked vendors to configure servers for this roundup with mirrored (or duplexed) disk subsystems, because we believe this to be a cost-effective solution for many midsize networks. The level of redundancy you provide on your server, however, will also depend on how mission critical your applications are. Your backup needs, too, will vary depending on how difficult it is to reconstruct lost data; once-a-day backup regimens are not uncommon.

One more thing: Don't forget to hook your server up to a UPS, because if the power goes out, all bets are off. □

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CIRCLE 345 ON READER SERVICE CARD

the motherboard (all of which support bus mastering) four were occupied by IBM EtherStreamer MC 32 network interface cards. Two more slots contained the SCSI controller card (with 4MB of onboard cache) and an SVGA graphics adapter, leaving two available for further expansion.

The IBM PS/2 Server's case offers nine half-height drive bays, three of which were empty in the system we looked at. The other six drive bays were occupied by four 1GB SCSI-2 IBM hard disks, a CD-ROM drive, and a 2.88MB floppy disk drive.

The IBM PS/2 Server is a product that stands out in performance as well as design and yet is reasonably priced. Its only weaknesses are the absence of extensive standard server-management tools and, arguably, its reliance on Micro Channel. IBM Personal Computer Co. offers with this system a three-year warranty, which includes on-site service.

If you like the IBM PS/2 Server's features and performance but are concerned about the long-term viability of Micro Channel, take a look at the just-released IBM PC Server. The IBM PC Server is the company's first EISA-based server; it shipped too late for us to test for this story but is reviewed in the First Looks section of this issue.—*WPF*

Polywell Computers Inc.

• Poly RAID-586EV

In many ways, the Poly RAID-586EV file server from Polywell Computers is more like a high-end desktop system than a server. The major differentiator that classifies this Pentium/66-based system as a file server, as opposed to a high-end workstation, is its four hot-swappable hard disks. Priced at $12,500, the Poly costs about two-thirds as much as some of the leaders in this roundup, but it can't match their performance, features, or management amenities.

The Poly maintained throughput that was respectable but still merely average. The Poly's throughput steadily increased until the workload reached approximately 16 users. At that point, its throughput leveled off and remained nearly constant, but it did not decrease under extremely heavy client loads as did the throughput of some of the other systems here.

The Poly's CPU utilization results were not so strong. At the 12-workstation level, the system had already exceeded 80 percent CPU utilization; with 32 users, CPU utilization reached 100 percent, meaning that all of the Poly's processor resources were consumed. By comparison, the Compaq ProLiant 1000 486DX2/66 reached only 60 percent CPU utilization at a 60-client load.

Our test configuration was equipped with five 1.2GB Seagate hard disks (including one hot spare) and an additional 80MB hard disk, which contained the server's DOS partition. The five Seagate hard disks were encased in removable caddies made of hard plastic and metal to facilitate hot-swapping. The casing for each disk plugged into another casing installed permanently in the system and attached to the SCSI cables. Two more drive bays were occupied by the CD-ROM drive and floppy disk drive, leaving just one bay free.

The hard disks used for the server's NetWare partition were driven by a Mylex EISA-based SCSI controller with 4MB of hardware cache. The system also contained an Adaptec ISA-based SCSI controller for the lone 80MB disk. The Poly employs an EISA/VL-Bus design; with the two SCSI controllers, four ZNYX network interface cards, and a graphics adapter installed, only one EISA expansion slot remained open.

The Poly supports up to 128MB of system memory (which does not support error correction) and was equipped with the maximum 512K of processor cache.

Polywell provides detailed documentation with the Poly, which would be a welcome addition if the documentation actually covered any material relevant to file servers. The manual, with its chapters on how to use a mouse and keyboard, seems to be aimed at novice desktop users and is probably below the level of even the greenest network administrators.

The Poly is an average system with an average design. It is covered by an unusually long five-year warranty on labor and a two-year warranty on parts. On-site service costs an extra $175 for the first year.

Compared with other machines in this roundup that were engineered from the ground up to be file servers, the Poly is unexceptional.—*WPF*

FACT FILE

Poly RAID-586EV



List price (tested configuration): $12,500. **Processor/memory:** Intel Pentium/66, 64MB RAM, 512K write-back cache. **Data storage:** Five 1.2GB Seagate ST-11200N hard disks and one 80MB Conner CP30080E hard disk, Adaptec AHA-1520 controller, Mylex DAC960 EISA controller with 4MB cache, NEC CDR-500 CD-ROM drive. **Network cards:** Four ZNYX EtherAction EISA. **Power supply:** 300-watt. **In short:** More like a desktop PC turned on its side than a file server from the ground up, the Poly RAID-586EV was an average performer.

Polywell Computers Inc., 1461 San Mateo Ave., South San Francisco, CA 94080; 800-999-1278, 415-583-7222; fax, 415-583-1974.

467 on reader service card

SUITABILITY TO TASK	
Expandability/ Scalability	GOOD
Security/Fault tolerance	FAIR
Server management	POOR
Performance	FAIR

Tangent Computer Inc.

• Tangent "Just'N Case" Server 100

Tangent Computer likes to tout the fault-tolerant features of the Tangent "Just'N Case" Server 100. The server provides not just hot-swappable hard disks run by redundant duplexed disk controllers, but twin hot-swappable power supplies as well. At $9,995, the Tangent "Just'N Case" has a below-average price compared with that of the other units in this roundup. Its performance on our benchmark tests was slightly above average.

The hot-swappable components are the system's most salient feature. Other components, however, are more standard: The Tangent "Just'N Case" is powered by a 66-MHz Pentium processor outfitted with 256K of external cache (expandable to 512K). Four EISA slots and four PCI slots, including one shared EISA/PCI slot, are provided; all eight of the slots support bus mastering.

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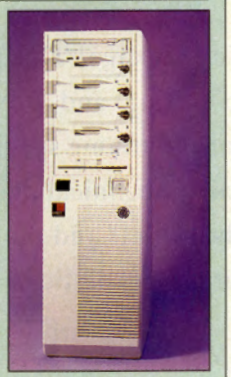
Tangent "Just'N Case" Server 100



List price (tested configuration): $9,995. **Processor/memory:** Intel Pentium/66, 64MB RAM, 256K buffered write-through cache. **Data storage:** Four 1GB Seagate ST31200N SCSI-2 hard disks, two Adaptec 2940W PCI Fast-Wide controllers, NEC CDR84 CD-ROM drive. **Network cards:** Two Cogent Technology EMaster 960 PCI, two Cogent Technology EMaster 935 EISA. **Power supply:** Two 250-watt. **In short:** The Tangent "Just'N Case" Server 100 provides redundant disk controllers and power supplies in addition to hard disks. Its performance was average.

Tangent Computer Inc., 197 Airport Blvd., Burlingame, CA 94010; 800-800-5550, 415-342-9388; fax, 415-342-9380.

468 on reader service card

SUITABILITY TO TASK	
Expandability/ Scalability	GOOD
Security/Fault tolerance	EXCELLENT
Server management	POOR
Performance	GOOD

Tangent Computer was the only vendor in this roundup to fill its server's expansion slots with two different models of network adapters—one pair PCI-based, the other pair EISA-based. (All four of the network interface cards were part of Cogent Data Technologies' E/Master family.) The reason: Two PCI slots were occupied by Adaptec SCSI disk controllers, and one of the EISA slots was occupied by a combination graphics/I/O card, leaving neither bus with four available slots. All of the expansion slots were occupied on the unit we tested.

By scrutinizing the results of our benchmark tests, we discovered that the client workstations connected to PCI network interface cards enjoyed about a 25 percent throughput advantage, on average, over those connected to EISA adapters. Overall, however, the network adapter combination resulted in middling throughput results for the Tangent "Just'N Case." The system managed throughput that was slightly below average for the tested group of machines, and about two-thirds that of the scores posted by the leaders under loads of 12 client workstations or more. CPU utilization results were fair; the server managed to remain below 80 percent utilization until reaching a 32-client workload.

The tower case provides eight drive bays; four of them support hot-swappable hard disks. The system uses four 1GB Seagate disk drives mounted in custom-designed caddies that combine SCSI and power leads into a single large connector that can be easily connected and disconnected. Each drive module has its own drive activity light—a nice touch. The hot-swappable bays are also lockable, and a single key fits all four locks. Tangent Computer includes an extra caddy, so you can buy a spare hard disk yourself.

Two of the other drive bays in our tested unit were occupied by a combination 3.5-/5.25-inch floppy disk drive and a double-speed CD-ROM drive, leaving two bays free. System memory is expandable to a maximum of 192MB in six SIMM slots.

Documentation for the Tangent "Just'N Case" is sparse and oriented more toward novice users than experienced network managers, and the server doesn't provide any server-management or monitoring capabilities. It does come with a two-year parts-and-labor warranty, with on-site service available for an additional $495 for the first year.

The Tangent "Just'N Case" is rather unusual for its extensive component redundancy, but its performance was unexceptional, and the combination of PCI and EISA network interface cards smacks of compromise. On the other hand, if you just love the idea of yanking out a server's hard disk—or even one of its power supplies—without anyone on the network being any the wiser, then the Tangent "Just'N Case" will let you indulge yourself.—*CSK*

Wyse Technology Inc.

• Wyse Series 6000i Model 665

Wyse Technology obviously put some thought into the design of the Wyse Series 6000i Model 665; this $14,459 machine isn't simply a desktop PC that's been promoted to server duty. Yet the design of the Wyse Series 6000i offers little expandability and actually hinders easy maintenance. Moreover, the performance of the unit was no better than average on our tests.

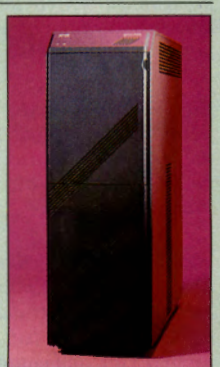
The Wyse Series 6000i is housed in an average-size tower case, but the internal layout of the case is extremely tight in spots. The system has only six drive bays, arranged in a configuration at the top of the case that hinders replacement. In fact, replacing two of the hard disks is downright difficult: They are in a modular cage that must be disassembled just to reach them. The other four drive bays are front-accessible but don't support hot-swappable hard disks.

In the configuration we tested, all of the drive bays were occupied. Further crowding the upper area inside the case was a 325-watt power supply that ran the length of the system parallel to the floor and, below it, a fan that cooled the drive array.

By contrast, the inside of the server's lower portion was relatively clear of cables and wiring. The motherboard has seven EISA slots, one of which was available after the four network interface cards, the Tseng Labs ET4000–based

▶ FACT FILE

Wyse Series 6000i Model 665



List price (tested configuration): $14,459. **Processor/-memory:** Intel Pentium/60, 64MB RAM, 256K write-back cache. **Data storage:** Four 1GB Fujitsu M2694ESA SCSI-2 hard disks, DPT PM2022 EISA controller with 16MB cache, TEAC CA-50 CD-ROM drive. **Network cards:** Four 3COM 3C579 Etherlink III. **Power supply:** 325-watt. **In short:** The Wyse Series 6000i Model 665 is housed in a case that makes upgrading difficult. Its performance was unexceptional.

Wyse Technology Inc., 3471 N. 1st St., San Jose, CA 95134-1803; 800-438-9973, 408-473-1200; fax, 408-473-1222.

469 on reader service card

SUITABILITY TO TASK	
Expandability/ Scalability	FAIR
Security/Fault tolerance	POOR
Expandability	POOR
Performance	GOOD

video adapter, and the DPT SCSI controller were installed. The motherboard has six SIMM banks, which can hold a maximum of 192MB of RAM.

The Wyse Series 6000i was configured for our tests with a Pentium/60, 64MB of system memory, a 256K write-back cache, and a RAID Level 1 disk array using four 1GB hard disks manufactured by Fujitsu.

The Wyse Series 6000i posted middling results on our tests. The unit's throughput peaked at 24 users, at which point its throughput was about 60 percent that of the leaders'. On the other hand, the Wyse Series 6000i's CPU utilization remained comfortably low under a variety of workloads. Even with 60 clients—when half of the tested units had run out of processing power—the Wyse Series 6000i maintained a CPU utilization of only 73 percent.

A weak spot of the Wyse Series 6000i is documentation, with its outdated references to ESDI hard disks and interleave factors.

A significant weak spot of the Wyse system is its documentation, which is decidedly outdated: An entire chapter in the manual discusses formatting of now-obsolete ESDI hard disks, for example.

The Wyse server is backed by only a one-year parts-and-labor warranty—relatively limited coverage compared with that offered by most of the other vendors here.

The Wyse Series 6000i comes at a reasonable price, but there is little else to recommend here. The unit is crowded and poorly designed, which makes it hard for a network manager to maintain, and its performance was below that of similarly configured systems. Sacrificing both performance and functionality to save a few dollars may make sense in some environments but not in a heavy-duty server. —*WPF*

Zenith Data Systems

• ZDS Z-Server EX DP66E

With the $18,500 ZDS Z-Server EX DP66E, Zenith Data Systems shows what smart engineering can do with the inherently large internal space of a tower system. This system's performance was very competitive, and its design makes upgrades to the memory, processor, and disk subsystem relatively easy.

The ZDS Z-Server employs dual Pentium/66 processors located on a removable processor card. NetWare does not currently support multiple processors, so the second CPU remained idle during our testing procedure. We expect an equivalently configured single-processor ZDS Z-Server would perform at the same level; Zenith Data Systems sells a similar system with a single Pentium/60 CPU for $15,124. The unit we tested had 256K of write-back cache that was split between both CPUs.

The ZDS Z-Server's throughput was somewhat better than average but didn't quite match that of the leaders. The server's performance peaked sharply just after completing the 40-workstation component of our tests; between 44 and 52 users, the system's throughput rate began a rapid decline. Even with this decline, however, its performance remained better than that of the majority of the systems in the group.

The ZDS Z-Server's CPU utilization scores were excellent: At the maximum client load of 60 workstations, only 61 percent of the server's processing power on the active CPU was used. Only the Compaq and IBM servers could claim similar results.

The ZDS Z-Server is well laid out, too. The unit has 11 drive bays, 8 of them located at the bottom of the case in an orderly row for easy maintenance and removal. The motherboard is in the middle, and the 384-watt power supply and 3 external drives (one empty, the others holding the floppy disk drive and the Toshiba CD-ROM drive) are in the upper section of the case.

Graphics and I/O ports are integrated on the motherboard, as are four SIMM banks that support memory expansion of up to 256MB; by adding an expansion card to a proprietary slot, you can boost the total to 384MB. Upgrades to the ZDS Z-Server's processor are facilitated by another proprietary slot integrated on the motherboard. The system that we evaluated had two EISA slots available after the four Intel network interface cards were installed.

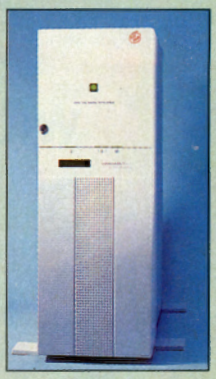
The lack of removable hard disks is about the only design shortcoming you'll find in this system. Although the disks are not accessible externally, they are at least easily accessible when the cover is removed.

The documentation sent with the ZDS Z-Server was adequate; it included a system guide as well as individual manuals for all the components and software installed. ZDS also protects your investment with a three-year warranty that includes parts and labor as well as on-site service.

The ZDS Z-Server is a well-built file server with better-than-average performance. Its fault tolerance isn't as extensive as that offered by some of the other servers we tested, but its dual-Pentium support, moderate expandability, and above-average performance make it a solid choice and definitely worth consideration.—*WPF* □

FACT FILE

ZDS Z-Server EX DP66E



List price (tested configuration): $18,500. **Processor/-memory:** Two Intel Pentium/66, 64MB RAM, 256K shared external processor cache. **Data storage:** Four 1GB Seagate ST31200N SCSI-2 hard disks, one Mylex DAC960 SCSI controller, Toshiba XM-4101B CD-ROM drive. **Network cards:** Four Intel EtherExpress 32 EISA. **Power supply:** 384-watt. **In short:** The ZDS Z-Server EX DP66E was a strong performer that uses a forward-looking dual-processor architecture.

SUITABILITY TO TASK	
Expandability/ Scalability	EXCELLENT
Security/Fault tolerance	POOR
Server management	POOR
Performance	GOOD

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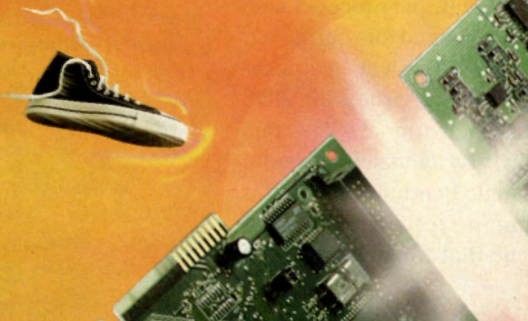



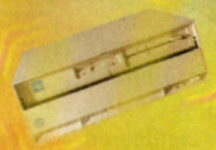









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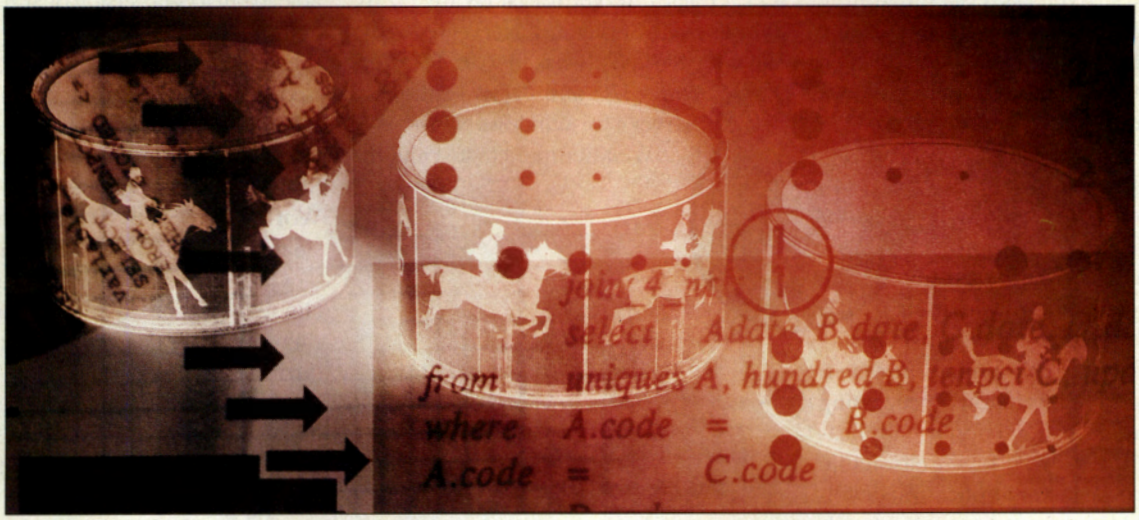
SQL DATABASES



The Great Leap Forward

The awkward years are over. PC-based SQL database servers have grown up to deliver on the promise of reliability and power.

By Brian Butler and Thomas Mace

Maturity has come quickly to PC-based structured query language (SQL) databases. In last year's roundup, we asked if 32-bit SQL databases for Intel processors were good enough to bet a business on. The answer, coming after months of ups and downs in the test labs, was only a qualified yes. While some of the products shone, many ran into serious difficulties and a few suffered outright failures (for details, see "PC-Based SQL: Time to Commit?", *PC Magazine,* October 12, 1993).

This year's testing offers a much rosier picture. Even though we more than quadrupled the size of our test database and boosted the complexity of our performance tests, all vendors came through with flying colors. While we still saw a wide range of performance

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Photography by Scott Van Sicklin

results, stability and reliability have improved dramatically across the board.

This is not to say that client/server SQL has become a trivial exercise. Integrating and debugging client and server operating systems, application code, networking components, and the SQL database itself demand real expertise. Even the best database must be backed up by solid client systems, networking cards and cabling, the network operating system and protocols, and the server hardware itself.



The advantages to client/server computing clearly predominate, however. For on-line transaction processing (OLTP) and decision-support applications, client/server offers reasonable hardware costs, faster application development, and for your end users, the familiar PC environment. Upsizing PC databases to client/ server carries with it the benefits of greater reliability, lower network loads, and centralized management. But whichever path you're on, SQL database servers for the Intel platform have made a quantum leap in quality.

OUR REVIEW LINEUP

This story covers most major 32-bit SQL database servers currently available for the Intel platform. All products covered in last year's story receive follow-up coverage and are reviewed in full if they have been released in major new revisions. Our main reviews, based on five months of lab testing, cover Informix OnLine for SCO Unix 5.01, Microsoft SQL Server for Windows NT 4.21, Oracle7 Server for NetWare 7.0.16, Sybase SQL Server for NetWare 10.01, Watcom SQL Network Server for NetWare 3.2, and XDB-Enterprise Server 4 for Windows NT.

We attempted to test and review the ASK Group's Ingres Server for OS/2 6.4.3. Ingres Server had serious difficulties with last year's tests, and many of the problems we found had not been resolved in the version we saw this year. During testing, The ASK Group was acquired by Computer Associates International, which withdrew Ingres Server from the market for debugging (for details, see the sidebar "Ingres Server: Still on Hold").

Client/server offers reasonable hardware costs, faster applications development, and for end users, the familiar PC environment.

Two databases covered in last year's story, Gupta SQLBase Server for NetWare and IBM DB2/2 have not been upgraded in the interim but will ship in major new revisions within the next few months. We were able to put a beta version of SQLBase Server through some of our tests (for details, see the sidebars "Preview: Gupta SQLBase Server" and "Coming Soon: A New DB2/2"). We were also able to examine a beta version of Borland International's new SQL entrant, The Borland InterBase Workgroup Server 4.0 (for details, see the sidebar "Preview: Borland's InterBase").

Cincom Systems and Raima Corp. declined to participate in this story because they could not free up support resources during our test cycle. Btrieve Technologies' NetWare SQL (formerly Novell's NetWare SQL) has not had a significant upgrade since it was last reviewed.



OS UNDERPINNINGS

Vendors were allowed to specify a 32-bit operating system for their server platform. Three OS's are represented this year: Microsoft Windows NT, NetWare, and SCO Unix.

Windows NT, which shipped during the past year, is a new platform for SQL. Its thread-based model, graphical administration tools, and strong networking support worked well for both Microsoft SQL Server and XDB-Enterprise Server. Other vendors, including IBM and Sybase, also plan to ship NT versions of their products.

NetWare, chosen by Oracle, Sybase,

HIGHLIGHTS

SQL Databases

ADVANCED FEATURE SETS are fast becoming standard as SQL databases grow ever more sophisticated. Most of the products we saw support ANSI cursors, triggers, stored procedures, and declarative referential integrity. All support BLOBs and cost-based query optimization.

SYMMETRIC MULTIPROCESSING is clearly the next performance frontier as SMP hardware becomes more common. Some engines use operating-system threads or processes to divide tasks over CPUs; others launch multiple instances of the database itself. Though some servers are SMP-ready, others require that you buy a special SMP version. Upcoming releases will add dedicated support for parallelizing queries, loading, and index creation. The only platform bucking this trend is Novell NetWare, which does not support multiple CPUs.

PRICES ARE DROPPING, driven by increased competition. Much of the pressure comes from sophisticated bundles targeted at the workgroup market. Client/server SQL remains an expensive proposition, however. The need for skilled administrators and the lack of turnkey software solutions means substantial outlays for software development and maintenance.

COMMAND-LINE ISQL, the traditional SQL interface to the database server, has just about seen its day. Most products now ship with menu-driven tools for setup, tuning, and administration. Some sport sophisticated Microsoft Windows–based interfaces, a trend that will be widely copied in the coming year.

and Watcom, remains somewhat controversial because the operating system, database, and any server-based utilities all run at Ring 0, the most privileged level of the Intel 386 protection scheme. In practice, we found NetWare to be problem-free once properly set up. Ring 0 operation is also extremely fast.

SCO Unix, chosen by Informix, is now a mature, highly stable product. Its only drawback is that it demands solid expertise on the administrator's part. OS/2, which was not chosen by any of this year's entrants, seems to be lagging in popularity as a SQL server OS.

• Oracle7 Server for NetWare, Version 7.0.16

Designing a SQL database server is a tremendous challenge. It must provide the safety and integrity of a mainframe. It must be fast, robust, and above all, completely stable. Our Editors' Choice award for SQL database servers goes to Oracle7 Server for NetWare, the product that comes closest to meeting the ideal. Oracle7 is a virtual compendium of the industry's best features, and its solid core technology, including a multiversioning consistency model and row-level locking, give the product a clear performance edge. It ran friction-free through our punishing test suite, finishing in first place in most categories. Its impressive scores were obtained with almost no tuning. Oracle7 ships with a strong suite of administration tools and is well suited for distributed databases. Oracle7 demands deep pockets and professional administration skills, but it remains the overall best choice in high-stress transaction-processing environments.

An honorable mention goes to Microsoft SQL Server for Windows NT. Its strong performance, superb graphical administration tools, easy setup, and tight integration with the Windows NT operating system make for a compelling package. Significant enhancements to the base kernel include implementation of native Windows NT threads, making the package SMP-ready out of the box. Virtually everything needed for success is included in this attractive bundle.

Rounding out the top three contenders, Sybase SQL Server for NetWare delivered superb performance and the benefits of Sybase's sophisticated, feature-rich engine. We look forward to the release of Sybase System 10 add-ons for this product.

ROBUST FEATURE SETS

This year marks the first time that relational database technology on the PC can be considered a broad success. All the tested products showed solid transaction-processing technology, the core of any SQL database. Log managers and lock managers all functioned smoothly, and we saw none of the instabilities, crashes, and data loss that plagued last year's lineup. These products offer what mainframe users take for granted: the ability to recover from a total system shutdown with data integrity intact.

We also saw a clear trend toward converging feature sets where many formerly cutting-edge features are fast becoming commodities. All the reviewed products except Watcom SQL and XDB-Enterprise Server support both triggers and stored procedures, and both Watcom and XDB will add them in upcoming releases. All the reviewed products support storage of binary large objects (BLOBs) in the database. All but XDB-Enterprise support two-phase commit, although only Oracle7 supports it transparently.

There may be not-so-subtle differences in how common features are implemented, however. For example, while all the reviewed products except Microsoft SQL Server support declarative referential integrity, XDB-Enterprise Server offers the most flexible approach. Child records can be automatically updated by changes to a parent record (a feature called *cascading update*) or deleted if the parent is dropped (*cascading delete*). Oracle7 supports cascading deletes but not cascading updates. Informix OnLine, Sybase SQL Server, and Watcom SQL take another tack, simply restricting any operation that tries to remove a parent with references to existing children. Comparable differences exist among implementations of triggers, stored procedures, and two-phase commit.

SPEED LIMITS

How fast a database delivers your data is always a big concern. While this year's performance results look lower than last year's because of our revamped tests and larger test database, performance has actually improved, in some cases significantly. Part of the reason is cost-based optimization, now used by all the reviewed products. Another is the maturing of lock and cache managers.

As giant applications strain the limits of existing servers, the next performance horizon is clearly the use of symmetric multiprocessing (SMP). Intel-based SMP hardware is becoming more common and under optimal conditions can deliver doubled performance when CPU and disk resources are doubled (for more information, see the sidebar "Intel-based SMP: How Strong?").

One performance question left unanswered in last year's story was how well Intel-based SQL servers stack up against heavyweight RISC platforms. In tests using Sybase System 10 that pit five high-end RISC servers against an Intel-based SMP server, we saw the Intel system

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clearly holding its own (for details, see the sidebar "Competing with RISC").

SHINY NEW TOOLS

The days are gone when simple command-line Interactive SQL (ISQL) tools were the state of the art. Administrators increasingly expect a bundled set of menu- or GUI-based tools for database creation, administration, and tuning chores. Long-established vendors such as Informix, Oracle, and Sybase are playing catch-up while Microsoft, with its experience in application interfaces, is a clear leader in sophisticated Windows-based tools. Oracle has shipped Windows-based administration tools with its Workgroup Server product (not reviewed here) and Sybase has Windows tools in beta testing. Watcom and XDB will move to GUI tools in future releases.

SIMPLER PRICING

SQL database prices are clearly on a downward trend, driven by new packages aimed at the departmental and workgroup markets. Pricing models have also gotten simpler. Where most vendors used to charge separately for users, client software, and networking components, all of the products in this story except Informix OnLine are priced on a per-user basis. While prices for the reviewed products vary widely, a price/performance analysis shows most products deliver similar bang for the buck (for details, see the sidebar "The Price of Performance").

Features, price, and performance can create daunting choices. Despite the hurdles, the news is good: PC-based SQL has never been stronger. The reviews that follow will help you find the database best suited to your needs.

Suitability to Task: SQL Databases

SQL databases were created for huge mainframe applications, but in today's PC-based client/server incarnations, they find employment in a wide range of tasks. Qualities that shine in one area can be drawbacks in another, and products that are tuned to excel in certain operations may falter elsewhere. Taking feature sets and test performances into account, we examine each reviewed product from four different perspectives.

For **production OLTP** applications, a database must be absolutely stable and offer excellent multiuser performance, a function of its locking model, cache management, and transaction-log management. We also look for support for triggers, stored procedures, declarative referential integrity, and on-line backup. Support for transparent two-phase commit and symmetric multiprocessing hardware are a plus. Strong scores on our Random Write Transaction Mix test contribute substantially to the rating.

To judge suitability for **decision support** applications, where large volumes of data are regularly moved to a decision-support server for analysis, we look for excellent loading, indexing, and ad hoc query performance. We also look for an efficient cost-based optimizer. Engine support for bidirectional scrollable cursors is a plus for easing development of GUI-based applications. Compatibility with industry-standard mainframe databases earns additional points.

Workgroup database servers frequently exist outside of an IS framework and pose a different set of demands. Here, we look for easy installation, ease of use, few tunables, and high-quality documentation that does not assume expert knowledge on the reader's part. A strong set of visual administration tools is a plus, as are an overall low initial acquisition cost and a good price/performance ratio. Databases that demand professional administration skill and intimate knowledge of the underlying operating system did not fare as well in this category.

Connectivity and deployment affect many other tasks. Here, we look for support for a wide range of network protocols and client environments. Server support for multiple concurrent protocols earns extra points, as do strong tools for monitoring and tuning the network, the operating system, and the database itself. We also look for a good selection of precompilers, a well-documented call-level C API, and the availability of gateways and connectivity products, either from the vendor or from a third party. A robust set of intuitive, GUI-based administration tools is a plus.

SUITABILITY TO TASK	
Company Name	
Production OLTP	EXCELLENT
Decision support	GOOD
Workgroup database	FAIR
Connectivity & deployment	POOR

Informix Software Inc.

• Informix OnLine for SCO Unix

ALL REVIEWS BY BRIAN BUTLER AND THOMAS MACE

Last year's roundup of SQL databases wasn't easy on Informix. While Informix OnLine for NetWare offered many strong features, it was plagued during our multiuser tests by numerous crashes.

This year, we looked at a major new release on a different platform: Informix OnLine for SCO Unix, Version 5.01. The bugs are gone, testing ran smoothly, and the product's feature set has been significantly enhanced. Informix OnLine's performance scores, which fell in the midrange of the review lineup, are comparable with last year's results. But its high price—more typical of the Unix world than of the competitive PC marketplace—gave it the poorest price/performance ratio of any product in the lineup.

We caught Informix OnLine right before a major new 6.0 release that will address a number of performance issues. The version we reviewed in last year's story, Informix OnLine for NetWare, Version 4.1, has not been upgraded, and the company has no plans to bring it up to date with its Unix cousins.

Informix OnLine has long offered a robust set of engine features, including a cost-based optimizer, engine-driven backward-scrollable cursors, cursor context preservation, mirroring of databases and transaction logs, and on-line backup.

NEW TO THIS RELEASE

The new release adds a number of features that are quickly emerging as industry standards. These include stored procedures (which can return multiple rows), triggers (added in Release 5.01), and declarative referential integrity (Restrict only). Restrict ensures that a user cannot delete parent records that have dependent child records. Automatic deletion of child records is not supported and must be coded using triggers. The database also supports entity integrity by enforcing acceptable data values (including default values) for particular columns. This release does not support group-level security or audit trails, however.

Informix has enhanced the cost-based

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CIRCLE 063 ON READER SERVICE CARD

Preview: *Borland's InterBase*

By Brian Butler and Thomas Mace

Borland International hasn't exactly been a leader in client/server databases, but the company is staking much of its future on a push into the client/server arena. While Borland's desktop databases and development tools will figure in this strategy, the cornerstone will be The Borland InterBase Workgroup Server, Version 4.0, a SQL database server due for release on a number of platforms this fall. Releases on Microsoft Windows NT and NetWare should be out by the time this article appears.



InterBase, created by InterBase Software Corp., is a technically advanced engine that found an early niche in the on-line complex processing (OLCP) market because of its pioneering support for features such as multiversioning, BLOBs, and multidimensional array data types. But the product languished after its initial sale to Ashton-Tate and up until now has seen little growth under Borland (at press time, InterBase 3.2 was the currently shipping version).

Our look at an early beta of the new InterBase, Version 4.0 for NetWare, revealed an enhanced product repositioned as an upsizing tool. The biggest change is that InterBase can now interface directly with Borland's desktop databases dBASE 5.0 for Windows and Paradox 5.0 for Windows.

STRONG CORE ENGINE

InterBase offers a strong core set of features that includes declarative referential integrity, triggers, stored procedures, event alerters, user-defined functions, a cost-based optimizer, BLOB support, and transparent two-phase commit. InterBase is based on a multiversioning database engine, an approach it shares with Oracle7.

Multiversioning provides transactions with a read-consistent view of the database: A given transaction sees the database as it was at the moment the transaction began, and multiple transactions can see the database in several different consistent states. The main advantage to multiversioning is that read transactions, especially long-running reads typical of decision-support applications, do not acquire locks that block write transactions, improving overall concurrency.

THE DESKTOP CONNECTION

InterBase offers a unique synergy with Borland's desktop database products dBASE for Windows 5.0 and Paradox 5.0 for Windows. Both can connect directly to InterBase, which in turn provides direct engine support for the desktop products' native record-navigation commands (in addition to InterBase's support for standard SQL). This lets developers migrate dBASE and Paradox apps to a client/server environment or use these PC databases as front-end development tools.

Borland is staking much of its future on a push into the client/server arena.

dBASE for Windows and Paradox for Windows share a common local database engine called the Borland Database Engine. This includes an IDAPI (Independent Database API) component for connecting to InterBase and other SQL databases. The IDAPI InterBase driver, called Client/Server Express, provides the direct low-level interface to InterBase. Since InterBase directly supports dBASE's and Paradox's record navigation, you can use commands such as dBASE's Skip -1000 and Go Bottom with InterBase data. The IDAPI component also includes Borland's SQL Link drivers for connecting to Microsoft SQL Server 4.21, Oracle7, Sybase SQL Server 10.01, and ODBC-compliant databases. These drivers also let you use dBASE or Paradox commands with third-party SQL databases, but only through a potentially slower SQL translation. The ODBC component of SQL Link will also let you develop applications for InterBase using non-Borland tools.

PACKAGING

In addition to the pending Windows NT and NetWare versions, ports for DEC Alpha OSF1, HP-UX, Sun OS, and Sun Solaris are scheduled to ship this fall. A Chicago version will ship soon after Microsoft's release of Chicago, and an OS/2 version is due by early next year. Borland also plans to bundle a version of Delphi (the code name for its upcoming Visual Basic competitor) for use in off-line applications development. Pricing is expected to be highly competitive, and client software, including the SQL Link and Client/Server components, ODBC drivers, a set of Windows-based administration tools, and the InterBase C API libraries, will be bundled free with every server.

A few holes remain in the current InterBase strategy. The product cannot operate with the new dBASE for DOS 5.0, so migrating existing dBASE apps to InterBase means porting them to Windows. Also, many of the engine's most advanced features are only accessible through proprietary interfaces. But InterBase's tie-in with Borland's Windows databases is compelling. dBASE and Paradox developers will certainly want to evaluate the product when it ships. □

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optimizer to be more intelligent about its choices, and it now lets you set the optimization level of the query. The default is High Optimization, which performs an exhaustive search through all possible access plans and picks the one with the lowest cost. With complex queries involving many tables, this process can be more expensive than the actual execution of the query. In such scenarios, you can select Low Optimization, which will make a quick best guess.

SUITABILITY TO TASK	Informix OnLine for SCO Unix
Production OLTP	GOOD
Decision support	FAIR
Workgroup database	POOR
Connectivity & deployment	GOOD

The optimizer did not make any mistakes during our tests, but we did run into a problem updating the optimizer statistics. A bad value placed in the statistics page caused two subsequent queries to crash the server. This was fixed by modifying the statistics page manually.

The new release has also improved Informix OnLine's index-creation speed. Last year, it was the slowest product at indexing our test database by a huge margin. This year its indexing score, while not exactly zippy, was more in line with other competitors'. Under Informix's new indexing scheme, index entries are sorted prior to their insertion into the B+tree structure.

The Informix OnLine engine has always offered strong binary large object (BLOB) support. As with the previous version of the product, BLOBs are stored in a distinct Blobspace, allowing you to tune the associated page size separately for best performance. The maximum allowable BLOB size is 2GB. BLOBs are written directly to disk, not to shared-memory data buffers. This saves space in the transaction logs and keeps the pool of shared-memory data buffers from being swamped. With the optional Informix-OnLine/Optical add-on product, BLOBs can be stored on WORM (write-once-read-many) optical subsystems. Unfortunately, we did not get a chance to test Informix OnLine's BLOB throughput capabilities because of time constraints in our test cycle. This was not due to any problem with the product.

Informix OnLine provides locking by row, page, table, or database and the unique ability to configure locking on a table-by-table basis. You can have one table set for a page-level locking scheme, another with record-level locks, and yet another large lookup table set for table-level locking. Isolation levels are also highly tunable and include support for dirty reads (no isolation), committed read isolation, cursor stability, and repeatable reads.

Version 5.0 added support for distributed Informix OnLine databases through the separate Informix-Star product. Informix-Star adds a two-phase commit protocol and lets users transparently manipulate multiple Informix OnLine databases at several locations. The current lets you update multiple databases on a single Informix OnLine server instance in a single transaction.

KNOW YOUR UNIX

While database administration does not usually call for much knowledge of the underlying operating system, this version of Informix OnLine demands a good working knowledge of Unix. During installation, we had to modify some SCO kernel parameters to get the package up and running. This process is documented in the machine notes file on the system.

Like most Unix database vendors, Informix recommends that you set up raw file partitions, a task that can be a tricky process. Because the Unix file system has its own cache, the database has no way of ensuring that writes have been physically committed to disk. This can lead to serious integrity problems if the system crashes. Using raw file partitions bypasses the Unix file system, the only way to ensure integrity loss doesn't happen.

Once the database is installed, you can use the supplied DB-Monitor utility to configure various system parameters including buffers, locks, users, and tables. This menu-driven utility also lets you change the server's mode of operation to on-line, off-line, or quiescent mode (a single-user administration mode). DB-Monitor also provides backup, recovery, and a window into virtually everything the engine is doing. It can display a multitude of statistics to aid in the tuning process, such as cache hits, disk reads and writes, and checkpoints.

The database also ships with a menu-driven setup tool called DB-Access for creating databases and tables and executing SQL statements. A set of command-line utilities, which can be driven by scripts, provides additional administrative functions.

COMING DOWN THE PIKE

We narrowly missed the next major release of Informix OnLine, Version 6.0, which should be shipping on the SCO Unix platform by the time this story appears. Where the 5.0 release is generally targeted at broadening engine functionality, Version 6.0 is primarily aimed at boosting performance.

Informix has rebuilt large portions of the database server, replacing the current process-based engine with an internal multithreaded system. The most important change will be the ability to exploit symmetric multiprocessing hardware through the addition of parallel index creation, parallel thread-level sorts, and parallel backup and restore capabilities. An upgraded 6.0 optimizer will be able to maintain data-distribution histograms. Declarative referential integrity support will be extended to cover cascading deletes.

▶ FACT FILE

Informix OnLine for SCO Unix, Version 5.01



List price: Server software, one development system, 60 client connections, and client software: $29,395. **Requires:** Server: 386-based PC or better, 2MB RAM, 5MB hard disk space, SCO Unix System V 3.24 or later. DOS client: 286-based PC or better, 700K RAM, 3.2MB hard disk space. **In short:** Version 5.01 of Informix OnLine adds significant enhancements to this veteran Unix database. New features include triggers, stored procedures, and declarative referential integrity. Unix knowledge is required, but the bundled administration tools make for easy setup and tuning. Informix OnLine ran smoothly through our benchmark tests, although its performance scores remain in the midrange. Its high price gives it the worst price/performance ratio of the roundup. By the time this story appears, a new Version 6.0 should be available that offers major performance enhancements.

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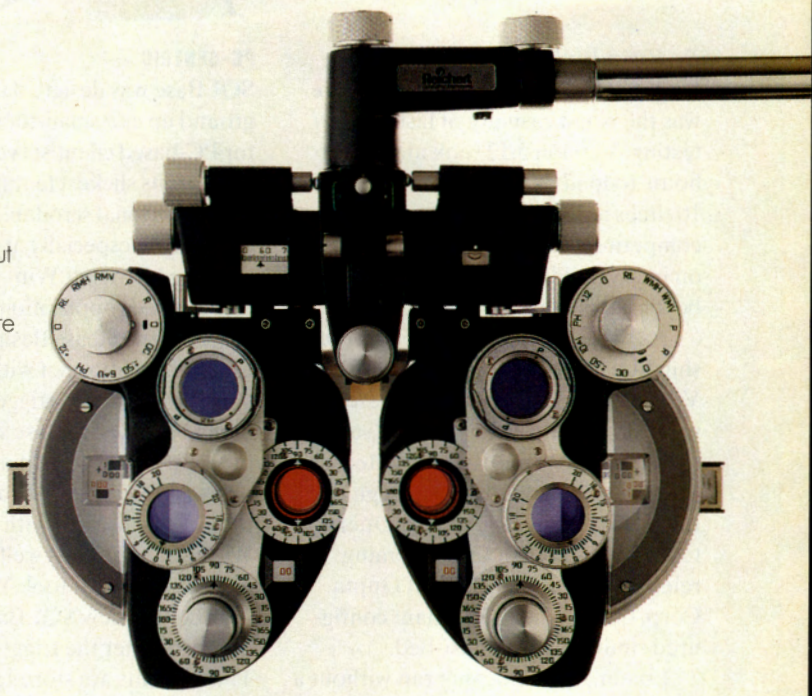

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Preview: *Gupta SQLBase Server*

By Brian Butler and Thomas Mace

Gupta SQLBase Server for NetWare was the worst casualty of last year's testing. Version 5.12 took almost 60 hours to load our database—more than 10 times as long as the next-slowest competitor—and crashed repeatedly on index builds. Testing never got beyond this point.

As we go to press, Gupta is about to ship SQLBase Server for NetWare, Version 6.0—a major new release that will extend the server's feature set and target the problems we encountered. We invited Gupta to run through our Load and Index and Ad Hoc Query tests using a beta of this upcoming release. Testing was done at Gupta Corp. on a Compaq ProLiant configured similarly to our test-bed.

Loading and indexing ran without a hitch, even though our test database is more than four times as large as last year's. Total load-and-index time was also significantly faster, placing SQLBase within reach of other products in this story (although it would still have placed last). SQLBase also ran smoothly through our ad hoc queries and demonstrated times that were reasonable but again were not as fast as the times posted by the other tested products.

PC-CENTRIC

SQLBase was designed from the ground up as a small-footprint engine for PC-based client/server computing. Some of its slickest features, such as bidirectional scrollable cursors, are especially at home in Microsoft Windows–hosted applications.



The new release fleshes out the feature set with stored procedures, triggers, and timer events. SQLBase stored procedures are written in the SQLWindows Application Language (SAL), providing close ties with Gupta SQLWindows—Gupta's well-known front-end development tool. You can specify whether the new SQLBase triggers fire before or after the triggering operation. Timer events are stored procedures that can be set to execute at a specific time or at predetermined intervals.

SQLBase 6.0 shows enhancements to usability as well. New utilities can automate installation; the new SQLEdit utility, a particularly welcome breath of fresh air, automatically handles network configuration for both clients and servers. In previous versions of SQLBase, you had to edit the SQL.INI file manually—a confusing, tedious process.

Support for distributed databases has also been strengthened. SQLBase 6.0 will offer transparent two-phase commit to manage transactions across multiple servers. SQLConsole 2.0, an impressive new Windows-based remote-management utility, will be bundled with the server. This slick tool allows remote tuning, monitoring, and maintenance of multiple servers through its Manager modules.

The Scheduling Manager automates such maintenance tasks as backups. The Alarm Manager monitors the network for more than 20 definable events and automatically executes an appropriate response when necessary. If the event remains unresolved, the alarm can trigger further responses. The Database Object Manager lets you graphically manage every database component, including stored procedures and triggers. SQLTrace is a debugging tool that can trap SQL traffic between a client and the server. You can replay the SQL through SQLTrace's graphical debugger.

Gupta appears to have made great strides with SQLBase 6.0, addressing stability, performance, ease of use, and administration in a single release. □

An even newer release, Version 7.0, was codeveloped with Sequent Computer Systems and is already shipping on Sequent's Symmetry multiprocessing platform. This version adds parallel data query (PDQ) capability and the ability to optimize the partitioning of tables based on the contents of the data.

Informix has long been known for its strong Unix databases, but it has been less active in client/server products for the PC environment. This seems to be changing. The current release, while no screamer, shows major improvements over previous versions. The pending 6.0 release seems poised to add the missing element of top-flight performance.

Microsoft Corp.

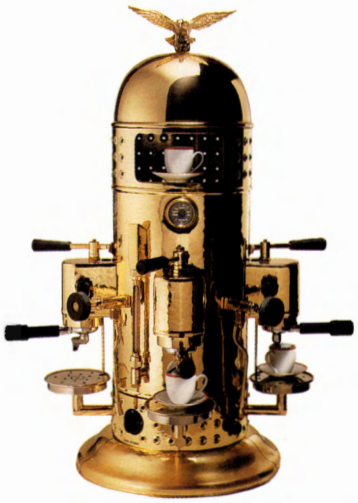
• Microsoft SQL Server for Windows NT

For those who've wrestled with mix-and-match client/server environments, Microsoft SQL Server for Windows NT, Version 4.21, offers all the seductions of one-stop shopping. For a very competitive price, it delivers a powerful SQL engine, superb tools, strong networking components, and the benefits of close integration with the Microsoft Windows NT operating system—all in a single box.

There are some caveats, particularly for enterprise applications. The server is not ideally equipped for distributed environments and does not support replication. Its performance, while generally very fast, was surprisingly slow in a few areas critical for decision support. More fundamentally, Microsoft is clearly steering you into a total Windows NT solution, something that may be incompatible with larger enterprise strategies. But for workgroups and larger departments—even those with heavy transaction loads—Microsoft SQL Server is a compelling solution.

MAJOR REWRITE

Although Microsoft SQL Server had its genesis in Version 4.2 of Sybase SQL Server, Microsoft significantly rewrote



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many important system components for the current release. While the changes are largely targeted at improving integration with Windows NT, they also fixed a few idiosyncrasies and made some important enhancements to the engine. While Microsoft has been careful to preserve full compatibility with the older Microsoft SQL Server for OS/2, Version 4.2, both Microsoft's and Sybase's SQL Server products are now clearly headed in different directions. The only official compatibility between them is at the 4.2 level of DB-Library.

The level of integration between Microsoft SQL Server and Windows NT is high. Microsoft discarded the internal threading engine used in its OS/2 product and has implemented Microsoft SQL Server as a single process using native Windows NT threads. Threads are preemptively scheduled and can be distributed over multiple processors, making Microsoft SQL Server SMP-ready out of the box.

The database also uses Windows NT's asynchronous I/O capabilities to handle physical inputs and outputs concurrently with other operations. As a whole, the database runs as an operating system service that can be started, stopped, or paused from the Windows NT Control Panel. Windows NT also lets Microsoft SQL Server simultaneously support multiple network protocols and connection types, including IPX/SPX, Named Pipes, NetBEUI, sockets, and TCP/IP. Server-based gateways to other databases can be written through the Microsoft Open Data Services (ODS) API. Backups are handled via Windows NT's backup facility. You can dump multiple databases to a single device and schedule on-line backups. Microsoft SQL Server supports any backup devices that are also supported by Windows NT.

Microsoft SQL Server integrates with the Windows NT Performance Monitor to provide a graphical display of database, network, operating system, and hardware performance data such as CPU utilization, I/O activity, cache hits and misses, database users, and network connections. This window into a client/server system takes much of the guesswork out of performance tuning and provides a firm guide when making hardware modifications. The Performance Monitor also lets you

Coming Soon: *A New DB2/2*

By Brian Butler and Thomas Mace

If anyone knows databases, it's IBM. That's why last year's look at IBM's OS/2 database—DB2/2, Version 1—was such a disappointment. DB2/2 proved stable in testing, but it was extremely slow and lacked basic amenities such as the ability to span a database across multiple logical volumes. NetBIOS was the only supported network protocol, and though you could connect to a DOS client, there were no available DOS development tools (all development had to be done in OS/2). A point revision, Version 1.2, improved network connectivity and added ODBC support and DOS client development tools but failed to address other shortcomings.



An important new release, Version 2.0 of DB2/2 is poised to energize this hitherto stodgy product. Enhancements will include a totally revamped query optimizer, flexible tablespace allocation, and a host of new engine features. Version 2.0 will be entering beta testing in the fall and should be generally available early next year. This release will be available for both OS/2 and Microsoft Windows NT.

STARBURST OPTIMIZER

New optimizer technology is high on IBM's list of enhancements. DB2/2's new cost-based optimizer, called Starburst, has been developed by some of the research-team members responsible for IBM's pioneering System R, the original prototype of DB2. IBM claims that Starburst will be the most advanced optimization technology on the market—more advanced than the mainframe version of DB2, with which it will share some technology. An accompanying visual tool will show a graphical representation of the access plan chosen by the optimizer for assistance in tuning. A graphical performance monitor will also be included.

Version 2.0 of DB2/2 will also address the previous one-volume limitation on database size by letting you divide a database into separately managed tablespaces. You will now be able to specify where tables or indexes are created by specifying the tablespace in which they reside. On-line backup capability at the database or tablespace level will also be added.

The new release will bring the engine feature set up to date by adding user-defined functions and data types, triggers, constraints, recursive SQL, and BLOB support. The DB2/2 engine has also been rewritten to support native operating-system threads, making it SMP-ready. While DB2/2 will not have its own server-based 4GL, you will be able to write 3GL stored procedures as DLLs. In addition, the new version will include Distributed Relational Database Architecture (DRDA) Server capability. (The previous release was a DRDA Requester only.) Two-phase commit will be supported.

IBM will also be releasing a set of data-replication products that support replication from multiple sources—including DB2/MVS, DB2/400, IMS, and VSAM—into DB2/2 and DB2/6000 databases. On the networking side, Version 2.0 will add support for TCP/IP.

DB2/2's upcoming feature set looks strong. If IBM delivers performance to match, this product will be a force to be reckoned with. □

Performance Tests: SQL Databases

How We Tested

Our demanding tests revealed improved performance across the board. Oracle7 took first place overall while Sybase led the pack in multiuser read transactions. Microsoft SQL Server delivered strong results everywhere except in ad hoc queries and load-and-index operations. Watcom SQL and XDB-Enterprise brought up the rear.

To evaluate the SQL relational database management systems in this roundup, we used a heavily modified version of the AS^{3}AP (ANSI-SQL Standard Scalable and Portable) Benchmark Tests for Relational Database Systems, originally developed at Cornell University by Dina Bitton and associates. This set of cross-platform performance tests covers a wide spectrum of typical database operations (although based on ANSI SQL, the AS^{3}AP tests are not an ANSI benchmark.)

For our database server, we used a Compaq ProLiant 4000 equipped with a single 66-MHz Pentium processor card, 128MB of ECC RAM, five 2.1GB Hewlett-Packard disk drives in an external cabinet, four Compaq EISA NetFlex-2 network adapter cards (configured for Ethernet), and a Compaq Smart SCSI-2 Array disk controller. Compaq's hardware RAID 0 striping was available to vendors if they chose to use it. On the client side, we used a network of 60 physical clients comprising a mix of 386- and 486-based machines. All clients were equipped with 8MB of RAM and an NE2000 network card. The network was divided into four segments (15 clients per segment); each segment communicated with a separate network card on the server. The Ad Hoc Query test workstation was a 486/33 PC equipped with 8M of RAM and an NE2000 network card.

All vendors were invited to Ziff-Davis Labs to observe testing and help us tune the database engines. Among the vendors whose products we reviewed, only Informix declined to send a representative. To give Informix equivalent representation during testing, ZD Labs hired Gregory D. Balfanz, an Informix consultant and Unix specialist from Open Systems Engineering of Boerne, Texas, to help us tune the Informix database.

Vendors were allowed to run their products under their choice of Intel-based operating systems and network protocols. Informix Software chose to run its Informix OnLine for SCO Unix 5.01 under Santa Cruz Operation's SCO Version 4.2 using TCP/IP. Originally, Informix chose to run Version 5.02 of the server, but after we encountered a memory-leak bug during our Load testing, the company substituted its 5.01 release. Microsoft ran Microsoft SQL Server for Windows NT 4.21 on Microsoft Windows NT Advanced Server 3.1 using Named Pipes on top of NetBEUI. Oracle Corp. ran Oracle7 Server for NetWare 7.0.16 on NetWare 3.11 using SPX/IPX. Sybase chose to run Sybase SQL Server for NetWare 10.01 on NetWare 3.12 using TCP/IP. Watcom International ran Watcom SQL Network Server for NetWare 3.2 on NetWare 4.01 using SPX/IPX. Finally, XDB Systems ran XDB-Enterprise Server 4 for Windows NT on Windows NT Advanced Server 3.1 using TCP/IP. The Windows NT products applied Service Pack 2 to the operating system. The client-side TCP/IP stack was FTP Software's PC/TCP Plus 2.3.

Our test database consisted of ten tables containing a total of 18.61 million rows. The breakdown of the table sizes was as follows: one table with 7 million rows, one table with 5 million rows, one table with 2 million rows, four tables with 1 million rows each, one table with 100,000 rows, one table with 10,000 rows, and one table with 5,000 .GIF images. We also created two empty tables used for inserts. The database size typically ran well over 2GB when fully loaded and indexed.

The raw data for our test database was generated using the AS^{3}APGen 2.0 program from Dina Bitton and Jeff Millman at DBStar of San Francisco, California. All the tables had the same structure, and each row was approximately 160 bytes long, although the exact values varied by vendor. The test data for each table was supplied in the form of an ASCII comma-delimited file. The data types in the database columns included integer, floating-point, and date, as well as fixed-length and variable-length character strings.

The multiuser tests were automated using the Benchmark SDK utility from Client/Server Solutions of St. Louis, Missouri. All of our multiuser tests measure total system throughput—the amount of work that the system is performing every second—calculated in transactions per second (tps). We generated tps scores using 11 different client-load levels ranging from 1 to 60 simultaneously active network clients.

Beginning with a single client, we ran each client level for 10 minutes. Scores for the first 3 minutes 45 seconds were discarded to allow the database cache to stabilize. During the next 5 minutes, we counted the number of transactions executed. This was followed by a rampdown interval of 1 minute 15 seconds, during which no measurements were made. Before moving to the next client level, we added a 30-second quiet period to allow the network to settle. This overall approach allows us to guarantee accurate and consistent scores. Transactions are processed as quickly as the database allows; test code does not include think time. This generates a workload far greater than 60 real-world clients would produce.

WEIGHING THE RESULTS

This year's testing was based on a significantly larger test database than last year's, and our test queries were considerably more demanding. As a result, this year's raw scores are considerably lower than last year's, despite the use of Pentium-level server hardware and 32MB additional server RAM. The best comparison with last year's results is provided by the Single Random Read test, which was not redesigned for this year's testing. Even assuming that the hardware used this year is twice as fast as last year's (and discounting the larger test database size), we still saw improvements of between 15 and 270 percent.

In general, it is important to realize that a benchmark testing scenario can bring optimizations into play that may not be fully exploited in real-world situations. A good example is the issue of manually striping the database across multiple disks versus using the hardware to stripe it. In a benchmark situation, a vendor can often achieve optimal performance by manually placing the database objects on the disk subsystem because the transactions and access methods are very well defined. Given enough time and intimate knowledge of the database engine, the vendor can find an absolutely optimal balance of inputs and outputs across the disk drives.

This type of optimization is usually achieved

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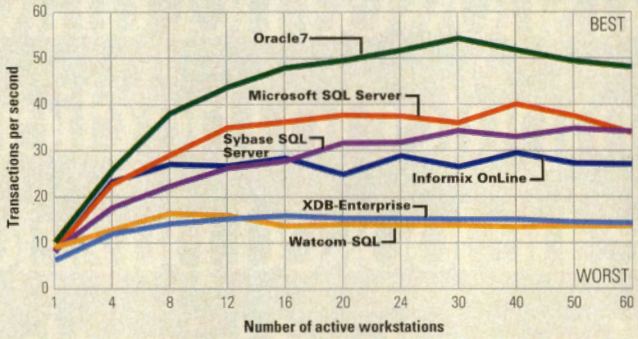
through trial and error, which is costly in both time and resources. In the real world, it is very rare that the administrator has comparable knowledge of data access and the database engine—let alone the time for experimentation. Informix and Sybase chose to stripe the database manually, while Microsoft, Oracle, and Watcom used hardware-level striping. XDB chose not to use hardware striping but was able to achieve significant optimization by experimenting with placement of tables and indexes on the disk array.

Below we describe the results we observed and attempt to explain these results in terms of each product's features. SQL databases are extremely complex artifacts, and it may not always be possible to isolate the many interrelated factors contributing to observed behavior.

RANDOM WRITE TRANSACTION MIX



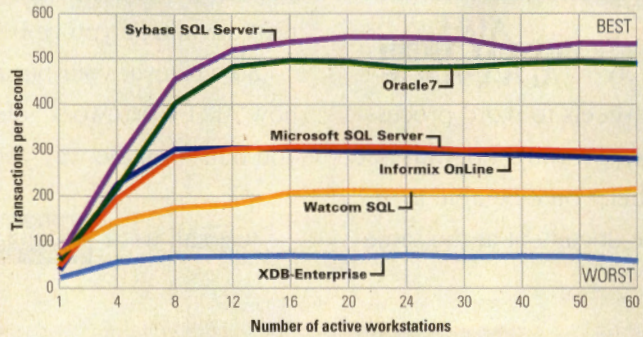
The **Random Write Transaction Mix** test, which accesses six tables in our database, simulates a heavy mixed workload of read and write transactions. This test simultaneously stresses Delete, Insert, Select, and Update functions of the database server. During the test, each station randomly selects and then executes a series of queries from a pool of five possible query types. The randomizer is constructed so that the frequency of execution for query types numbered one through five will be in a ratio of 6:4:4:3:3.

The first transaction updates an integer field in the 7-million-row table via the primary key using a Between operator. The second transaction is a two-way join between two 1-million-row-tables. The third transaction updates an integer field in a 1-million-row table and includes some in-line logic that stores the update in one of the blank tables. The fourth updates the 2-million-row table via an In clause, and the fifth moves a row from the 5-million-row table to a blank table. We used an extensive auditing script to ensure that all the products were actually performing these tests as specified.

The best performer on this extremely demanding test was Oracle7. Its high score is attributable to its record-locking scheme and efficient log management, features that have been part of the product for quite some time. The engine ran error-free and required very little tuning to achieve the measured performance level. Oracle7 only logs changes to the data, and its support for fast commit and group commits further reduces log-management overhead. The amount of data Oracle7 can write in a group commit is limited only by the operating system. Record-level locking provided optimal concurrency: No deadlocks occurred during the execution of the test. Oracle7 did not use its Discrete Transaction feature on this test.

Following close behind was Microsoft SQL Server. This test highlights how much work Microsoft has done to speed up the transaction-processing aspect of the database's engine. One new feature, *asynchronous checkpoints*, allows translation processing to continue during the checkpoint process. A Lazy Writer feature, also new to this release, lets the database engine clean up dirty database pages in the background, minimizing the work required during the checkpoint process. Microsoft SQL Server also supports group commits of up to eight 2K pages at a time. A factor working against the product may have been its page-level locking scheme.

SINGLE RANDOM READ



Since two of our transactions perform an Insert into an empty table, we created a clustered index to avoid contention on the last page. Without a clustered index, the last page of the table is consistently locked, forcing a serialization of operations. With a clustered index, Insert commands are distributed over the range of the table. The only drawback to this approach is the extra overhead for maintaining the index. We avoided deadlocks by using a fill factor on the affected indexes.

Sybase, which came in third, implemented this test with stored procedures accessed via remote procedure calls (RPCs). The company also coded several of our transactions using its newly added support for cursors within the stored procedures itself. Another new feature of the tested NetWare port is Sybase's Buffer Wash mechanism. This is a background process that cleans up dirty pages, guaranteeing a supply of free pages. While checkpoints are essentially unchanged since Version 4.2, the new Buffer Wash feature means that checkpoints must perform significantly less work. Sybase also supports group commits, but only up to a single 2K page at a time. The company used a fill factor to avoid deadlocks. For this test, we allowed Sybase to modify the database schema slightly to make the update columns Not Null. This allowed the company to work around the engine's limitation on update-in-place for nullable columns.

Informix, which came in fourth, used record-level locking on all tables that were updated. Informix performed well once the database and operating system were properly tuned, although the tuning process was not particularly intuitive. The database was stable in operation and we encountered none of the problems with failed checkpoints that plagued it in last year's tests.

Watcom SQL and XDB-Enterprise brought up the rear. Although Watcom SQL supports group commits and only logs changed data to the transaction log, its performance was only about 25 percent as fast as the fastest product. XDB-Enterprise does not support group commits and logs the entire before-and-after image of the row.

The **Single Random Read** test, based on a single-record read via the primary key, shows the maximum number of concurrent retrievals the system can handle. This test has not been modified since our last roundup and is included to show how far the products and hardware have come in the interim.

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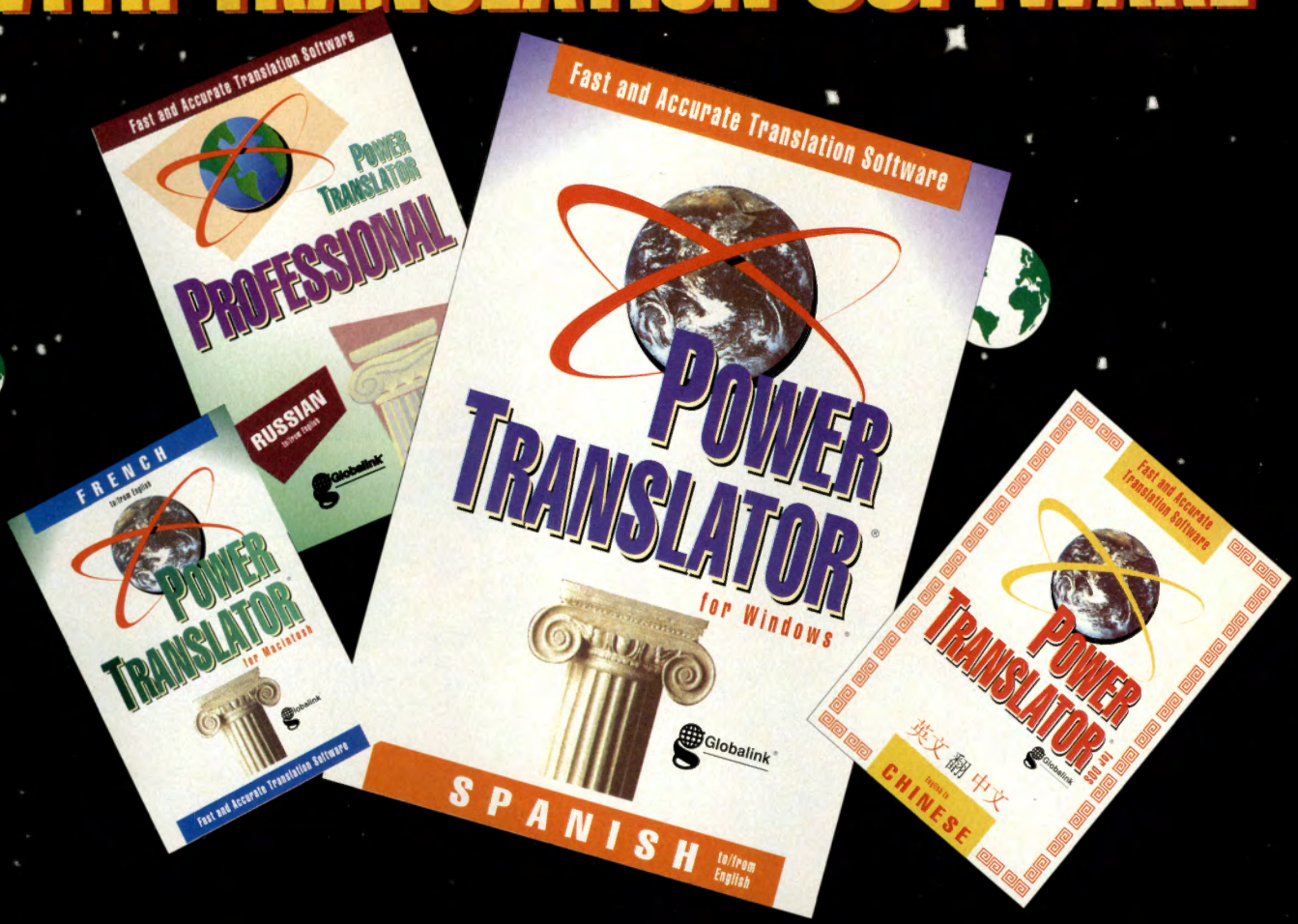

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Performance Tests: SQL Databases

In this test, each workstation selects a random row from a single table that is then fetched across the network and discarded. All active workstations repeat this process at the maximum speed supported by the database. This scenario does not stress every component of a database engine and the results tend to exaggerate the engine's actual transaction-processing power. The small, quick transaction involved does put a significant stress on the network components of the operating system, however. For products tested under Windows NT and SCO Unix—both of which are true protected-mode operating systems—the overhead for privilege-level checking proved to be costly. Records are read in the lowest lock level each product supports, thus permitting the greatest degree of concurrency (we required that each vendor take at least a shared-level lock on the row or page). Since all locks are shared-level, no blocking occurs; multiple clients can access the same row or page without concurrency loss.

The best performer on this test was Sybase SQL Server. Contributing factors are the efficiency of its NetWare Loadable Module (NLM) architecture, Sybase's clustered indexes, and the use of stored procedures. Sybase called its stored procedures via an RPC instead of by using a straight stored procedure call. In an RPC, the function call is translated into a binary representation at the client; a normal stored procedure call is sent across the network as text and translated at the server. Sybase believes that the use of RPCs in CPU-bound situations such as this test can significantly improve performance.

Oracle7, which came in second, did not use a stored procedure due to the simplicity of the transaction. It did open and maintain a cursor, however. Since Oracle7 has the ability to share cursors across multiple clients, this approach allowed clients to execute the transactions without having to reparse and optimize the SQL statement—in effect, the same advantage provided by a stored procedure. Oracle7 also supports a unique method of executing and fetching multiple rows in a single function call, thereby reducing network traffic. Most other products require several function calls to do the job, one to execute the query and others to retrieve the results.

Microsoft SQL Server placed third. It used clustered indexes and stored procedures but did not use RPCs. While clustered indexes usually help Microsoft SQL Server considerably, they were offset by the stress on the operating system's network communications layer.

Close behind Microsoft came Informix OnLine. We did not test Informix using its clustered indexes or stored procedures. The opinion of our Informix consultant was that stored procedures would be slower than a prepare/fetch mechanism, and the clustered indexes would have drastically slowed the index creation times.

Watcom SQL came in fourth—earning it the award for being the most improved product since last year. Improved performance was mostly due to the move to NetWare, a true 32-bit environment, and asynchronous I/O, which was not available in the DOS product we tested previously. Watcom does not support stored procedures at this time; a prepare/fetch mechanism was used to avoid the parsing/optimization phase of the query.

In last place was XDB-Enterprise, which did not use striping. The database table and index used in this test resided on a single drive, something that proved to be the biggest bottleneck. While performance could have improved by moving the index to a separate spindle, this approach would have hurt the product's multiuser test results. This highlights the problem with manually placing database objects: Tuning for one type of operation can hurt performance elsewhere.

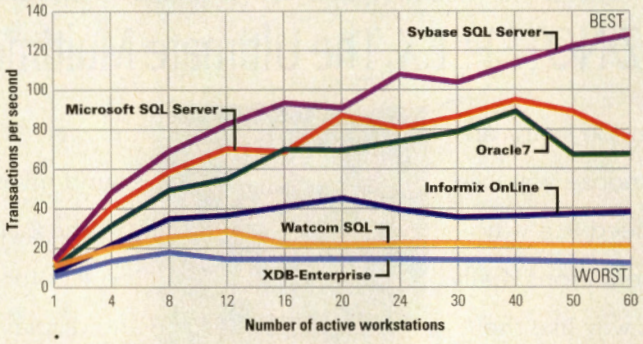
The **Random Read Transaction Mix** test, which accesses five tables in the test database, simulates a mixed workload of read-only queries. This test was designed to stress the data-retrieval capabilities of the database engine, and proved to be extremely disk bound. During the test, each station randomly selects and then executes a series of queries from a pool of five possible query types. The randomizer uses the same ratios as for the Random Write test.

The first query is a single record read via primary key (this is identical to the Single Read Transaction test). The second is a Join on the primary key between two 1-million-row tables. The third is a Select on the 7-million-row table using a Between clause. The fourth query is a two-way join between a 1-million-row and a 2-million-row table using a Between as a restriction and a Join on a character field. The fifth query is a two-way Join between a 1-million-row and a 5-million-row table using an In clause; the Join is on a character field.

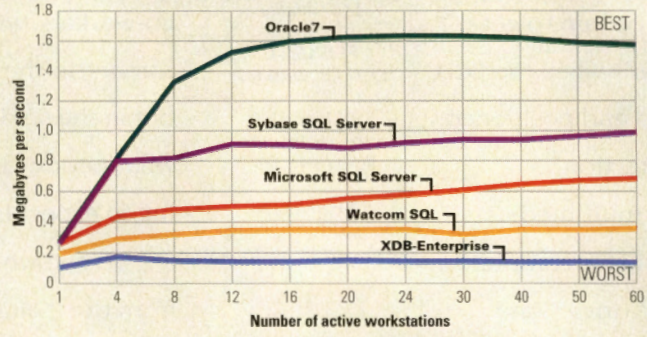
Sybase SQL Server was the clear winner. Its performance can be attributed to the use of clustered indexes and stored procedures (using RPCs), and the NetWare operating system's low overhead. Sybase SQL Server seemed able to satisfy the transaction requests with less I/O than other vendors, and its stored procedures cut down on network traffic. The package's clustered indexes must also be considered an important contributing factor since two of the queries used a Between clause on a clustered key. Since the data is physically arranged on the disk in clustered order, these queries could be typically resolved in fewer disk inputs and outputs than when using products that do not support clustered indexes. Sybase experimented with using SPX/IPX on this test, but TCP/IP, its original protocol of choice, proved to be slightly more efficient.

Microsoft SQL Server, which also used stored procedures and clustered indexes, came in second. While Sybase and Microsoft coded the test

RANDOM READ TRANSACTION MIX



BLOB RETRIEVAL



transactions in a similar manner, Microsoft chose not to use RPCs to call the stored procedures. The overhead of Windows NT may have also played a slight role in the performance difference, although, as the transaction size increases, Windows NT overhead appears to decrease.

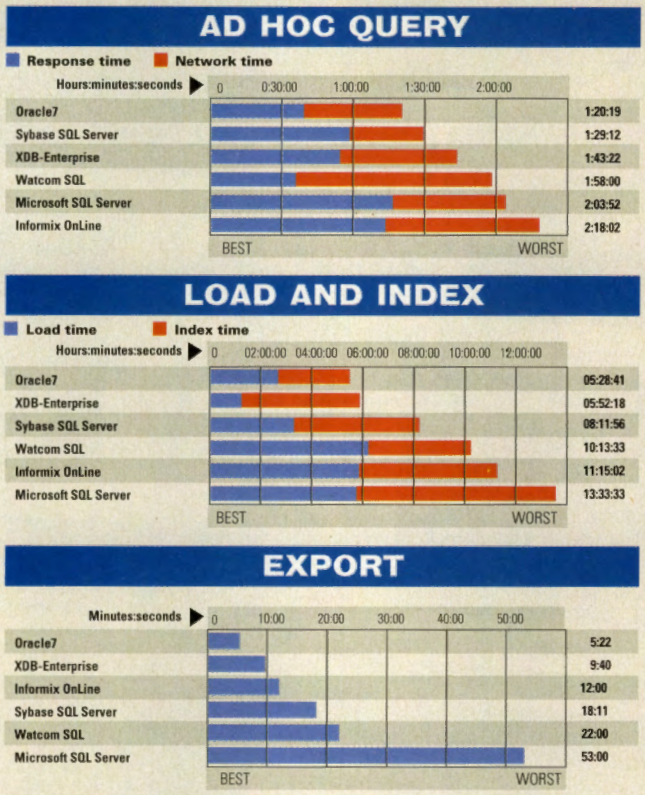
Third-place Oracle7 was able to share the cursor among the clients, and its ability to do an execute and fetch in one statement also helped performance. Oracle7 is also unique in that it can retrieve multiple rows in a single network fetch. But its performance was bottlenecked on this test by the disk I/O subsystem, something that could be attributable to nonclustered indexes and the nature of the queries. As an experiment, we added another five drives and saw tangible improvements before the system became clearly CPU-bound. Other vendors may well have achieved comparable improvement.

Informix came in fourth. We did not use the clustered index feature of the database engine, because of its affect on the index time. Our Informix consultant also advised against using Informix's stored procedures since he feels that they are inefficient for our type of transactions. To achieve optimum performance, each station used a prepare/fetch mechanism, saving the processing overhead of a parsing/optimization process. The overhead of SCO Unix may also have been a factor.

Watcom SQL came in fifth with XDB-Enterprise pulling up the rear. Watcom SQL did not use clustered indexes to avoid undue load times, and the product does not currently support stored procedures. The transactions were coded using a prepare/fetch mechanism. XDB-Enterprise's results may be attributable to the product's manual distribution of database objects.

Binary large objects (BLOBs) are structures used for storing images and other large binary fields in the database. The **BLOB Retrieval** test measures how fast the client can retrieve these large structures—in effect, how well the database can utilize the network. All the tested products offer a method for fetching large blocks of data in a single network call, and many are able to change the default network packet size dynamically.

This test used a database table containing 5,000 unique bitmapped images in .GIF format ranging in size from 20K to 150K, with a majority in the 70K range. During the test, clients randomly selected and retrieved a series of images. Images were not displayed, but we required that the full binary file be sent across the network. While the BLOB Retrieval test executes in a similar manner as our other multiuser tests, it measures sustained system throughput in megabytes per second (MBps).



Oracle7 was the clear winner with a maximum transfer rate of 1.61 MBps. No tuning of the network packet size was needed to achieve this result. While creating the BLOB table, however, we discovered that Oracle7 was the only product unable to load our BLOB images from a DOS client because the Oracle7 DOS client does not have a mechanism for sending BLOBs piecemeal to the server, and not enough memory could be allocated to load the entire image at once. We used an OS/2 client as a workaround. In experimenting with network protocols, we found that using TCP/IP gave Oracle7 about a 25 percent performance boost over the SPX/IPX protocol used for official testing (charted numbers show results for SPX/IPX).

Sybase SQL Server came in second with a maximum transfer rate of just under 1 MBps. The package's DB-Library does not support negotiated packet size, so the default packet size of 512 bytes was used. (The company's Open Client does support negotiated packet size, but it is currently available under Windows only.) We experimented with substituting SPX/IPX for the TCP/IP protocol Sybase chose for official tests. We observed a 45 percent performance degradation under SPX/IPX (charted numbers show results for TCP/IP).

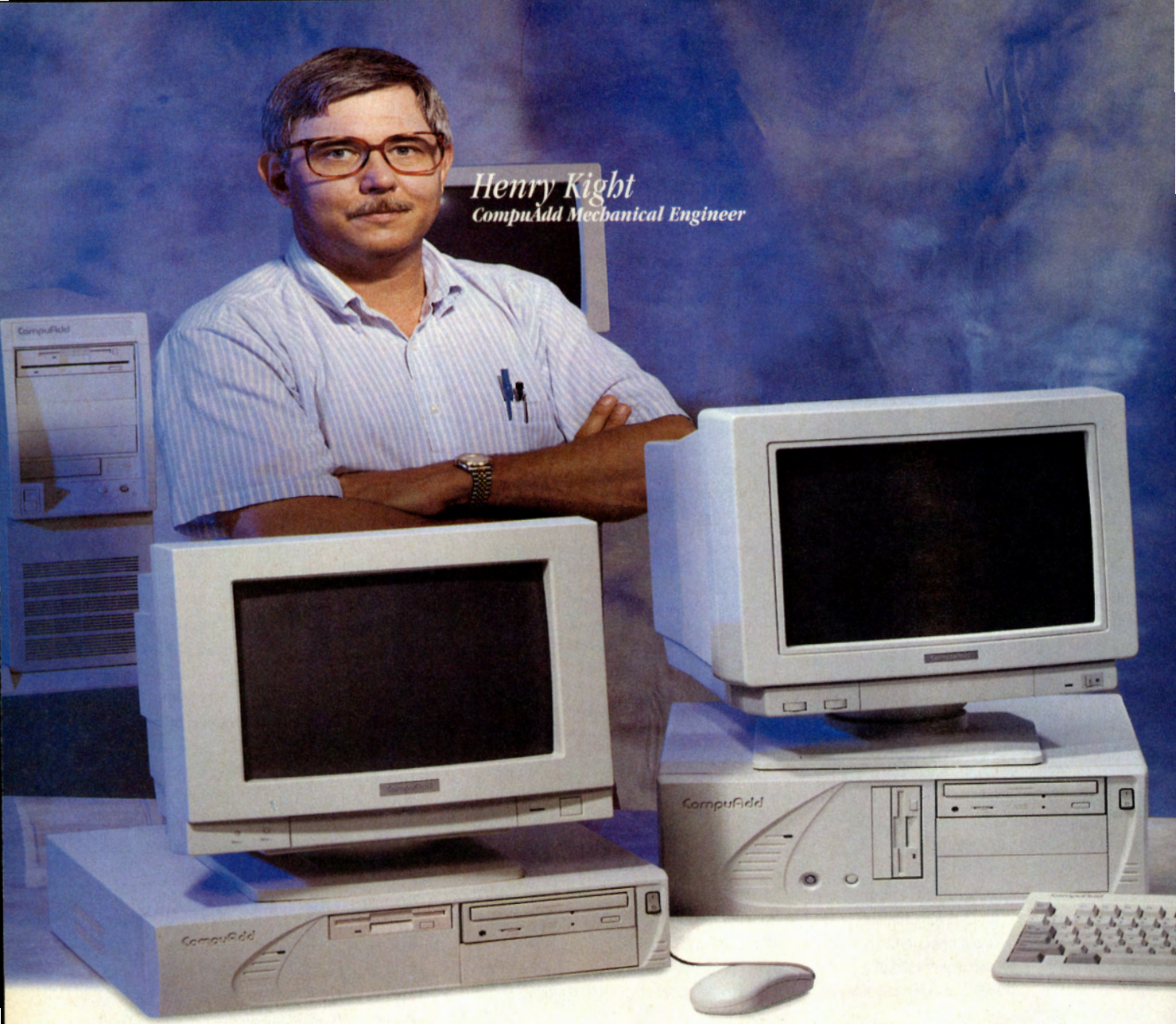
Microsoft SQL Server came in third with a maximum transfer rate of 0.68 MBps. Microsoft tuned for this test by increasing the default packet size from 512 bytes to 4K. The negotiated packet size feature allows clients to configure the packet size at connection time. This feature is only supported under Named Pipes.

Watcom SQL placed fourth with a transfer rate of 0.35 MBps, and XDB-Enterprise was last with a transfer rate of 0.17 MBps. Watcom SQL also lets you specify the packet size when the DOS requestor is started. Watcom used a packet size of 1,450 bytes for our entire suite of tests (the default packet size is 512 bytes). While XDB-Enterprise used TCP/IP, the network was not an overriding factor in the package's performance. Since all of XDB-Enterprise's BLOBs resided on a single disk, the server remained strongly disk-bound throughout the test.

We could not obtain results for Informix OnLine due to time constraints. This was not due to any fault in the product.

The **Ad Hoc Query** test measures each product's effectiveness in a decision-support environment. The query mix is submitted from a single 486/33 client, and both the response time (the time for the first row to be returned) and the total elapsed time for each query are recorded. Response time is an important metric in a real-world environment in which the user is waiting to see results. Once the first row is returned, the user can begin scrolling through the data. Total elapsed time is more important in a batch-reporting environment in which large reports are being printed.

Because of the large number of rows returned by some of our queries, network overhead is in some cases the factor limiting performance. It is also difficult to separate engine processing speed from network overhead since many products



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return rows to the user before the query is completely resolved.

The Ad Hoc Query test consists of 34 queries that stress six different types of server functions: selects, joins, projections, aggregates, sorts, and subqueries. Ten select queries measure the speed at which a database can selectively scan a table. Nine join queries show how well an optimizer can pick the fastest access path from the available indexes (the joins range from a two-way to a seven-way join). Two projection queries measure how fast a database can determine the number of distinct values in a table. Five aggregate queries calculate a variety of aggregates (minimum, maximum, average, and count). Five sort queries measure how fast the database can sort data sets ranging in size from 10,000 rows to 2 million rows. And finally, three subqueries show the effectiveness of the optimizer in resolving correlated subqueries and outer joins.

Oracle7 takes the top spot on this test with a total time of 1 hour 20 minutes. But when we first ran the test, Oracle7's optimizer made a mistake on the sort query, returning a score of over 10 hours, by far the worst score we saw. The optimizer chose to use an index when it should have performed a table scan. This entailed extra I/O in jumping between index pages and data pages and did not let the database take advantage of its read-ahead mechanism. This error was easily corrected using a Hint, a well-documented method of overriding the optimizer. Because all optimizers are based on statistics, there is always a probability of making a mistake. Consequently, an override mechanism is a must.

While the Oracle7 optimizer was not the most robust we saw on our 34 test queries, the currently shipping Oracle7 Server for SCO Unix, Version 7.1, was able to execute the same queries without hints, indicating that the problems have been addressed.

Interestingly, Oracle7 took second place in both response time and network time, yet the combination of the two made it the fastest. Oracle7 offers a way to tune the query for response time or total time. Due to the nature of our queries, the company chose to tune for total time.

Sybase SQL Server was close behind Oracle7 and was able to the run the queries untouched, something that demonstrates the strength of Sybase SQL Server's optimizer. While Sybase SQL Server only ranked fourth in terms of the response time for the queries, it was the fastest in terms of network time. We briefly substituted SPX/IPX for TCP/IP and saw that this made very little difference in the results. Third-place XDB-Enterprise sports a cost-based optimizer and a read-ahead mechanism. It was able to run the queries unaltered.

Watcom SQL ranked forth, and once again gets the most-improved award, having taken last place in last year's tests. The addition of read-ahead capability and the work done to improve the optimizer have clearly paid off. Watcom SQL had the highest score in terms of response time but the lowest in terms of network-transfer time.

Microsoft SQL Server, which placed fifth, required a little tuning to optimize performance (unoptimized results, not shown here, were in excess of four hours). But in many cases, the company found that tuning for response time hurt the product's total time, and vice versa. Microsoft also found that a smaller packet size (512 bytes) improved many of the smaller queries but slowed queries returning a large number of rows (larger 4K packets improved those). While Microsoft would have preferred to tune for individual queries, our benchmark testing specification did not allow for this.

Informix OnLine pulled up the rear despite their read-ahead mechanism and cost-based optimizer. We also encountered an optimizer bug that caused a server crash on two of the queries (the database was not corrupted by the crash). The problem was in the Update Statistics command that placed an invalid number in the statistics page. The Informix consultant was able to patch the statistics page to work around the problem.

The **Load and Index** test measure how quickly the database system can import 18.11 million rows, and create 33 indexes. This test is of particular interest for judging products used to implement decision-support systems, where the database must be loaded and indexed on a regular basis. Load times for our BLOB table were not included in the load score. The raw data was provided to the vendors in key order.

Vendors were allowed to choose the structure of the indexes, although we specified the columns on which indexes had to be created. Because load-and-index is typically an isolated operation, we allowed vendors to tune specifically for this test, whereas we required them to run all other tests with a single preselected set of runtime values. All tables were loaded serially. It should be noted that real-world load-and-index times can be reduced by using multiple sessions.

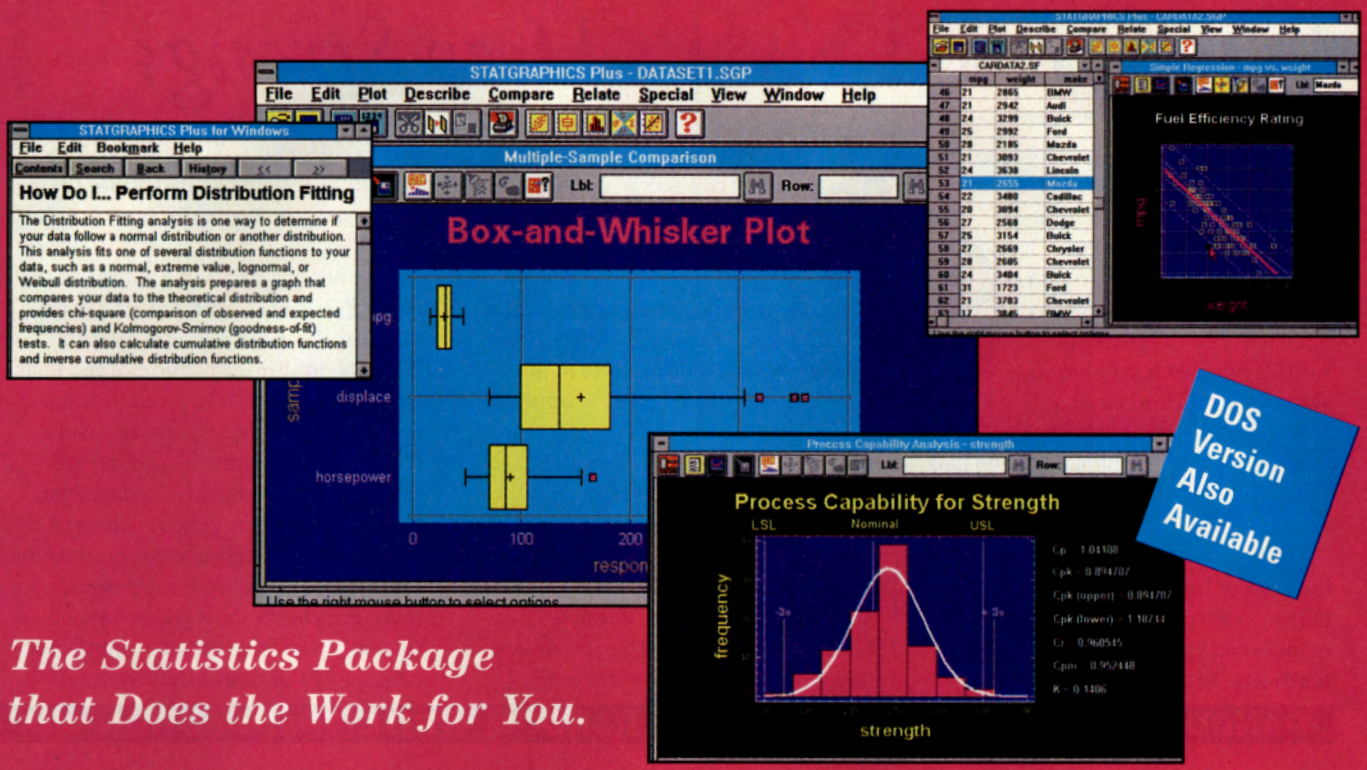
All vendors loaded the database directly from the server, thus eliminating network bottlenecks and optimizing load rates. In addition, all vendors provided a mechanism to bypass the transaction log for better performance. All vendors except Watcom also provided a utility or used SQL extensions to perform the load. Watcom's ISQL utility does include a feature to load data but it is not an NLM implementation. To optimize performance, Watcom took advantage of the engine's NetWare interface to write a custom NLM load module. While most users would probably not do this, we felt that this approach might make sense in a decision-support environment. Watcom SQL is the only database in this story that can directly interface with another NLM.

Oracle7 demonstrated its ability to load and index very quickly. While the actual load times lagged behind XDB-Enterprise, Oracle7 quickly made up for lost time with its efficient indexing mechanism. XDB-Enterprise was second overall, and takes top honors in load speed. This may be attributable to Windows NT's asynchronous I/O capabilities and the multithreaded nature of the load utility. Sybase SQL Server placed third, an impressive achievement considering that it created a clustered index on all the tables. While Sybase SQL Server did not have to perform a sort on the data, it did have to move the data physically to put it in a clustered structure. Watcom SQL took fourth place but with the second-fastest index time. Informix OnLine placed fifth, and Microsoft SQL Server placed last. While Microsoft SQL Server did place fourth on the data load, the overhead of creating a clustered index pulled the package to the rear.

The **Export** test measures how fast a database can export a 1-million-row table into comma-delimited ASCII text format. The export was made to a local disk on the server to avoid network overhead. Interestingly, several of the vendors actually took longer to export the table than to load it. This may be due to the overhead of a binary-to-ASCII conversion, which is typically more expensive than ASCII-to-binary. Also, when loading data, a database can cache multiple rows and write them as a single block. Export operations are typically dependent on the operating system's file-system cache. For most users, data export times will not be a significant issue.

—Analysis written by Brian Butler

NO EXPERIENCE NECESSARY



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Intel-Based SMP: *How Strong?*

By Brian Butler and Thomas Mace



Even the fastest Intel-based servers may not be fast enough for massive client/server database applications. The classic gambit for the power-starved has been to forgo the Intel platform in favor of RISC-based symmetric multiprocessing (SMP) servers. (For information on comparative performance of Intel and RISC servers, see the sidebar "Competing with RISC.")

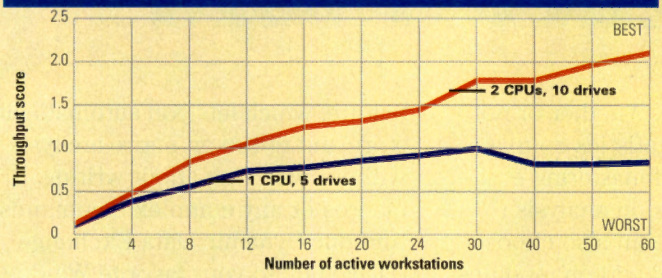
There is an alternative. The emerging class of Intel-based SMP servers delivers substantially improved performance over traditional single-CPU hardware. Scalability testing on the Intel-based Compaq ProLiant 4000, which can accept up to four CPUs on plug-in daughtercards, showed that with an appropriate operating system and database, doubling the number of processors and disk drives in the server can effectively double performance.

CLOCKING SMP ON INTEL

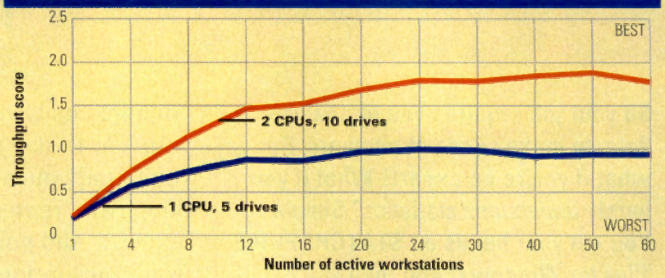
To investigate the benefits of Intel-based SMP database servers, we ran a series of scalability tests using Oracle7 Server for SCO Unix, Version 7.1. Under Oracle7, each client connection to the server is an independent process. The underlying SCO Unix operating system can distribute these processes symmetrically across multiple CPUs.

For testing, we used a subset of the AS^{3}AP database performance tests used for the main reviews. Results from the multiuser portion of the tests show throughput measured in transactions per second (tps). These results (see the accompanying graphs) are shown in normalized form based on the maximum throughput achieved by a single-CPU reference configuration. Query, Load, and Index are timed tests; the charts show the enhanced system's performance as a simple percentage of the reference system's

RANDOM READ TRANSACTION MIX



RANDOM WRITE TRANSACTION MIX



define conditions that can trigger an operating system script. You could use this feature to perform functions such as sending an administrator alert and initiating an automatic backup when a certain percentage of remaining log space is exceeded.

Other modifications to the database server and optimizer include a rewritten lock manager and loosened constraints on update-in-place. The optimizer can now use an available nonclustered index for queries containing an Order By clause. Microsoft has also implemented asynchronous checkpoints so that transactions can continue while a checkpoint is implemented. Dirty data pages are written to disk by a lazy-writer thread, reducing the overhead of the checkpoint operation.

While the server supports triggers and stored procedures, it also adds a powerful new feature called *extended stored procedures* aimed at leveraging workgroup technologies such as e-mail. Extended stored procedures are external Windows NT dynamic link libraries (DLLs) that can be dynamically loaded and executed on the server. For example, you could use this feature within a trigger to broadcast an e-mail message in response to a changed inventory level. Because every thread on the server is under structured exception handling, the server and database are protected from any errors arising from an extended stored procedure. Should a protection fault occur, only the thread would be terminated, not the process.

SUITABILITY TO TASK	Microsoft SQL Server for Windows NT
Production OLTP	EXCELLENT
Decision support	FAIR
Workgroup database	EXCELLENT
Connectivity & deployment	EXCELLENT

Although Microsoft has made improvements to Sybase SQL Server 4.2, it has not adopted some of the significant enhancements that Sybase introduced in its System 10. These include replication, declarative referential integrity, and ANSI cursors. Unlike Sybase System 10, Microsoft SQL Server cannot dump a single database to multiple backup devices.

Microsoft SQL Server also lacks transparent two-phase commit (this feature must be coded via the C interface), row-level locking, and built-in auditing. Remote procedure calls are outside of transaction management, a potential danger since consistency between remote databases cannot be physically guaranteed. While the Windows NT operating system is C2-level secure, the database provides only standard table-level security. Microsoft has committed to shipping a number of enhancements in future releases including declarative referential integrity, bidirectional scrollable cursors, parallel backup, and replication.

score.

We began by establishing a reference score using the ProLiant 4000 in the standard test configuration for this story: an array of five 2.1GB hard disks and a single 66-MHz Pentium CPU. In this configuration, Oracle7's performance is strongly I/O-bound so that simply adding a second CPU would have had little effect.

To scale performance while keeping the same balance between CPU and disk loads, we added five additional drives and a second Pentium CPU and reran our tests. The results of the Random Read Transaction Mix test show that throughput for the 2-CPU, 10-disk system was well over twice that of the reference system. The Random Write Transaction Mix test results show that the SMP system was just shy of twice as fast.

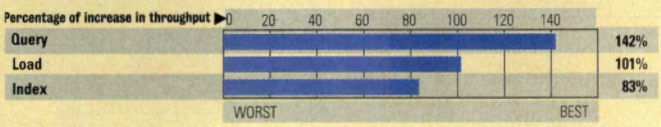
Version 7.1 of Oracle7 for SCO Unix also supports parallelization of query, load, and index operations internally. The engine accomplishes this by dividing operations into separate tasks that are spread across multiple processors. Examples of operations that can be parallelized include table scans, joins, aggregations, and various sort operations.

To see how well the ProLiant 4000's SMP capabilities support these features, we selected queries from our standard Ad Hoc Query test. The results show better than a 140 percent improvement in query execution time on the double-CPU system. Not all queries benefit from parallelization, however. We tried several queries that do not perform table scans or large sorts and saw no performance improvement. The tests also show a doubling of load performance and a substantial improvement in indexing, in part because of the efficiency of parallel sorts.

While the lure of RISC-based servers remains strong, Intel-based database servers with SMP upgradability offer an alternative that is definitely worth investigating. □

QUERY, LOAD, AND INDEX

2 CPUs and 10 drives vs. 1 CPU and 5 drives



SLICK TOOLS

The superb graphical administration tools bundled with the server let the administrator manage the database, the operating system, and networking from a single location. The SQL Object Manager is a slick change-management application that can be used to create stored procedures, triggers, tables, indexes, rules, views, and other database objects. It also includes a bulk-copy program that, unlike the original command-line bulk copy program, provides postmortem information for failed operations. The SQL Object Manager can also generate a transact SQL data definition language (DDL) script from existing database objects that can be used to recreate a database on another server or document an existing database structure.

The SQL Administrator tool is targeted at device and database management. You can use it to create databases, devices, and users and to implement security. The ISQL/Windows program provides a basic Interactive SQL (ISQL) server interface with the convenience of a few Windows navigation features. It also lets you create a *showplan,* a graphical display of the access plan for any given query, and displays I/O statistics graphically for tuning and optimization. Standard command-line ISQL is also provided.

All of the Microsoft tools can simultaneously connect to multiple databases, but they cannot administer multiple servers as a group. Like most competing toolsets, they also lack integration; you'll need to switch from one to the other depending on the task at hand. Microsoft plans to roll SQL Administrator and Object Manager into a single tool eventually. Future versions will also support OLE 2.0 drag-and-drop behavior and allow for remote management of server groups.

Although Microsoft SQL Server is positioned as a client/server computing solution for the masses, its overall performance—despite a few gaps—puts it in a league with the industry leaders. Its stability and strong administration tools are benefits in any applications. Except for the fading OS/2 release, Microsoft SQL Server is an NT-only solution and will ultimately be only as scalable as Windows NT itself. But if you are a believer in Windows NT, Microsoft SQL Server is a robust, well-oiled solution.

FACT FILE

Microsoft SQL Server for Windows NT, Version 4.21



List price: Server software, one development system, 60 client connections, and client software: $8,690. **Requires:** Server: 386-based PC or better, 16MB RAM, 25MB hard disk space, Microsoft Windows NT 3.1 or later. DOS client: 286-based PC or better, 640K RAM, 1MB hard disk space. **In short:** Microsoft SQL Server offers a compelling combination of a powerful database engine, superb graphical administration tools, excellent connectivity features, and unmatched integration with the Windows NT operating system. Its performance goes beyond workgroup demands and puts it among the top products in our roundup. This product is a Windows NT–only solution, but if your organization can buy into a closed-shop strategy, the integration of server, operating system, and networking components is hard to beat.

Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080; fax, 206-936-7329

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Oracle Corp.

EDITORS' CHOICE

Oracle7 Server for NetWare

Oracle7 Server for NetWare, Version 7.0.16, is a comprehensive, complex package that rolls together just about all the features you'll find in competing products. It is exceptionally fast, eminently stable, and very well suited to both multiuser and decision-support tasks. Oracle7 demands a sizable up-front investment and solid professional skills to get it up and running. But for mission-critical applications, especially in distributed environ-

Competing with RISC



By Brian Butler and Thomas Mace

From a PC-centric perspective, the Compaq ProLiant 4000 used as this story's test platform is a powerful machine. But large companies will naturally consider other hardware options when weighing a major client/server investment. This raises a basic question: How well does Intel hardware perform when compared with RISC?

We used ZD Labs' Ritesize IV test suite based on Sybase System 10 RDBMS to pit four RISC-based servers against a ProLiant 4000 equipped with two 66-MHz Pentium CPUs. The evaluated RISC systems were the Data General AViiON 8500 powered by six Motorola 88110 processors; the DEC 3000 Model 800S AXP Deskside Server with a single 200-MHz AlphaAXP 21064; the HP 9000 Series 800 Model G70 with two 96-MHz PA-7100 processors; and the IBM RISC System/6000 POWERserver 590 with a single 66-MHz IBM POWER2 CPU.

The Sybase System 10 database engine we used for testing the platforms supports SMP hardware by launching multiple instances of the database engine. The database server then binds the engines to a particular processor.

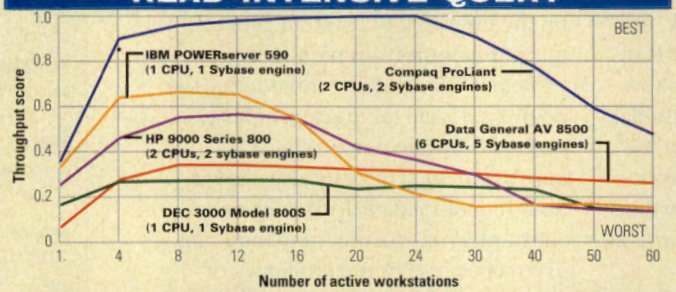
The 60-client test-bed was similar to the one used for review testing. In the accompanying graphs, the scores are shown in normalized form, with the maximum throughput achieved by the Compaq ProLiant in each test indicated as 1.0.

Our Processor-Intensive Query test selects a small number of cached rows. The Read-Intensive Query test performs a join on two tables that exceed the database cache size. The Mixed Workload test runs four transactions: the Processor-Intensive Query, the Read-Intensive Query, an Update transaction, and an Insert.

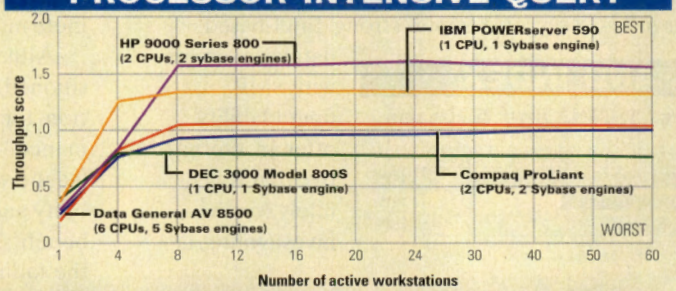
While the overall winner was the HP 9000, the Compaq ProLiant was a competitive midrange performer on both the Mixed Workload and Processor-Intensive Query tests. On the Read-Intensive Query test, it was fastest overall thanks to its strong disk-controller technology.

Examining performance is only part of the process of selecting a database server. Operating system maturity, hardware redundancy, service, and even intangibles such as the company's reputation will play a role. But in a straightforward speed comparison, Intel SMP hardware is clearly in the same league as the RISC-based heavyweights. □

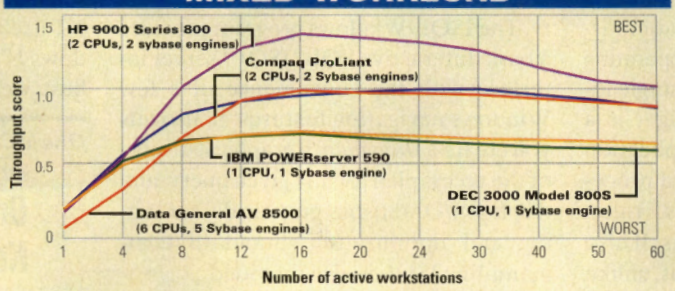
READ-INTENSIVE QUERY



PROCESSOR-INTENSIVE QUERY



MIXED WORKLOAD



ments, you'll be hard pressed to find a more robust solution.

Version 7.0.16 is little changed from the version we saw last year. But even after a year's time, Oracle7 still looks extremely competitive. A newer release, Version 7.1, is already available on several platforms and is expected for NetWare by the end of this year. The same Oracle7 code base is currently available on about 80 hardware platforms, extending the product's reach from the Microsoft Windows desktop to the mainframe.

PERFORMANCE EDGE

While Oracle7 has adopted many of its competitors' best features, it owes some of its performance edge to technology that is not widely used by other products. For example, Oracle7 implements a multiversioning concurrency model, a unique feature in this roundup (Borland's upcoming InterBase Workgroup Server will offer a similar design).

In a multiversioning scenario, each transaction sees a consistent, unchanging view of the database precisely as it was when the transaction began. If the underlying data is changed by a later transaction, information from rollback segments

Intel Technology Briefing



Networking Technology

Tracking Your Network

FAST ETHERNET AND DMI: TWO NEW STANDARDS THAT PUT MORE CONTROL IN SIGHT.

Today's business environment is putting greater demands on our networks than ever before. Multi-megabyte e-mail, graphics and multimedia files are becoming quite common. But so are network traffic jams. And to complicate things further, the thousands of products that make our PCs so flexible are also making them harder to manage. In this brief, we'll tell you how Intel is working with other industry leaders to develop two new standards—Fast Ethernet and the Desktop Management Interface—to help you manage and control your network.

FAST ETHERNET

Given the demands on today's networks, even the most powerful PCs are becoming handicapped by 10 Mbps Ethernet. So in an effort to increase Ethernet throughput, Intel joined with other industry partners in 1993 to form the Fast Ethernet Alliance.



What resulted was a specification for ten times the original 10 Mbps bandwidth. The new 100 Mbps Ethernet provides all the bandwidth today's new technologies require while maintaining the original CSMA/CD protocol. Which means companies don't have to sacrifice their original Ethernet investment.

THE DESKTOP MANAGEMENT INTERFACE

But network traffic isn't the only place we're losing control. The more than 80,000 applications and products that can be added to the PC have made it much more flexible, but they've also made it more difficult to control because they have no common form of management.

That's why Intel formed the Desktop Management Task Force with companies like AST,* Compaq,* DEC,* Dell,* HP,* IBM,* Microsoft,* Novell,* SunSoft,* Symantec* and SynOptics.* The goal was to create a technology that allowed manufacturers to design management capabilities and intelligence into their products.

Their answer was the Desktop Management Interface (DMI). DMI is a technology that defines a standard mechanism for accessing and configuring data in any piece of hardware or software.

MANAGING THE PC'S MANY PIECES

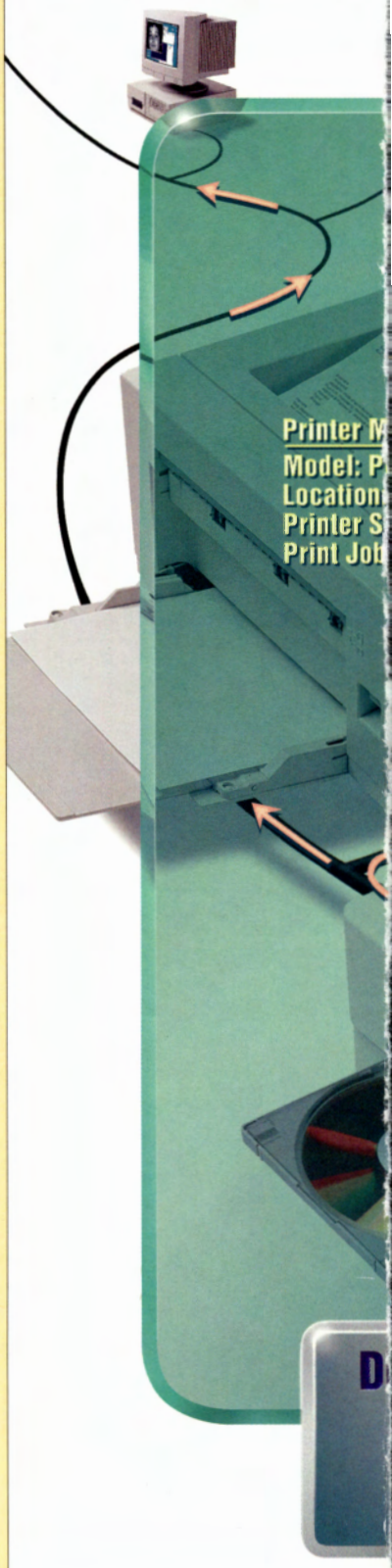


DMI ACTS AS AN INFORMATION BROKER, ENABLING A LAN MANAGER TO GAIN CONFIGURATION DATA ABOUT THE DESKTOP AND ITS MANY PERIPHERALS AND APPLICATIONS. TAKE SOFTWARE DISTRIBUTION, FOR EXAMPLE. WITH A DMI-COMPLIANT MANAGEMENT APPLICATION (LIKE INTEL'S LANDESK™ MANAGER SOFTWARE), A LAN MANAGER CAN TELL WHAT VERSION IS CURRENTLY RUNNING, AS WELL AS GET INFORMATION ABOUT THE SYSTEM'S PROCESSOR, MEMORY AND DISK CAPACITY. THIS ALLOWS HIM TO SET UP THE SOFTWARE BASED ON THE CONFIGURATION AND FEATURES OF THE PARTICULAR PC, SIMPLIFYING THE INSTALLATION PROCESS.

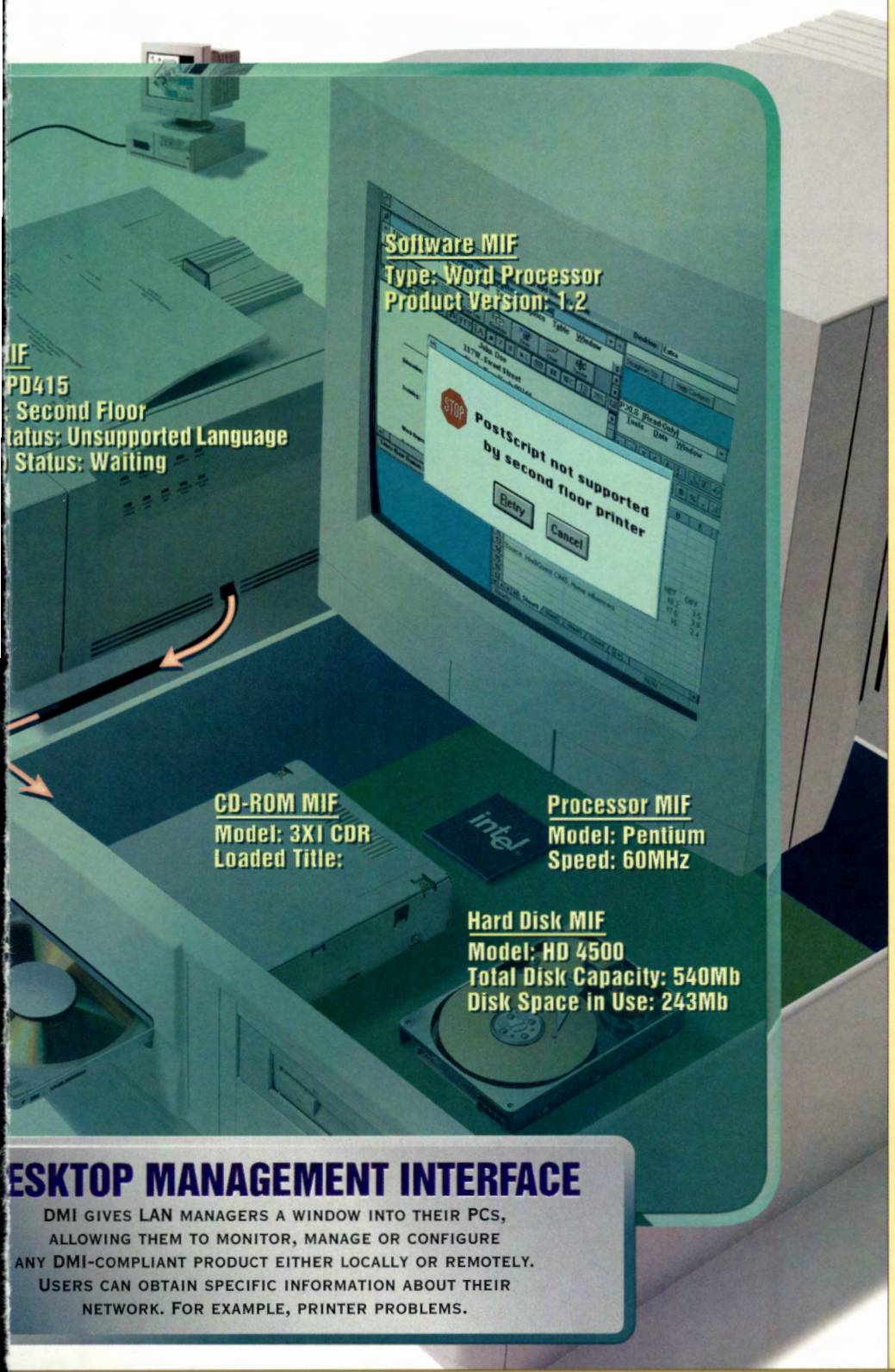
TROUBLESHOOTING IS ALSO SIMPLIFIED BECAUSE DMI-COMPLIANT PRODUCTS CAN SUPPLY INFORMATION ABOUT AN ERROR, REQUEST, OR UNEXPECTED EVENT. FOR EXAMPLE, A DMI-COMPLIANT PRINTER WILL BE ABLE TO COMMUNICATE THAT IT IS JAMMED OR OUT OF PAPER, RATHER THAN SEND A VAGUE "CANNOT PRINT" MESSAGE.

BEFORE DMI, A TRIAL AND ERROR PROCESS HAD TO BE PERFORMED TO FIND OUT WHAT RESOURCES WERE ON A SYSTEM, AND OFTEN THE USER HAD TO BE ASKED TO LOOK UP THE DIFFERENT CHARACTERISTICS OF A MACHINE. BUT TODAY, DMI PROVIDES A STANDARD WAY TO ACCESS THAT INFORMATION.

NETWO



RKING TECHNOLOGY



ESKTOP MANAGEMENT INTERFACE

DMI GIVES LAN MANAGERS A WINDOW INTO THEIR PCS, ALLOWING THEM TO MONITOR, MANAGE OR CONFIGURE ANY DMI-COMPLIANT PRODUCT EITHER LOCALLY OR REMOTELY. USERS CAN OBTAIN SPECIFIC INFORMATION ABOUT THEIR NETWORK. FOR EXAMPLE, PRINTER PROBLEMS.

HOW DOES DMI WORK?



BASICALLY, DMI IS SOFTWARE CALLED THE SERVICE LAYER AND AN ASCII DATABASE CONTAINING MANAGEMENT INFORMATION FORMAT FILES (MIF FILES).

EVERY DMI-COMPLIANT PRODUCT SUCH AS A HARD DISK, CD-ROM, ETC. HAS ITS OWN UNIQUE MIF DESCRIBING ITS IDENTIFYING CHARACTERISTICS LIKE MODEL NUMBER, SERIAL NUMBER AND SPEED, AS WELL AS THE DEVICE'S MANAGEABLE CHARACTERISTICS, SUCH AS A MONITOR'S RESOLUTION.

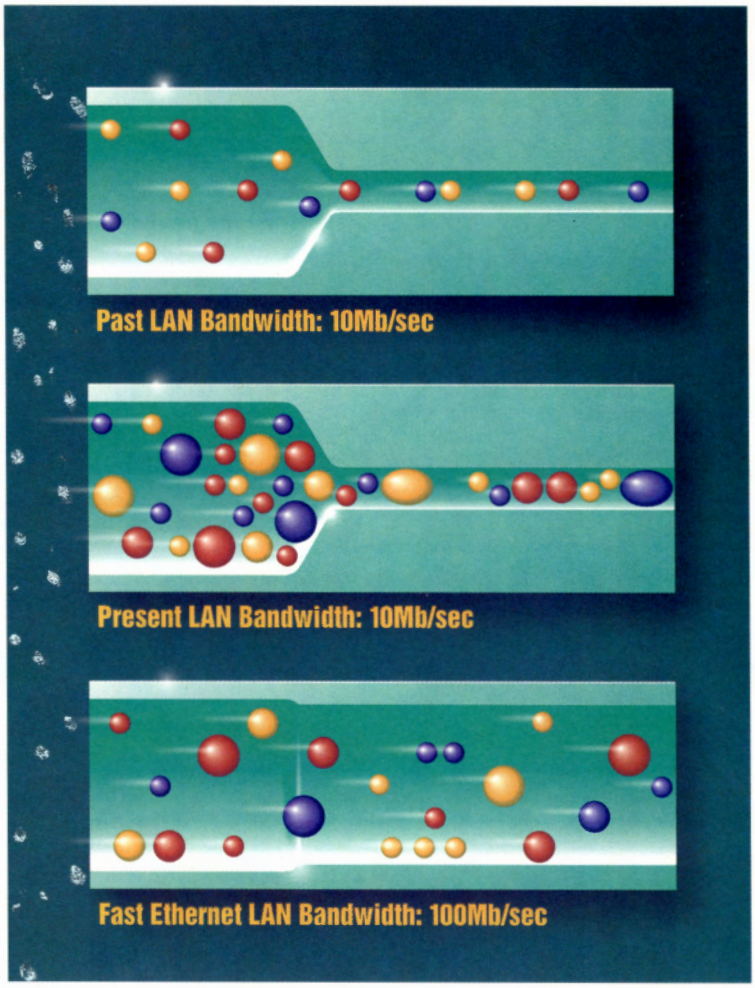


THE SERVICE LAYER

WHEN AN APPLICATION OR HARDWARE PRODUCT IS INSTALLED, ITS MIF IS PASSED TO THE SERVICE LAYER AND THEN STORED IN A DATABASE ON THE PC'S HARD DRIVE. THE SERVICE LAYER IS SOFTWARE THAT RESIDES IN THE OPERATING SYSTEM AND ACTS AS A TRAFFIC CONTROLLER, HANDLING ALL REQUESTS FOR DATA IN THE MIF. THE SERVICE LAYER DYNAMICALLY NOTIFIES MANAGEMENT APPLICATIONS OF THE NEW DEVICE, THEN MAKES INFORMATION ABOUT THAT DEVICE AVAILABLE TO OTHER PRODUCTS—EVEN IF THEY'RE FROM DIFFERENT MANUFACTURERS.

INCREASING DEMANDS ON NETWORK BANDWIDTH

THE AVERAGE NUMBER OF USERS CONNECTED TO NETWORKS HAS ALMOST DOUBLED OVER THE PAST FEW YEARS. AND THE NUMBER OF MESSAGES PER USER ON THE NETWORK HAS GROWN AS WELL. BUT PERHAPS MORE IMPORTANTLY, THESE MESSAGES HAVE GROWN IN SIZE. FOR EXAMPLE, E-MAILS OFTEN CONTAIN SEVERAL DOCUMENTS OR MULTIMEDIA AND GRAPHICS FILES. ALL OF THIS PUTS A TREMENDOUS STRAIN ON NETWORK BANDWIDTH. BUT WITH TODAY'S FAST ETHERNET SPECIFICATION, THE ORIGINAL 10 MBPS BANDWIDTH IS INCREASED TO 100 MBPS, PROVIDING MORE THAN ENOUGH ROOM FOR THE LARGE NUMBER OF USERS TRANSMITTING LARGE QUANTITIES OF DATA OVER THE NETWORK.



WHAT DO DMI AND FAST ETHERNET MEAN TO INTEL PRODUCTS?

In addition to developing these two new standards, Intel is incorporating them into their new networking products.

For example, the new Intel EtherExpress™ PRO/100 adapter cards utilize the Fast Ethernet standard, making them the first network interface cards to integrate seamlessly into your Ethernet environment at both 10 Mbps and 100 Mbps.

Intel's entire line of EtherExpress PRO adapters supports the DMI specification. Which means a LAN manager, working from any DMI-compliant application, will be able to access information about the adapter's address, IRQ, drivers and more for maximum network control.

DMI will also be supported in the next version of Intel's LANDesk Manager software, providing a robust, end-to-end solution.



WANT TO LEARN MORE? CALL 1-800-955-5599.

For more information about the DMI and Fast Ethernet standards, or about Intel networking products that incorporate these technologies, just call our toll-free number and ask for literature package #207. Or dial Intel's FaxBack* at 1-800-525-3019 and ask for document #5572.

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Ingres Server: *Still on Hold*

By Brian Butler and Thomas Mace

Last year's SQL roundup included a review of Ingres Server for OS/2, Version 6.4, which at that time had just been acquired by The ASK Group. We found this product to be intriguing but flawed by serious bugs. This year we planned a follow-up look at a point release of Version 6.4 designed to address the problems we encountered. Working with technical representatives from The ASK Group, we put the updated product through our standard tests in preparation for this story. Ingres Server made it through our Load and Index and Ad Hoc query tests without a hitch but in our multiuser tests, we ran into significant bugs that made the product spontaneously drop clients. The performance numbers we were able to generate put Ingres Server at the bottom of the test lineup.

In the middle of our tests, the ASK Group was acquired by Computer Associates International (CA), which immediately withdrew all Intel-based Ingres Server products from the market, including the product we were testing. CA stated that the version we saw was a beta product not ready for release. Customers who received the product were told that they had received a beta version and that they would get the final release when it was ready.

CA plans to debug the existing Intel ports and release them once they are fixed. As we went to press, a ship schedule had not been announced. Releases for Microsoft Windows NT, NetWare, OS/2, SCO Unix, Solaris, and UnixWare are planned. CA also stated that it will continue to support the existing Ingres installed base.



TECHNOLOGY PIONEER

Ingres Server, which had its origins in the Berkeley Ingres prototype, has always had a reputation as one of the most academically strict relational databases. In the past, Ingres has served up impressive technology, pioneering cost-based optimization and many other now-standard database features, including triggers, which Ingres calls *rules.* Other high-end engine features of the version we tested include event alerters, user-defined data types, user-defined functions, stored procedures, and two-phase commit. Ingres also offers a distributed database strategy through its Ingres/Star server.

Ingres Server is unusual in that some of its most powerful features are managed by a server extension product called Ingres Knowledge Management. This component provides Ingres's rules and event alerters and also offers administration of permission levels by individual, group, or application. It also offers a resource-control feature based on the Ingres optimizer for preventing runaway queries.

Although the Ingres Server product we looked at suffered few protection-fault shutdowns during testing, most of the problems we encountered seemed to stem from the Ingres client libraries. CA agrees with our assessment and plans to concentrate its debugging efforts in this area. In the near term, CA plans to work on performance improvements within the existing engine and sees Ingres Server ultimately challenging Oracle and Sybase in mainstream OLTP markets. In the long term, they plan to rearchitect the database to support parallel operations and massively parallel hardware.

Ingres Server has clearly languished in the recent past, but its strong technology deserves a better fate. We look for future releases from CA to turn the product around. □

is used to maintain the first transaction's consistent view. The big advantage to a multiversioning model is that read transactions do not need to acquire locks that block write transactions, improving overall concurrency.

When locks are needed, Oracle7 uses a row-level locking scheme instead of the more conventional page-level locks. The database supports an unlimited number of row-level locks that never escalate to page or table locks. While the page-level locking schemes used in other products are adequate for most applications (and theoretically entail less management overhead), the page is not a "natural" unit of storage. This can increase the difficulty of tuning operations. Row-level locking also provides optimal concurrency, indicated by Oracle7's excellent scores on our Random Write Transaction Mix test.

Oracle7's triggers are similar to those in other products except that the user can stipulate when a trigger executes relative to execution of the SQL statement that fires it. The database also supports declarative referential integrity, and automatic cascading deletes can be set to eliminate child rows when parent rows are deleted.

Since Version 6.0, the log manager has been optimized to support fast commits and group commits. Moreover, only changes to data are logged, not the entire before-and-after image of the row.

Oracle7's cost-based optimizer does not use histograms, but it does gather a number of statistics from tables and indexes. Using the Analyze command, you can update these statistics based on a subset of the data. This can be useful for huge decision-support databases where a complete table scan would be unduly long.

On our Ad Hoc Query test, the optimizer picked the wrong access method on our sort query. This resulted in a

SUITABILITY TO TASK	Oracle7 Server for NetWare
Production OLTP	EXCELLENT
Decision support	EXCELLENT
Workgroup database	GOOD
Connectivity & deployment	EXCELLENT

The Price of Performance

By Brian Butler and Thomas Mace

If all of the SQL database servers in this roundup cost the same, picking out the right one would only be a matter of weighing feature sets. But the wide range of prices here—from a mere $5,390 to almost $30,000—adds to the complexity of your decision. In order to help clarify pricing issues, we look at SQL database prices in two different ways: total cost and bang for the buck.

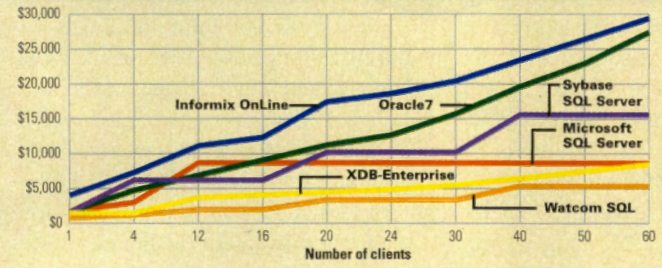
One good piece of news is that SQL database pricing has gotten noticeably simpler. SQL vendors used to be notorious for devising complex schemes with separate pricing for server connections and client libraries. This year, all with the exception of Informix are pricing on a per-user basis, where client software is now essentially free. Workgroup bundles from the major players will soon simplify pricing even further.

STRAIGHT COST

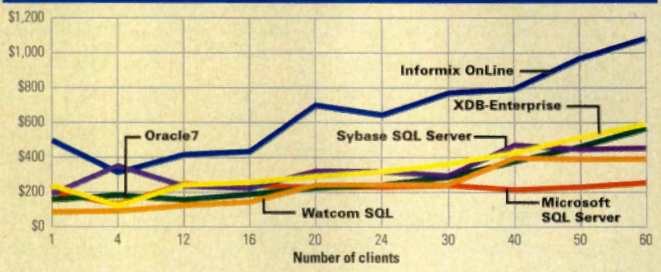
The simplest way to view the price of a database is by its straight deployment cost (see the chart "Price by Number of Clients"). This cost, shown for 1 to 60 users, includes the required number of user licenses, required client software, and one standard 3GL development kit (the cost of network protocol stacks and support is not included).

Prices vary widely and exhibit a

PRICE BY NUMBER OF CLIENTS



PRICE PER TRANSACTION



10-hour run on a test that ultimately took only one hour and 20 minutes to complete. The problem was fixed using Oracle's well-documented Hint mechanism for overriding the optimizer. A nice Hint subtlety is that the mechanism lets you tune queries for best response time (the amount of time required to return the first row of data) or best overall query time.

Stored procedures are available, although they cannot return result sets. But you can send an array of values to a stored procedure. This elegant trick could be used for problems such as inserting multiple line entries in an order table. Stored procedures can be logically grouped together into what Oracle calls a Package. This makes for easier administration, allowing the user to maintain all the stored procedures for a particular application as a single entity, for example. You can define global variables for an entire Package and also grant and revoke permissions at the Package level.

The current release of Oracle7 still lacks the GUI administration tools that recently premiered on Oracle's Workgroup Server product. It does ship with a full-featured character-based administration tool called SQL*DBA. This utility manages tasks such as opening and closing the server and lets you monitor system performance and use, perform backups, and interactively execute SQL statements. SQL*DBA provides two modes of operation: a screen-based interface complete with drop-down menus, and a command-line interface. You can also use SQL*DBA to monitor a variety of system statistics and to create and drop tablespaces and rollback segments.

The current release offers the convenience of role-based security administration. Users can be added to more than one role, and user privileges can be granted or revoked at the role level as needed. While this seems like a simple concept, it marks a big improvement over previous versions of the product in which privileges had to be granted individually for each user. The current version is B2-level secure. A separate product, Trusted Oracle7, is C2-level secure.

Oracle7 has strong support for distributed databases. It supports transparent two-phase commit and controls remote procedure calls (RPCs) as an integral part of transactions. Oracle7

▶ FACT FILE

Oracle7 Server for NetWare, Version 7.0.16



List price: Server software, one development system, 60 client connections, and client software: $27,400. **Requires:** Server: 386-based PC or better, 12MB RAM, 30MB hard disk space, NetWare 3.0 or later. DOS client: 286-based PC or better, 100K RAM, 100K hard disk space. **In short:** Excellent transaction processing speed and a rich feature set add up to one of the most sophisticated databases available. Oracle7 offers virtually all the features of competing products, and its multiversioning consistency model and row-level locking provide excellent concurrency. Despite its high price, Oracle7 still garners an excellent price/performance ratio, but it is not geared toward organizations with limited budgets. This is not a database for the meek, but for the most demanding applications, you'd be hard-pressed to find a better solution.

Oracle Corp., 500 Oracle Pkwy., Redwood Shores, CA 94065; 800-672-2531, 415-506-7000; fax, 415-506-7200

478 on reader service card

number of strategies. Informix On-Line is consistently the most expensive; its price increases in a smooth curve from $3,995 for one user up to $29,395 for 60 users. Oracle7, the second most expensive package, takes a similar approach to pricing. Sybase SQL Server is less expensive and shows a simpler tiered pricing structure. Microsoft SQL Server carries simplification even further, providing for 12 to 60 clients for the same price of $8,690. Watcom SQL, the least expensive package we tested, begins at $790 for one user and rises to a modest $5,390 for 60 users. XDB-Enterprise, while slightly more expensive, closely follows Watcom SQL's pricing.

PRICE/PERFORMANCE

A price/performance analysis shows the products in a very different light (see the chart "Price per Transaction"). To generate this graph, we divided each price by each product's transaction-per-second throughput on our Random Write Transaction Mix test.

The products look much more alike from this perspective. Oracle7, Sybase SQL Server, Watcom SQL, and XDB-Enterprise deliver very similar price/performance ratios across the range of client loads. Microsoft SQL Server is the leader above 20 clients, albeit by a narrow margin. The only standout is Informix OnLine, which offers the poorest mix of price and performance across the board. As with most product groups offering similar bang for the buck, your choice here will be dictated by the performance level you need.

As you calculate server prices, it's important to remember that servers are only a part of the equation. Client/server technology remains an expensive proposition to implement successfully due to the lack of turnkey systems, and by the time that you've factored in software development and support costs, the price of the most expensive server may not look so big. □

also initiates two-phase commit for any RPC outside the Oracle7 since the database has no way of knowing what the result of the RPC will be. Cost-based optimization is available for distributed queries based on statistics and available indexes in the distributed environment. Oracle7 also has a trigger-based replication scheme for making distributed read-only copies of tables, table subsets, or query results. Oracle has announced a more robust symmetric replication technology, which is expected to ship by the end of this year.

Access to non-Oracle7 data through RPCs or SQL is provided by the Oracle Transparent Gateway (formerly SQL* Connect), a set of gateway products for a variety of relational and nonrelational systems.

Its first-place Load and Index test scores are attributable in part to its SQL*Loader, one of the fastest, most functional loaders we used. It supports both direct-path and conventional-path loading. We used direct-path, in which records are written directly to the database block, bypassing most database processing. While direct-path loading has some restrictions, conventional-path loading is always available as a workaround.

The next version of the NetWare product should ship as Version 7.1 before the end of the year. This revision will add Oracle7 Symmetric Replication, and the impressive parallel query–execution, data-loading, and index-creation features already available in the Unix release we used to test CPU scaling (see the sidebar "Intel-based SMP: How Strong?"). Version 7.1 will also include support for user-defined SQL functions and dynamic SQL statements—statements whose contents are not known until runtime. Additional slated improvements include tweaks to the optimizer, encrypted network passwords, and faster database recovery.

SUITABILITY TO TASK **Sybase SQL Server for NetWare**	
Production OLTP	EXCELLENT
Decision support	EXCELLENT
Workgroup database	GOOD
Connectivity & deployment	EXCELLENT

NOT FOR THE MEEK

Oracle7 was the fastest database tested for this roundup, taking the lead on five out of seven tests. Almost no tuning was required to achieve these results.

At the same time, this is not a database for the meek. Exploiting its huge array of features demands expertise and time spent with the superb encyclopedic documentation. Oracle7's price/performance ratio is excellent, but its high price is targeted at users who need speed and functionality, not savings. But for bullet-proof operation in high-stress transaction-processing environments, Oracle7 is a winner.

Sybase Inc.

• Sybase SQL Server for NetWare

Sybase SQL Server for NetWare, Version 10.01, represents a solid upgrade to Version 4.2, which we reviewed last year. Sybase has made numerous enhancements, tweaks, and fixes to the engine, which proved to be stable and extremely fast in testing.

The jump from Release 4.2 to 10.01 brings Sybase SQL Server's version numbering in line with the company's System 10, an important family of add-on server products designed to address connectivity, replication, administration, and scalability.

NetWare makes an excellent showcase for the database engine's core features and performance, but a lack of add-ons leaves Sybase SQL Server in limbo as a product: While many System 10 components are shipping on other platforms, the only component available for the NetWare product we tested is the Backup Server. Our testing bundle only included the server, Backup Server, bulk copy program, and Interactive SQL (ISQL). Later this fall, Sybase plans to sweeten the offering by releasing NLM versions of some other System 10 components and repackaging the NLM server in separately priced workgroup and enterprise editions.

MATURE ENGINE

The NLM version of Sybase SQL Server we tested includes much of the advanced engine technology that first lifted Sybase to prominence. The list includes Sybase SQL Server's stored procedures (which

YOU'RE LOOKING AT THE PRICE, PERFORMANCE



Compaq ProLinea MT 4/33S

$1,529

*Or $54 per month**

Minitower case with EasyAccess™ side panel has five expansion slots and five drive bays for superior expandability. It's easy to add options like a data+fax modem, a tape backup drive, or CD-ROM drive. And it's upgradable to Pentium™ technology.

ProLinea™ MT Features:

33MHz 486SX
(other processors available)

4MB RAM (upgradable to 64MB)

420MB Hard Drive

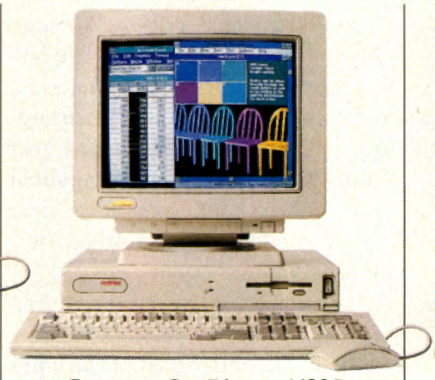
3.5" Diskette Drive

Local Bus Graphics with 1MB

14" SVGA Color Monitor (1024 x 768)

Preinstalled MS-DOS 6,
MS-Windows 3.1, and TabWorks

Preinstalled Multimedia Solution Paq available.



Compaq ProLinea 4/33S

$1,349

*Or $48 per month**

Multimedia Solution Paq™
With SoundBlaster 16-bit sound board, internal dual-speed CD-ROM drive, external stereo speakers, microphone & multimedia software. Starts at $449.

ProLinea 4/33S Features:

33MHz 486SX
(upgradable to Pentium technology)

4MB RAM (upgradable to 100MB)

270MB Hard Drive

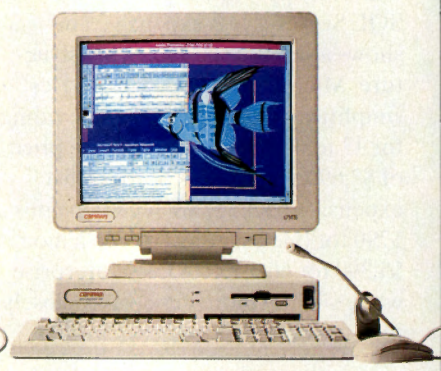
3.5" Diskette Drive

Local Bus Graphics with 1MB

14" SVGA Color Monitor (1024 x 768)

Preinstalled MS-DOS 6,
MS-Windows 3.1, and TabWorks.

Preinstalled Multimedia Solution Paq available.



Compaq Deskpro XE 4/66

$2,249

*Or $80 per month**

You couldn't ask for more in a business PC. From powerful processors to QVision™ Local Bus Graphics and enhanced audio, it offers some of today's latest technology.

Deskpro XE:

66MHz 486DX2 Processor
(others available, including Pentium)

8MB RAM (upgradable to 32MB)

270MB Hard Drive

3.5" Diskette Drive

QVision Local Bus Graphics
with 1MB VRAM

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▶ SUMMARY OF FEATURES CONTINUES

SQL Databases

PC MAGAZINE EDITORS' CHOICE

Products listed in alphabetical order ■ = YES □ = NO	Informix OnLine for SCO Unix 5.01	Microsoft SQL Server for Windows NT 4.21	Oracle7 Server for NetWare 7.0.16	Sybase SQL Server for NetWare 10.1	Watcom SQL Network Server for NetWare 3.2	XDB-Enterprise Server 4 for Windows NT
List price*	$29,395	$8,690	$27,400	$15,590	$5,390	$8,490
Cost of standard one-year telephone support	$1,980	$7,500	$1,290	$4,000	$5,000	$2,000
SQL Implementation						
ANSI compatibility:						
ANSI Level 2 with Enhanced Integrity	■	□	■	■	■	■
ANSI Level 2	■	□	□	■	■	■
ANSI Level 1	■	■	□	□	■	■
Full DB2 compatibility	□	□	□	□	□	■
Binary large object (BLOB) data types	■	■	■	■	■	■
User-defined data types	□	■	□	■	□	□
User-defined range limits on data types	□	■	□	■	□	■
Advanced mathematical and statistical functions	■	■	□	■	□	■
User-defined functions and operators	■	□	□	■	□	□
Cost-based/rule-based optimization	■□	■□	■■	■■	■■	■□
Transaction Management						
Locking:						
Record-level	■	□	■	□	■	■
Page-level	■	■	□	■	□	□
Table-level	■	■	■	■	□	■
Adjustable for each table	■	□	□	■	□	□
Automatic lock escalation	□	■	□	■	□	□
Consistency levels supported:						
Cursor stability	■	■	N/A❶	■	■	■
Repeatable reads	■	■	■	■	■	■
Multiversioning	□	□	■	□	□	□
Release locks	■	■	□	□	■	■
Uncommitted reads	■	□	□	□	■	■
Read-only databases	■	■	□	■	■	■
Cost-based deadlock-detection schemes:						
Engine can abort transaction causing the deadlock	■	■	■	■	■	■
Engine can abort via a timeout option	■	■	□	■	□	■
Programming Interface						
Includes call-level interface	■	■	■	■	■	■
ODBC support included	■	■	■	■	■	■
Host-language interface:						
ANSI-compatible cursors	■	□	■	■	■	■
Included SQL precompilers	C	C, COBOL	C, COBOL, FORTRAN	ADA, C, COBOL	C, C++	C, COBOL, DL/1
Backward scrolling in result set	■	■	□	□	■	■
Preserves cursor context after Commit and Rollback	■	■	□	□	■	■
Supports result-set inserts	■	■	□	■	■	□
User can insert, update, and delete using an array of variables	■	□	■	■	□	□
Stores procedures in database	■	■	■	■	□	□
Embedded select, update, delete, insert	■	■	■	■	N/A❷	N/A❷
Supports control and flow logic	■	■	■	■	N/A❷	N/A❷
Supports message and error-code handling	■	■	■	■	N/A❷	N/A❷
Accepts variables and returns values or messages	■	■	■	■	N/A❷	N/A❷
Supports row-at-a-time processing	■	■	■	■	N/A❷	N/A❷
Supports remote stored procedures	■	■	■	■	N/A❷	N/A❷
Performs binding and optimization before runtime	■	■	□	□	■	■
Offers Wait and Nowait for lock to be released	■	□	■	□	■	□
Database Server Environment						
Database server architecture	Multithreaded	Multithreaded	Process-per-user	Multithreaded	Multithreaded	Multithreaded
Portability:						
DOS	□	□	□	□	■	■
Microsoft Windows	□	□	■	□	■	■
Microsoft Windows NT	□	■	■	■	□	■
NetWare	□	□	■	■	■	□
OS/2	□	■	■	■	■	■
Unix	■	□	■	■	□	□
VM	□	□	■	□	□	□
VMS	□	□	■	■	□	□
MVS	□	□	■	□	□	□

* The list price includes server software, 60 client connections with client software, and 1 development system.
N/A❶--Not applicable: The product implements a multiversioning concurrency model.
N/A❷--Not applicable: The product does not have this feature.



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CIRCLE 056 ON READER SERVICE CARD

SUMMARY OF FEATURES — ENDS

Products listed in alphabetical order ■ = YES □ = NO	Informix OnLine for SCO Unix 5.01	Microsoft SQL Server for Windows NT 4.21	Oracle7 Server for NetWare 7.0.16 (PC MAGAZINE EDITORS' CHOICE)	Sybase SQL Server for NetWare 10.01	Watcom SQL Network Server for NetWare 3.2	XDB-Enterprise Server 4 for Windows NT
Database Server Environment (continued)						
Networking protocols on reviewed server	IPX, TCP/IP	IPX, NetBEUI, TCP/IP	IPX, TCP/IP	IPX, TCP/IP	IPX, NetBIOS	NetBIOS, TCP/IP
Data Storage Features						
Database segmentation	■	■	■	■	■	■
Clustered indexes	■	■	□	■	■	■
Clustered tables	■	□	■	□	□	□
Hashed indexes	□	□	■	□	□	□
Database Administration						
Includes performance monitor	■	■	■	□	□	■
Performance information accessible through an API	■	■	■	■	□	□
GUI-based administration tools	□	■	□	□	□	□
Keeps tables and logs on separate devices	■	■	■	■	■	■
Supports duplexing or mirroring of journals	■	■	■	■	□	□
Automatic system recovery with journal logs	■	■	■	■	■	■
Automatic media recovery with journal logs	■	■	■	■	□	■
Database backup/recovery:						
On-line backup	■	■	■	■	■	■
Incremental backup	■	■	■	■	■	□
Backup and recovery by database segment	■	■	■	■	□	□
Point-in-time recovery	□	□	■	□	■	□
Fast recovery:						
User can specify number of log records written between checkpoints	□	□	□	□	□	□
Indicates estimated time for recovery	□	□	□	■	■	□
Indicates percentage of log full	□	■	□	□	□	□
Indicates amount written to log	■	■	■	□	□	□
Maintains audit trail automatically	□	□	■	■	□	□
Can create audit trail via triggers	■	■	■	■	□	□
Import/export file support:						
ASCII	■	■	■	■	■	■
.DBF	□	□	■	□	■	■
.WKS	□	□	■	□	■	■
Other	Proprietary	Proprietary	Btrieve	Proprietary	.DIF, SQL Insert statements	DBNAUI, .DIF, DSNTAUL, SYLK
Security:						
Grant and Revoke by user	■	■	■	■	■	■
Grant and Revoke by group	□	■	■	■	■	■
Supports mirroring of database tables	■	■	□	■	□	□
Connectivity						
Distributed database support:						
Automatic two-phase commit	□	□	■	□	□	□
Programmatic two-phase commit	■	■	□	■	■	□
Distributed cost-based optimization	■	□	■	□	□	□
Distributed recovery	■	□	■	□	□	□
Distributed deadlock detection	■	□	■	□	□	□
Gateways:						
DB2	■	□	■	■	□	■
RDB or VMS	□	□	■	■	□	□
Legacy databases supported:						
IDMS	□	□	■	■	□	□
IMS	□	□	■	■	□	□
RMS	□	□	■	■	□	□
VSAM	□	□	■	■	□	□
DBMS Integrity						
Triggers:						
Executes triggers automatically for each modification to a table	■	■	■	■	N/A ❷	N/A ❷
Supports multiple triggers	■	■	■	□	N/A ❷	N/A ❷
Triggers can cascade	■	■	■	■	N/A ❷	N/A ❷
Supports recursive triggers	□	□	■	■	N/A ❷	N/A ❷
User can apply rules to table columns	■	■	■	■	□	■
Declarative database integrity:						
Supports cascading deletes	□	□	■	□	□	■
RI syntactically enforced by primary and foreign keys	■	□	■	■	■	■
Maintains domain integrity	■	□	■	■	■	■

N/A❷--Not applicable: The product does not have this feature.

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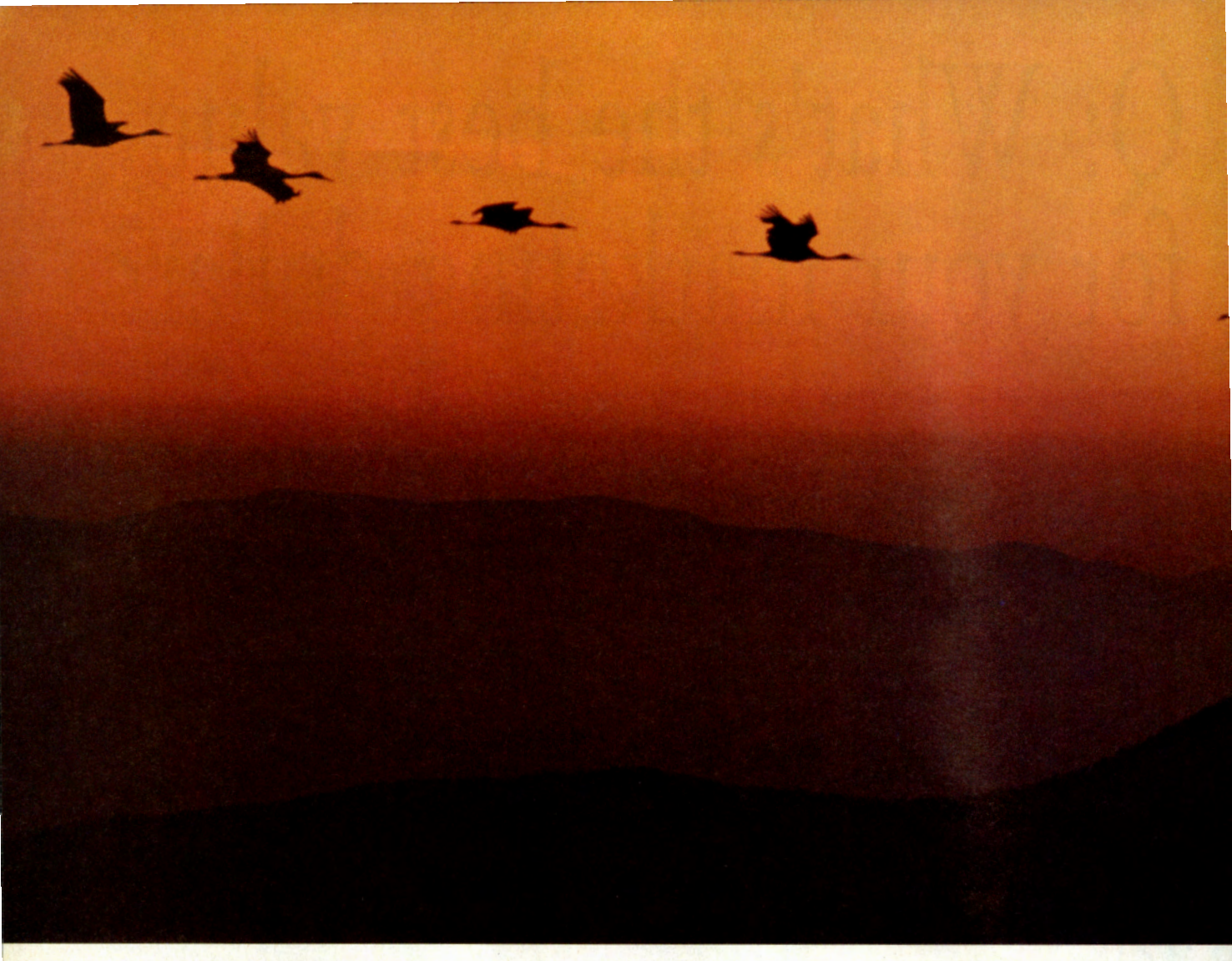

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can return multiple result sets from a single procedure), triggers, and one of the industry's most robust cost-based optimizers. While these once-cutting-edge features are fast becoming commodities, Sybase SQL Server's implementations are mature and time-tested.

Version 10.01 also adds a number of new features (some of which derive from Sybase SQL Server, Versions 4.8, 4.9, and 4.9.1, which were not released on the NetWare platform). One of the most important is that Sybase SQL Server is now fully compliant with ANSI SQL-89, including support for declarative referential integrity, enforced through Restrict. The new version also adds ANSI cursor support, allowing direct row-by-row processing of result sets. ANSI cursors are available from within stored procedures as well.

Several new datatypes, including decimal, scaled numeric, and double precision, have been added. New Transact SQL keywords and other syntax modifications may make it necessary to change existing applications. For example, creating a column called Key will now generate a Reserved Word error.

A number of enhancements make database and index creation faster. Instead of initializing database space one 2K page at a time, the engine now writes eight pages in a single operation. To speed index creation, you can allocate I/O buffers in memory from which multiple pages can be written to disk in a single physical I/O.

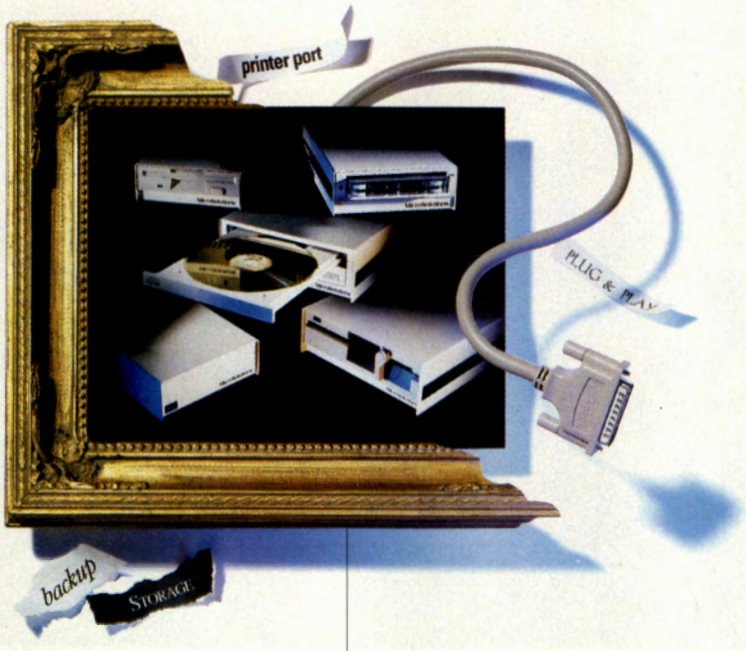
Dumps and loads, now handled by the bundled System 10 Backup Server, have been substantially improved. The Backup Server NLM can run on the same physical platform as the database or on an independent server, letting you back up across the network. Formerly you could only back up a single database to a single device at a time; now you can simultaneously dump multiple databases to a single device and dump single or multiple databases to up to 32 devices in parallel. A new Threshold Manager feature, used with a stored procedure, can send a warning or initiate a backup when the transaction log or a data segment becomes too full.

Although the query optimizer has not been fundamentally changed, enhancements have been made. Select statements that lack a Where clause can now take advantage of available indexes. Queries containing an Order By clause can use a nonclustered index if the index covers the sort column. Subquery processing has also been improved, and the engine now keeps more representative statistics on the data to apply to query optimization.

The new release also adds several security features aimed at C2-level compliance. The most important are encrypted passwords with expiration and audit trails for log-ons, log-offs, and commands. Accounts can now be locked without having to delete the user log and associated objects. Administrator tasks have been divided into three separate tiers called *roles*, each with distinct privilege levels and log-ons.

A FEW MISSING PIECES

There are still a few missing features we hope will be addressed in future releases.



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FACT FILE

Sybase SQL Server for NetWare, Version 10.01



List price: Server software, one development system, 60 client connections, and client software: $15,590. **Requires:** Server: 386-based PC or better, 32MB RAM, 30MB hard disk space, NetWare 3.12 or later; DOS client: 386-based PC or better, 640K RAM, 1MB hard disk space. **In short:** Sybase SQL Server is one of the fastest SQL databases we saw and was the performance leader on read-intensive tests. The engine, available on a large number of platforms, fairly bristles with advanced features, although a few niceties remain on the wish list for future revisions. The NetWare version we tested is still waiting for ports of Sybase's System 10 products that add replication, connectivity, gateways, and GUI administration tools. These should begin shipping this fall, turning what is currently an impressive technology demonstration into a well-rounded product.

Sybase Inc., 6475 Christie Ave., Emeryville, CA 94608; 800-879-2273, 510-922-3500; fax, 510-658-9441

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Remote procedure calls (RPCs) are not currently integral to transactions; this means consistency cannot be guaranteed between distributed databases when RPCs are used. Two-phase commit must still be added programmatically. While Sybase has clearly chosen replication over two-phase commit as its strategic direction, transparent two-phase commit remains a desirable feature.

The current implementation of declarative referential integrity enforces integrity rules as a restrict only. Operations such as cascading updates and deletes or Set Null must still be added programmatically using triggers. The engine's maximum lock granularity is still the page, an approach that requires less lock management overhead than row-level locking, but also provides less concurrency.

The bundled ISQL interface has been around forever and is in great need of a facelift. Its bare-bones command line interface lacks the most basic convenience features such as command history. The bulk-copy program (BCP) bundled with the server has not been changed since Version 4.6. It supports negotiated packet size between client and server for optimal copy performance, but it still suffers from a poor user interface and does not return critical postmortem information such as the type of error or the number of the row that caused it.

A few minor quirks we noticed in last year's tests have still not been resolved. The server still does not support update-in-place for variable-length fields, requiring a more costly Delete and Insert for an entire row (all nullable columns are treated as variable-length fields). Deadlocks are still resolved by killing the process with the longest user connection time and not the longest transaction time, which is essentially an arbitrary choice.

NEW PACKAGES ON THE WAY

Since our last review, Sybase has focused much of its energy on System 10 extensions to Sybase SQL Server, products the company sees as being key to its larger enterprise strategy. The most important System 10 components include Replication Server, OmniSQL Gateway, Open Server, Open Client, Monitor Server, and Backup Server. While many of these

MOVING?

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products have shipped on a variety of platforms over the past year, NetWare has seen relatively little attention.

In the near future, this situation should change. The initial rollout of System 10 components for NetWare will dovetail with a repackaging of the NetWare product into separate workgroup and enterprise editions, expected by this year's end. The workgroup version is slated to include Monitor Server, Open Client, and a set of new Microsoft Windows–based administration tools now in alpha testing. The enterprise version will offer System 10 products as unbundled additional-cost options. Currently, NetWare ports of Replication Server, Monitor Server, Open Client, Open Server, and Sybase's newly acquired Micro Decisionware MDI gateways are under development. The ultimate goal of Sybase is to make all System 10 components available on all its supported platforms.

Sybase SQL Server is one of the industry's fastest and most sophisticated databases, and the latest release adds many welcome enhancements. Its pricing is reasonably competitive, especially for smaller workgroups, but its aging toolset and the current lack of System 10 add-ons make today's NLM version a tough sell. We look forward to new bundles, new pricing, and the availability of new components to round out this fundamentally strong product.

Watcom International Corp.

• Watcom SQL Network Server for NetWare

While the giant SQL vendors fight performance and feature wars, Watcom International Corp. has carved out a niche for a shrink-wrapped SQL server that's stable, cheap, and easy to install. But don't be misled by its low cost and simplicity: Watcom SQL Network Server for NetWare, Version 3.2, delivers a surprisingly robust feature set with many industrial-strength bells and whistles. While its performance still lags behind that of our front-runners, Watcom SQL proved to be exceptionally stable in testing and handled our multigigabyte database with aplomb.

The current product is only one release beyond the 3.1 version we tested last year, but the engine has been ported to two important new platforms in the interim: OS/2 and NetWare (Watcom SQL supports NetWare 3.11, 3.12, 4.0, and 4.01). Along with the existing DOS and Microsoft Windows ports, this expansion brings the total of supported platforms to four.

Since our last review, Watcom has been acquired by the well-known tools vendor Powersoft Corp., and the Watcom SQL engine ships as the standard back end for Powersoft's PowerBuilder line of development tools.

SUITABILITY TO TASK	Watcom SQL Network Server for NetWare
Production OLTP	FAIR
Decision support	GOOD
Workgroup database	EXCELLENT
Connectivity & deployment	FAIR

A major upgrade, slated for release this month, will add important enhancements such as triggers and stored procedures, full declarative referential integrity, and GUI administration tools.

PERFORMANCE BOOST

The most obvious improvements to Watcom SQL since last year's review are in the area of performance. For example, Watcom moved from last place on last year's Ad Hoc Query test to a respectable middle-of-the-pack ranking; its Single Random Read score shows a five-fold improvement.

Part of this can be attributed to its new cost-based optimizer, which determines the optimal access path for queries using statistics such as minimum/maximum values, row counts, cardinality, and index structures. The optimizer in the previous release was essentially a rule-based system, although it could also track limited statistics. During each session, the optimizer collects access-path information for executed queries; this can be used to speed up subsequent queries that use all or part of the same access paths.

The move from extended DOS to NetWare, a true 32-bit environment, opened the door for other performance-boosting enhancements. One of the most important is the implementation of asynchronous I/O. Under the synchronous scheme used formerly, each I/O request must run to completion before any other database operation can occur. This forced serialization of operations can waste significant CPU time. With asynchronous I/O, the database server can issue requests to the disk subsystem and then service other operations before the I/O completes. The move to NetWare also means that the engine could take advantage of multiple network adapters in our test-bed.

Other than performance enhancements, this version is not dramatically different from the release we tested last year. Still, it does embody several welcome changes, including support for on-line backup (which dumps to a file, not directly to tape), multinational characters, BLOBs, and programmatic two-phase commit.

INSIDE THE ENGINE

In addition to standard transaction processing, Watcom SQL's engine delivers several advanced features. One of the most unusual is its bidirectional scrollable updatable cursors. These can be especially useful in a GUI environment for implementing listbox- or VCR-style browsing in the front-end application without extensive coding. Bidirectional cursors also provide the elegance of locking that is directly controlled by the server. Updatable multitable views are supported as well.

▶ FACT FILE

Watcom SQL Network Server for NetWare, Version 3.2



List price: Server software, one development system, 60 client connections, and client software: $5,390. **Requires:** Server: 386-based PC or better, 3MB RAM, 4.3MB hard disk space, NetWare 3.11 or later. DOS client: 286-based PC or better, 640KB RAM, 1.6MB hard disk space. **In short:** While not built for high-volume transaction processing, Watcom SQL delivers a low-cost, feature-rich engine that's ideal for departments and workgroups. The move to 32-bit NetWare and a new cost-based optimizer have significantly boosted overall performance since our last review. The product's easy installation and generic embedded SQL make this a great package for learning client/server systems. Version 4.0 of Watcom SQL, due out by the time this story appears, will add significant features including triggers, stored procedures, and declarative referential integrity.

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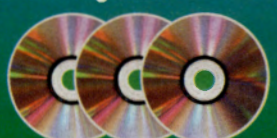

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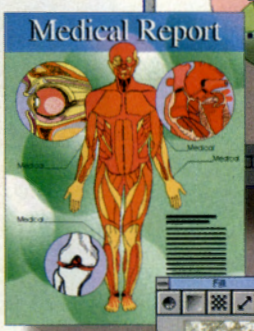



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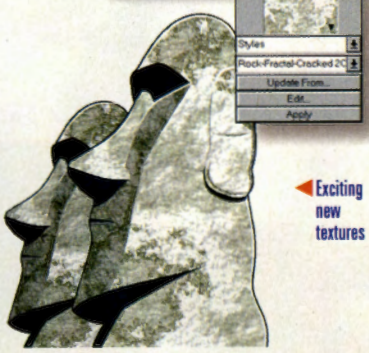

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The Watcom engine provides its own internal threading. Neither the current OS/2 port nor the upcoming Windows NT version will support native operating-system threads, however, so Watcom SQL will not be able to exploit SMP hardware in the foreseeable future.

The database provides both compression and encryption options. Compressed database files, intended for applications where disk size is restricted, are read-only unless used in connection with Watcom's Write File feature (write files are used to store changes made to a database so that the database itself can remain unchanged).

The only standard programming interfaces for Watcom SQL are embedded SQL and ODBC. But the NetWare version also exposes a direct programming interface that can be exploited by any other NLMs running on the server. Although Watcom SQL ships with a bulk-copy program, the company chose to use this interface to write a custom high-performance NLM loader for our tests. On the network connectivity side, NetBIOS and IPX are the currently supported protocols. There are no plans to add TCP/IP support in the upcoming version.

The supplied tools are functional but limited. Character-mode ISQL and Windows ISQL provide direct interfaces to the engine. The server also includes a basic character-based forms-creation package called ACME (Application Creation Made Easy).

Watcom SQL easily installs from a client and proved to be one of the simplest products to get up and running. Database files are created using a supplied utility instead of through ISQL, but the process is straightforward and well documented. A database can consist of multiple database files that can grow dynamically with use. Though an entire database can span multiple physical storage devices, a table and its associated indexes cannot be larger than a single device.

Watcom SQL's refreshingly simple pricing scheme is on a per-user basis, and there is no charge for client software. Its top price for unlimited users is extremely low, giving the product an attractive price/performance ratio. Watcom also sells a $99 single-user, royalty-free runtime engine for Windows. This is a fully functional database, though you are restricted to a frozen schema: You can't add tables or other database objects.

COMING ATTRACTIONS

Even with the improvements to the current version, there are still some missing pieces. As we go to press, the company is finalizing Watcom SQL Network Server, Version 4.0—an important upgrade that should address some of the gaps.

Probably the most important addition will be support for triggers and ANSI Level 3 stored procedures. Version 4.0 will also extend declarative referential integrity to include cascading updates, cascading deletes, and Set Null and Set Default options. (In the current version, referential integrity is enforced, but as Restrict only; cascading updates or deletes must be hand-coded.) Other slated improvements include GUI administration tools and support for mounting and dismounting multiple databases dynamically without restarting the server (the current engine supports only a single database per session). This would be especially useful for dismountable media such as CD-ROMs.

The new release will not add transparent two-phase commit. But Watcom SQL already offers a poor man's form of replication that lets you apply the transaction log from one version of a database to another to bring them into synchronization—something mobile users may find useful.

Watcom SQL is not a strong choice for high-traffic environments, but it offers a robust and straightforward solution for departmental databases. The enhancements due in the coming release should fill in the few remaining gaps.

XDB Systems Inc.

• XDB-Enterprise Server 4 for Windows NT

XDB's database server has long been know for its success in a specialized niche: full compatibility with IBM's mainframe-based DB2 relational database. The XDB engine first found employment as a platform for off-line development of DB2 COBOL applications; from there, it migrated naturally to become a decision-support server for offloaded DB2 data.

Today's product bears the stamp of this heritage. XDB-Enterprise Server 4 for Windows NT is still fully DB2-compatible and is well backed by DB2-connectivity add-ons. It also offers strong decision-support performance at one of the lowest costs of any product we reviewed. Other than in decision support, its performance was comparable to that of Watcom SQL, putting it at the bottom tier of our lineup.

Today, the company sees new horizons in the workgroup OLTP and tools markets. A standalone version of the XDB engine is bundled with Symantec Corp.'s Enterprise Developer client/ server development tool, and XDB hopes that similar bundles will move its server to a broader base of users. Given its current performance level, the product's Enterprise moniker seems farfetched outside of a DB2 environment. But its traditional strengths in decision support make it well adapted to a workgroup situation with moderate transaction loads.

SUITABILITY TO TASK

XDB-Enterprise Server 4 for Windows NT

Production OLTP	FAIR
Decision support	GOOD
Workgroup database	FAIR
Connectivity & deployment	FAIR

UNDER THE HOOD

XDB's database engine boasts some impressive advanced features. In addition to standard transaction processing, the database offers record-level locking, ANSI cursors, bidirectional scrollable cursors, and full declarative referential integrity with support for cascading updates and deletes.

Additional niceties include a Governor feature that lets the administrator put limits on user activity by specifying an allowable number of fetches, the amount of time processing calls, idle time, and engine time. This is especially useful for decision support, where a runaway query can effectively halt the server. Governor information is maintained in a system table and defined using XDB's User Control Utility. The engine's C API also supports some unusual cursor-positioning commands like NEXT, PRIOR, FIRST, LAST, and ABSOLUTE (these are not supported over

XDB's DB2 gateway). XDB's native SQL dialect offers a robust set of string-handling functions.

MEETING NEW DEMANDS

XDB has long supported transaction processing for DB2 compatibility, but the current release is the company's first real effort at optimizing for a demanding multiuser environment. XDB-Enterprise 4 embodies some improvements to the cache manager and log manager with this goal in mind. In particular, buffer-manager search algorithms have been improved, and the optimizer is able to detect when large block reads can provide greater I/O efficiency. The database does not support group commits, however, and logs a complete before-and-after image of updated rows. XDB's relative newness to the field of transaction-processing optimization may account from some of the product's low scores on our multiuser tests.

There are other significant areas where the database seems behind the times. It currently has no support for triggers, stored procedures, or two-phase commit. Single tables and indexes cannot span multiple logical devices or be larger than 2GB (tables can be on separate devices from their associated indexes, however). The database does not support striping, but you can manually place tables and indexes on multiple devices. One alternative is to take advantage of Windows NT's software or hardware striping using an appropriate disk controller. Without some form of striping, a table containing BLOBs will be effectively bottlenecked by the sustained transfer rate of the disk.

The Windows NT version we tested is a single-process, multithreaded design that uses native NT threads under NT structured exception handling. This makes XDB Enterprise Server SMP-ready out of the box. The database takes advantage of Windows NT's asynchronous I/O capabilities and uses multiple I/O threads. It currently supports connections via TCP/IP and NetBIOS, and it can support multiple protocols simultaneously. SPX/IPX support should be available later this fall.

In addition to the Windows NT port we tested, XDB-Enterprise Server is available for OS/2. An NLM version is under development and should be available by the end of the year. XDB has also demonstrated the NT version of XDB Enterprise Server running unaltered under the upcoming Microsoft Windows 4.0 (code-named Chicago). Standalone 16-bit versions of the product aimed at developers are available for Microsoft Windows and DOS. Currently, there are no non-Intel ports.

Though XDB-Enterprise lacks GUI server administration tools, the server provides a number of clear character-based screens for monitoring user log-ons, server and connection status, current queries, system and memory resources, and detailed cache statistics. These can be monitored remotely through a utility.

Installing XDB-Enterprise Server was not particularly arduous but should have been easier for a product targeted at workgroups. In particular, we found that network installation required some manual configuration of Windows NT and TCP/IP services. This process is not particularly difficult, but it is more involved than that for Watcom SQL or Microsoft SQL Server.

The best performance results we saw from XDB-Enterprise were on our Load and Index and Ad Hoc Query tests. The database loaded our test data faster than any other product and placed third on indexing. Its scores on our Ad Hoc Query mix were solidly mid-range.

DB2 CONNECTION STILL STRONG

Flirtation with a workgroup strategy has not eroded XDB-Enterprise Server's commitment to DB2. XDB remains fully compatible with IBM's DB2 SQL (and is more DB2-compliant than IBM's own DB2/2 product). Full DB2 SQL is supported, in addition to ANSI SQL and XDB's native SQL dialect. XDB-Enterprise's system catalogues are identical to DB2's, and the XDB optimizer works much like DB2's. If you tune your queries to work under XDB, they should run well under DB2.

XDB sells a number of DB2 connectivity products to strengthen the connection. Its XDB-Link is a DRDA requester gateway that provides location transparency for local XDB and mainframe-based DB2 data. XDB-Link also supports two-way data migration between DB2 and XDB-Enterprise. XDB Workbench supports PC-based DB2 COBOL applications development; unmodified code can be migrated to the mainframe. Additional tools include a QMF-compatible query and reporting package for development or on-line querying and reporting of DB2 data. XDB is currently developing a DRDA Server due for release about the time this article appears.

HOT COMMODITY

DB2 compatibility remains XDB-Enterprise Server's biggest differentiator, and the server is clearly well adapted for decision-support duty in a Big Blue environment. Though it is lacking in non-IBM gateways, its fast load-and-index times can extend its decision-support role. The product proved stable but slow on multiuser tests, and its current tools and installation are not quite as intuitive as the competition's.

At the same time, SQL engines that are small, stable, and inexpensive are a hot commodity these days, particularly when bundled with front-end development tools. We look to future releases to flesh out engine features, boost transaction performance, and increase ease of use. □

▶ FACT FILE

XDB-Enterprise Server 4 for Windows NT



List price: Server software, one development system, 60 client connections, and client software: $8,490. **Requires:** Server: 486-based PC or better, 16MB RAM, 10MB hard disk space, Microsoft Windows NT 3.1 or later; DOS client: 286-based PC or better, 640K RAM, 5MB hard disk space. **In short:** Long known for its full compatibility with IBM's DB2 mainframe database, XDB-Enterprise Server also has solid credentials as a general-purpose decision-support server. But the product's architecture is not yet optimized for multiuser OLTP environments, and transaction performance was slow in ZD Labs' testing. Advanced engine features include record-level locking, bidirectional scrollable cursors, and declarative referential integrity. If speed is not critical to your organization, low cost and stability make this product worth an evaluation.

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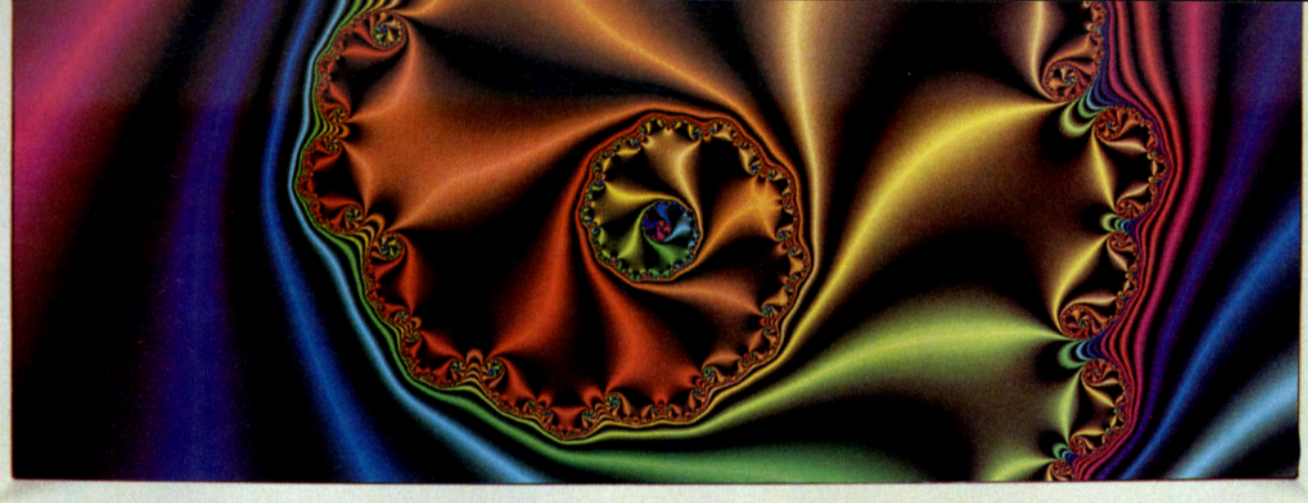

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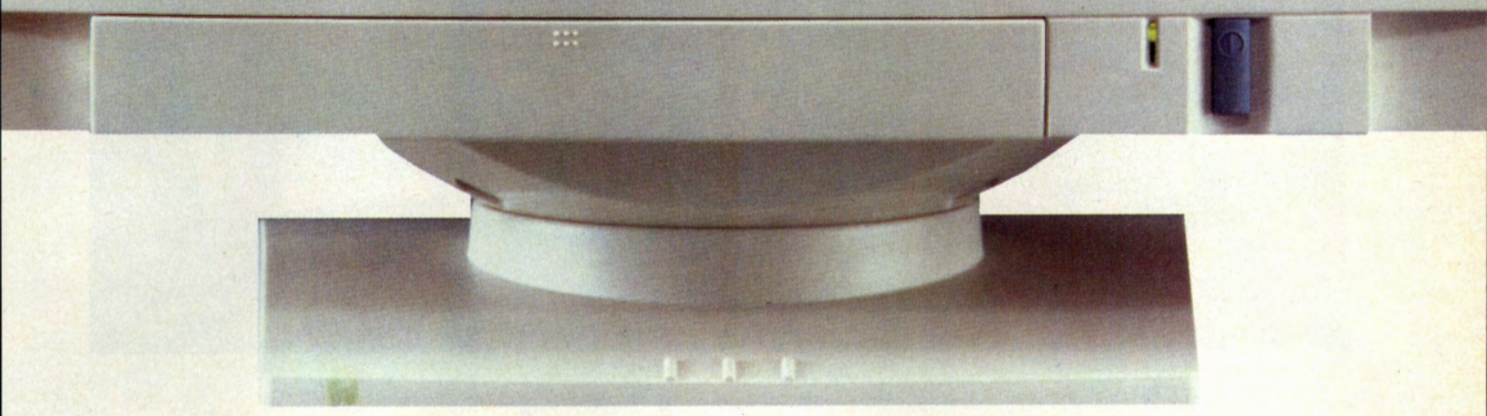

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SWITCHING HUBS

Switching to the Fast Track



Your hardworking network infrastructure chugs along, supporting shared applications, shared hardware, and remote connections. But if it's looking like "the little network that could," you just might need a switch.

By Gary Gunnerson

For network "engineers," these are the facts: Networks grow to support faster desktop processors running larger applications exchanging bigger files. Adding anything else—a multimedia CD-ROM drive, a high-speed printer, or an imaging application—contributes to stress on your LAN where none existed before.

This means more traffic over the wire; the LAN itself becomes the bottleneck to productive computing. Fortunately, you've got options to help speed up your LAN infrastructure. And you don't even have to scrap that great ol' 10-Mbps Ethernet locomotive for a sleek ATM bullet train right away.

One popular approach—the one we've considered in this roundup—is to add a switching hub, or switch, to your Ethernet LAN. The principal advantage to a switch is that you don't have to

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Illustration by Tom Upton

HIGHLIGHTS

Switching Hubs

FASTER DESKTOP processors and larger applications sending files over your Ethernet LAN leave it gasping for bandwidth. The network wire can become the bottleneck to productivity. Your LAN needs help, but what do you do?

SWITCHES ARE A GOOD SOLUTION for increasing bandwidth because you don't need to change other hardware, such as cabling or LAN adapters in client PCs. Basically, you take them out of the box and plug them in and they work. Most of the standalone, stackable units we review here require configuration, of course, but they are relatively easy to deploy.

SCALABILITY IS ONE of your considerations. You don't want to get locked into another scenario immediately. Many of these switches come with high-speed ports or the flexibility to add such ports, so you have got room to grow again when you feel the need. Some of these units will daisy-chain together.

IN ADDITION TO EASY SETUP, an approachable design is important. Most of these switches have all ports easily accessible and well spaced on the front of the unit. Several carry helpful status LEDs, and one even had an LCD.

WE DREW AN INTERESTING RANGE of products into this roundup. The ten external units cover everything from a switch with just 4 10-Mbps ports to a 76-port switch that also provides standard hub ports, several 10-Mbps ports, and an FDDI link.

PERFORMANCE WAS NOT A BIG differentiator. We found that switches with high-speed ports performed similarly overall and better than switches without high-speed ports.

TWO DIFFERENT METHODS of switching are used: store-and-forward and cut-through. Store-and-forward introduces more latency but provides for error checking on packets; cut-through is faster, but does not have error checking.

THESE SWITCHES ALL HAVE different options for management. Some bundle packages, some sell them separately, and most support SNMP and MIB II.

change any other hardware. Standard hubs broadcast conversations everywhere; switches isolate the conversations. Basically, you plug in the switch and voilà: extra bandwidth.

We reviewed 10 switches suited for small to medium-size PC-based workgroup networks or even a handful of high-end RISC-based workstations. We required that a switch be standalone (not a module in a chassis or rack-based unit, although it could also be rack-mountable) and do packet switching (not just port switching). We included switches that had high-speed ports and switches that did not.

These switches display a range of features. On the low end, NBase Switch Communications' NH203A On-the-Fly Ethernet Switch and Xedia Corp.'s MADswitch have four and six ports, respectively, and minimal functionality. At the high end, Alantec Corp.'s PowerHub Model 5006 and PlainTree Systems' WaveSwitch 100 have many ports, as well as management, routing, and high-speed capabilities.

After a close look, we found that the Network Peripherals EIFO Client/Server Switching Hub and NetWorth PowerPipes Ethernet/FDDI Switching Hub share the same hardware design and differ only in software and support. These units ended up earning Editors' Choice status for their mix of good port density, FDDI support, good pricing per port, scalability, and management options.

It is clear from our testing that switches with high-speed ports, such as the PowerPipes, Network Peripherals EIFO, Kalpana EtherSwitch EPS-2015 RS, and WaveSwitch, are worth their added cost for their better performance, flexibility, and scalability. Also worth mentioning is the fact that performance was similar within each class of switch (those with high-speed ports and those without).

THE UNIVERSE OF SPEED

So where do Ethernet switches fit in your range of options for giving your network a performance boost? Somewhere between faster adapters, more segments, and more hubs on the low end—and, say, routing and ATM on the high end. Switching hubs perform some of the same functions as bridges. (If you're not sure whether you need one, check out "Think It's Time for a Switch?") Buying faster network adapter cards for all your PCs can be helpful, but it also is usually cost-prohibitive (see "Adapters: The State of Affairs") and doesn't speed things up all that much.

You could segment your network with routers, but these devices can introduce complexity and management headaches. Ideally, your network upgrade should require very little change to the existing LAN structure while giving your network a quick kick in the bits.

A typical small to medium-size Ether-

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net network might consist of 20 386- or 486-based PCs with three high-speed LAN-attached printers and an optimized high-speed server. For connectivity, add three 10BaseT hubs connected through their cascade ports and the network functions admirably. With this configuration, your network would use only one 10-Mbps Ethernet segment for everything.

One simple solution would put an extra Ethernet card in the server for each hub, bringing the total network bandwidth up to three Ethernet segments or an aggregate 30 Mbps. But then the server becomes a piece of communications gear and divides its time between server and bridge/router duties (see "The Inside Switch"). If the server can handle the additional workload, this may be your lowest-cost option, but sooner or later even this quick fix will begin to falter.

The ultimate solution would upgrade the network adapter card in the server to a faster medium such as Fast Ethernet, FDDI, or ATM (asynchronous transfer mode), while letting each workstation keep its existing (10BaseT) card. By concentrating your investment in the server and communications equipment, you reduce the cost of retrofitting every client PC.

A nice, balanced architecture would use a 100-Mbps pipe to the server with ten individual 10-Mbps Ethernet segments to the client PCs/printers for a potential aggregate switching bandwidth of 200 Mbps. Switches promise this relatively painless upgrade, usually including management capabilities, for a modest capital investment.



- **Network Peripherals EIFO Client/ Server Switching Hub**
- **NetWorth PowerPipes Ethernet/ FDDI Switching Hub**

Ethernet switching is a good technology—it might earn an Editors' Choice itself as a solid, practical approach to improving LAN performance. It builds on what you have in place, increases bandwidth dramatically, and is inexpensive enough to be an easy decision.

These two switching hubs—actually the same hardware codeveloped by Network Peripherals and NetWorth—best characterize the strongest points about Ethernet switching. At this time, the only real differences between the two are some minor firmware changes and management software options. (Throughout the review process, though, Network Peripherals and NetWorth both confirmed that they plan to add features to their switches to differentiate them from each other. They might have a different look by the time you read this.)

The Network Peripherals EIFO and NetWorth PowerPipes combine good feature sets and port configurations—including an FDDI high-speed port—with very competitive pricing ($576 and $692 per port, respectively). They are also expandable and like other switches here, each permits more than 1,000 MAC addresses per port.

These switches employ the store-and-forward method of packet switching. This is the "safer" of the two standard methods and probably better for networks that don't absolutely need cut-through's minimal latency.

Both performed well on our testbed of 16 client PCs and 2 servers. They were bested only by Grand Junction's FastSwitch 10/100 (which assigns only one MAC address per port) and PlainTree's WaveSwitch 100.

Grand Junction's interesting approach of having one MAC address per port will work fine in many situations—and it translates into a great price-per-port ratio ($268 list). You must, of course, be prepared to accept its limitations. But as its first-rate performance on our tests shows, the FastSwitch can be a excellent choice under the right scenario.

Kalpana, the pioneer in Ethernet switching, still offers a good product with its EtherSwitch EPS-2015 RS. This unit was the performance leader among switches without high-speed ports. It uses only cut-through switching, though, so you won't get any error-checking.

SWITCHING SENSES

The Ethernet switch market entered maturity in the last year, with many companies offering new products. This roundup concentrates on lower-end models designed for small to medium-size Ethernet networks geared toward easy manageability and future growth. Our Suitability to Task scores indicate how easily the device can transparently plug into an existing network, how well the switch can expand over time to handle additional switched ports or multiple switches, and how easily a network administrator can manage these devices.

We found two technologies at work inside the boxes. Most of the switches look like transparent bridges using the store-and-forward method of packet switching with the 802.1D Spanning Tree Algorithm. The Spanning Tree Algorithm detects problematic loops in bridged networks and chooses an effective path. If a path fails, the algorithm changes to a backup path.

Other switches opted for a faster design called cut-through, which starts forwarding a packet as soon as the MAC (media access control) address is determined; this technique, however, provides no error checking. Which works best for you depends on your environment and your trust in the error-correcting abilities of your network operating system.

Nearly every LAN expert agrees that ATM technology is the future of networking, but few agree on how to get

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there from today's broadcast or token-passing LANs (see "Virtual Reality Check"). If the world were perfect, these switches would contain a physical ATM port for future connections to a super-switch running ATM. But they do not. Fortunately, FDDI and Fast Ethernet offer deliverable solutions today. You probably need to speed up your network now, so you're willing to leave some of the future behind.

PLUG IT IN AND IT WORKS!

Ethernet switches claim decided ease-of-use and transparent plug-and-play installations over more complex solutions. In fact, most of these units plug into your network and work right out of the box. They get increasingly complex when using advanced features, such as virtual networking, segment isolation, MAC address filtering, and remote management.

We observed that a good physical layout of components and connectors not only makes the installation easier, but also provides for an uncluttered wiring closet. Most of these switches exhibited a good design—one that situated the LAN segment connectors and their LED indicators on the front, with power connections on the rear.

PlainTree packed the ports too densely for easy access on the front of its WaveSwitch, and Alantec put all 76 ports on the back of the PowerHub. Cisco Systems' Catalyst Workgroup Switch includes cover-up bezels that could break off; all of its networking connections are on the back. This makes standard rack-mounting cumbersome.

Interconnecting cabling poses another problem. Many LAN sites find themselves with large quantities of straight-through RJ-45 cables used in standard patch panels. Switches that require the less common cross-connect cables or specialized transceivers cause LAN administrators to scramble to their local computer store during their upgrade. NBase requires cross-connect cables.

IT WORKS, BUT WILL IT GROW?

Scalability factors heavily into any network design that must work with an ever-changing systems environment. Many of the switches tested offer easy and far-reaching expansion capabilities; some adhere too closely to plug-and-play.

Neither Chipcom Corp. nor NBase provide expansion beyond their single unit; Xedia offered expansion but did not have it working yet. Kalpana's growth options sacrifice full-duplex Ethernet ports for connecting to servers and additional switches. Its intermediate solution allows multiple Ethernet ports to connect a Kalpana switch to a server or to another switch. You'll need an optional NLM if you plan to connect to the server.

As our performance tests show, the lack of a high-speed server port on these switches limits their total throughput. Most of these products use 100-Mbps technology of some kind to connect to additional switches or offer a high-speed server connection. PlainTree offers a dual-attached 100-Mbps FDDI port as a fault-tolerant server connection.

Kalpana provides much the same solution, albeit more slowly, using software and multiple Ethernet cards. Two low cost approaches to expansion are the use of Fast Ethernet at $399 from Grand Junction Networks and PlainTree's $1,825 proprietary WaveBus interface. FDDI ports usually cost several thousand dollars; both Network Peripherals and NetWorth include them in their prices.

A simple port count provides an expansion index for each of these Ethernet switches that ranges from 4 segments in the NBase NH203A to 16 in the PlainTree device. (Alantec has 76 ports, but only 12 Ethernet collision planes.)

The Grand Junction FastSwitch 10/100's unique solution allows only a single Ethernet connection (MAC address) to connect to each port, which means you need a dedicated port for each PC; your existing hubs are no longer needed. This may seem inappropriate, but the price per port and performance were excellent. On networks that need 24 connections or fewer, this unit can really cook.

Another real advantage switches offer over routers is low latency. Multimedia applications such as video CD-ROMs, virtual PBX, videoconferencing, and support

Suitability to Task: Switching Hubs

Lots of things conspire to slow down your Ethernet network. A switching hub is a relatively easy-to-implement, low-cost hardware/software solution that gives your LAN a boost of extra bandwidth. There's no need to replace the network adapters in your servers or users' PCs, as you'd have to do with a high-speed overhaul. A good switch shouldn't add complexity to your system, but it should integrate into the network fabric quickly as it boosts performance.

SUITABILITY TO TASK	
Plug-and-play	EXCELLENT
Scalability	GOOD
Management	FAIR

For our **plug-and-play** rating, we consider how easy the switch is to get up and running. We look at each switch and examine its physical configuration. We give additional credit to switches with an approachable design. To give you flexibility, we look for a switch to be stackable as well as rack-mountable. For rack-mountable switches, we prefer the ports to be situated on the front of the unit, with the power supply and on/off switch on the back. We further note whether the ports are well spaced for easy reconfiguration of port assignments. Also taken into account are good use of status LEDs and clear port labels, as well as whether the switch has an LCD. We consider the placement of the fuse and whether there is a dual power supply as well. Finally, we look at the documentation's content, organization, and ease of use.

Under **scalability,** we rate each switching hub's ability to support higher-speed connections and future growth. Our ratings take into account the differences between those switches with high-speed ports and those without high-speed ports. Switches without high-speed ports should have the capacity to connect multiple units together to achieve higher speeds. To rate switches with high-speed capability, we look at the number of high-speed ports. We give points to switches with support for more than one high-speed type—FDDI, CDDI, or 100-Mbps Ethernet. Support for multiple protocols is also noted.

For **management,** we note whether management software was included with the switching hub. We also consider whether the switch has a management port and support for SNMP or MIB II. We give additional points for an LCD for viewing, setting, and configuring parameters. We also note management features and capabilities, such as monitoring traffic and filtering packets on MAC address or protocol.

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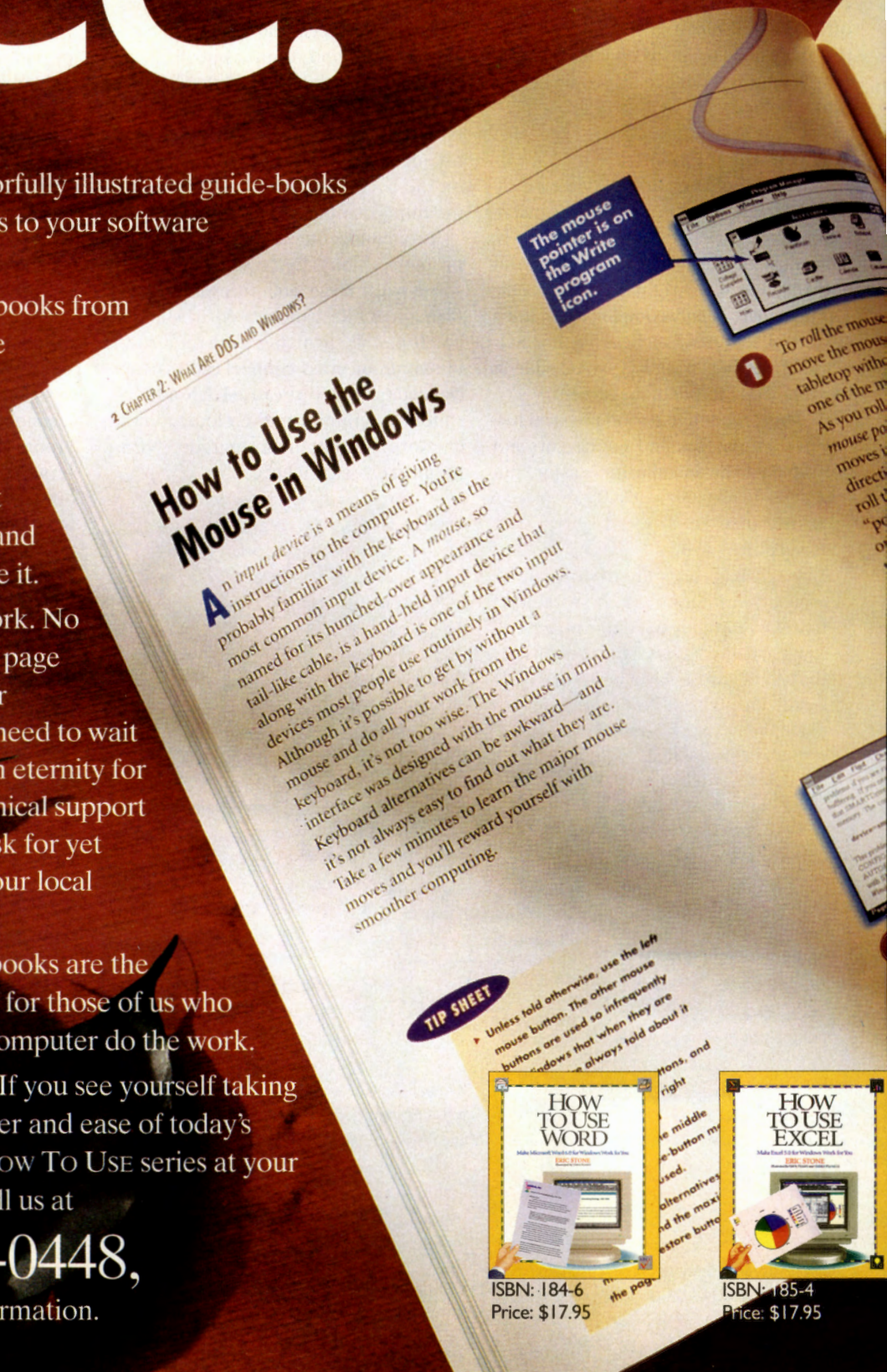

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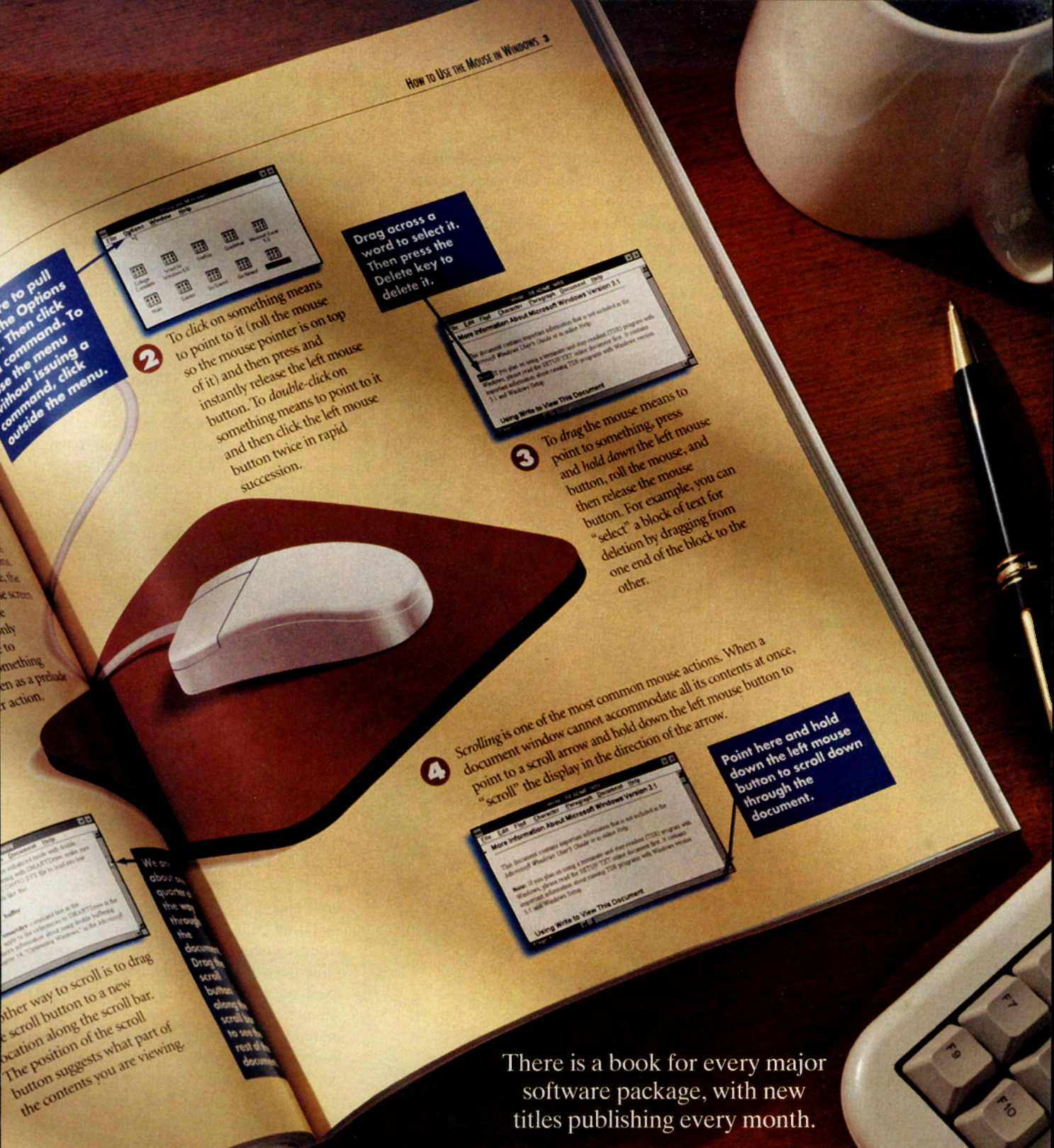

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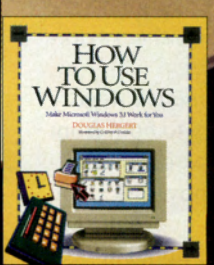

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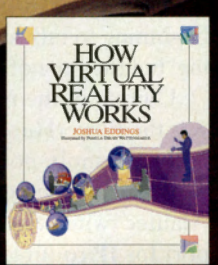

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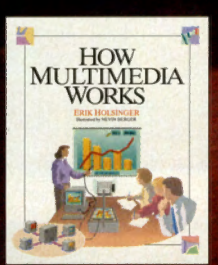

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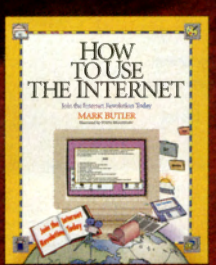

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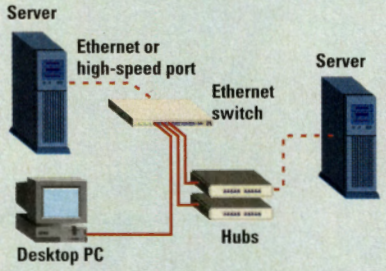
Another Piece in the Puzzle

Ethernet switches have created quite a stir in the networking community. They have been heralded by some as the only viable solution today for increasing networking bandwidth. Fiber Distributed Data Interface (FDDI) is too expensive, and other 100-Mbps solutions are just not ready yet. If your Ethernet is your bottleneck, as indicated by high utilization or a high number of collisions, an Ethernet switch may be in your future. Just like bridges, Ethernet switching hubs segment a single collision plane into multiple segments to deliver increased bandwidth to your network. There are many ways you can integrate switches into your network. They could augment your existing Ethernet hub structure or replace your routers in your collapsible backbone.

Ethernet switches



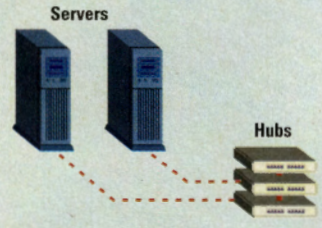
Advantages:

- **Provide much more available bandwidth than traditional hub-only networks.**
- **Lower cost per port than routers.**
- **Less complicated than routers.**
- **Lower latency than routers—beneficial for users working with time-sensitive applications such as video.**

You can use an Ethernet switch to segment your network dynamically—to give small workgroups or even single users their own 10 Mbps of bandwidth. Unlike traditional segmenting, Ethernet switches provide on-the-fly segmenting of network conversations, thus multiplying bandwidth.

With switching hubs you have many options for situating your servers. You can place a server on the same hub as those clients that will use it most often, or you can place it on its own dedicated switch port. You can also opt to buy a switch with high-speed ports and place the server on a high-speed port.

Hubs

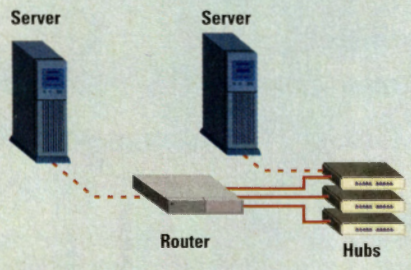


Advantages:

- **The least expensive approach.**
- **Provide 10 Mbps of aggregate Ethernet bandwidth.**
- **Easy to use.**

In the simplest Ethernet 10BaseT configuration, hubs are connected to form larger workgroups. This yields one segment in which all computers see all traffic. Alternatively, you can place multiple Ethernet adapters in your server and distribute your workstations among the resulting segments. This works fine for single-server environments but becomes onerous for multiple-server environments.

Routers



Advantages:

- **Prevent broadcast storms from spreading throughout the network.**
- **Provide increased security.**
- **Support WAN connectivity.**

Routers are often used in LANs as front ends for a group of servers or for a building or campus backbone. Frequently, the servers are placed on an FDDI ring. If you use routers to provide a collapsed backbone for your LAN, Ethernet switches will provide a less complicated and less expensive approach. You will, however, give up the intelligence of a router, which protects you from security breaches and broadcast storms.

for sound require low-latency solutions. Thus an advantage all switches enjoy over standalone bridges or routers is their ability to handle multimedia applications at full speed. Typical latency times for routers run upwards of 200 microseconds (μs); bridges tend to run about 100 μs. Switches using cut-through should provide lower latency, running about 30 μs.

TRACK CHANGE

Management options ranged from none at all to a full suite of SNMP/MIB II standards. The first and most basic method to configure and manage these devices remains the asynchronous terminal. All but the NBase NH203A provide an RS-232C port for this type of access.

In-band management using proprietary software provides the next step up the management chain. PlainTree's gratis gift of DOS-based monitoring software is welcome; NetWorth offers its Microsoft Windows–based HubView for an additional $995. If you already use Novell's NMS management software, you may be happy to note that NetWorth also provides a version of HubView for NMS. Kalpana provides NMS support as well.

All others go to the highest level of management support by using standard third-party SNMP consoles with MIB II. This advanced support will mean little to you, however, unless you can afford the cost of a full-blown SNMP workstation. For small networks, the price remains high and may override any advantages.

Other management features pop up when you consider logically segmenting your network by workgroups that may exist on completely different Ethernet segments. After all, if you use a matrix management model to run your company, your network should offer the same flexibility, right? This concept of virtual networking is just recently starting to catch on. PowerHub is on the track to virtual networking. Some other vendors here are beginning to talk about virtual networking, but they're not there yet.

Unique in the management category was the PowerHub's ability to boot from a Unix remote-boot server on the network or an included floppy disk. The Alantec switch was also unique in its support for IP routing with optional at-cost routing for IPX, AppleTalk, and DECnet.

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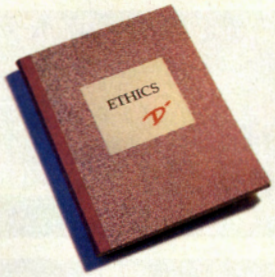

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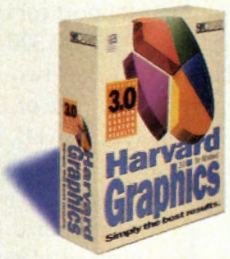

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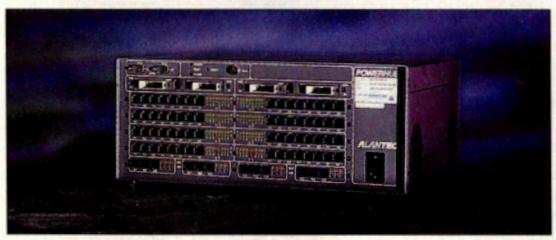
One final potentially sticky management problem exists for Ethernet switches: It has to do with how they handle packets. Unlike hubs, which broadcast traffic out all ports, Ethernet switches, operating at layer 2 of the OSI (Open Systems Interconnect) model, forward packets only to the appropriate destination port. This will render protocol analyzers—which rely on reading all the packets—ineffective. If your site already uses a LAN analyzer, you may want to look more closely at Cisco's and Grand Junction's devices: They provide a special port for analyzer access.

Once you've determined whether you need a low-end switch solution for a workgroup or one capable of growing to meet several hundred workstations, you will want to take a look at where this segment of Ethernet switching hubs is today and where it is headed.





Alantec's PowerHub Model 5006 is rack-mountable, with LEDs on the front—but its ports are located on the back.

Alantec Corp.

• PowerHub Model 5006

BY VISHY NARAYAN

Alantec's PowerHub Model 5006 combines hub, bridge, and router features in one box to provide enough port density for use even on a complex TCP/IP network. It also offers the capability to create virtual LANs. But with the PowerHub's 76 10BaseT ports (including 12 Ethernet collision planes) and support for several types of cabling comes a $30,000 price tag. This unit seems targeted to replace a small workgroup's entire infrastructure. In addition, configuring and maintaining the PowerHub requires good networking knowledge.

Alantec designed flexibility into the PowerHub. Along with the 76 10BaseT ports comes optional support for one or two FDDI rings; this adds up to 320-Mbps bandwidth. The switch has two serial ports and supports a full range of Ethernet cabling types, including AUI, BNC, RJ-45, and multimode fiber.

The PowerHub supports virtual LANs, which help you optimize bandwidth with logical workgroups of network devices regardless of geographical locations.

Alantec placed all the port connections on the back of its rack-mountable switch; so when all ports are in use, there can be considerable cable clutter. Some help is provided by an LED for each port on the front of the switch.

The PowerHub can boot from a disk or from the network via a Unix remote-boot server. This makes administration easier, especially if you need to maintain configuration for multiple PowerHubs at a central location.

The PowerHub includes a TCP/IP software suite for multiprotocol filtering and static IP routing. You can purchase additional static-routing software for IPX, AppleTalk Phase 2, or DECnet Phase IV with Level 2 for $1,250 each. The unit includes SNMP-agent software, which provides MIB II, bridging, and FDDI SMT MIB.

You can configure and manage the hub from a directly connected console or by setting up two simultaneous telnet sessions. The PowerHub offers port monitoring on any Ethernet or FDDI segment from anywhere on the LAN if one of the segments is dedicated to a network analyzer.

Even though the management software has a command-line interface, commands are grouped into subsystems, and on-line help is provided. The PowerHub has two levels of password security and a physical lock.

For bridging, the IEEE 802.1D Spanning Tree Algorithm is supported, along with full-duplex Ethernet and FDDI translation. The PowerHub's documentation is comprehensive, with definitions of cabling types and basic network concepts.

Alantec's PowerHub is an impressive system with supportive software suites for administration and management. It gives you scalability at a good price through its high-speed ports, support for multiple protocols, and virtual LAN capability. Be prepared, though, for some advanced configuring and management.

▶ FACT FILE

PowerHub Model 5006

List price: $30,450 (includes FDDI module); price per port, $296. **In short:** For $30,450, the PowerHub delivers hub, bridge, and router functions in the same Ethernet switching hub. Alantec designed the PowerHub so it has enough port density for even a complex TCP/IP network. The PowerHub provides good management facilities, including advanced functionality for creating virtual LANs. This switching hub is designed to replace a small workgroup's entire infrastructure. You get 76 10BaseT ports (which include 12 Ethernet collision planes), an FDDI module, and support for many kinds of cabling. It's a complete and advanced switching package for the right site, but you need extra networking know-how.

Alantec Corp., 70 Plumeria Dr., San Jose, CA 95134; 800-252-6832, 408-955-9000; fax, 408-955-9500.

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SUITABILITY TO TASK	
Plug-and-play	FAIR
Scalability	EXCELLENT
Management	GOOD

Chipcom Corp.

• StarBridge Turbo Switch

BY TIM CRAWFORD AND LESLIE WYGANT

Chipcom Corp.'s StarBridge Turbo Switch is easy to approach and comes with a complete set of basic switching features; it is also the priciest hub without a high-speed port we reviewed. The StarBridge lists at $8,500 for eight ports (that's about $1,063 per port); its performance was in the middle of the pack.

If you don't need to expand your port connections or scale to 100 Mbps anytime soon, you may find the StarBridge appealing for your workgroup network because of its clean design and generous use of LED status indicators. Its set of switching features won't let you down. You can filter frame packets by MAC address—by

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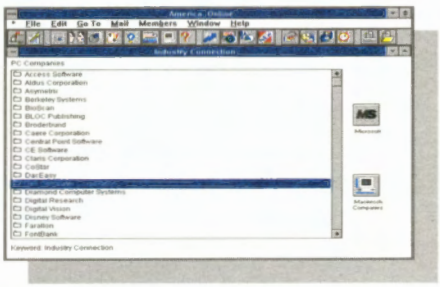

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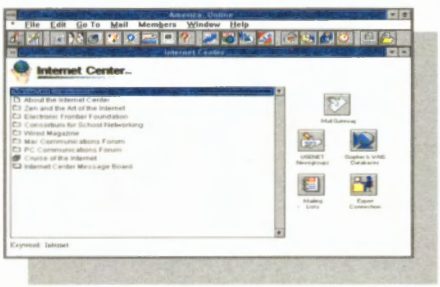

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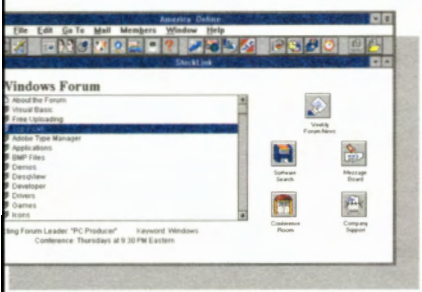

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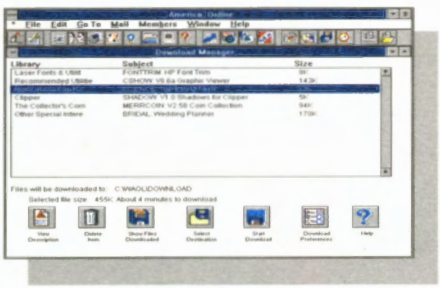

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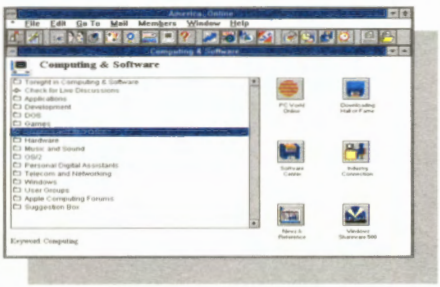

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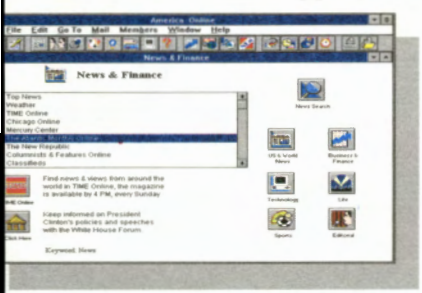

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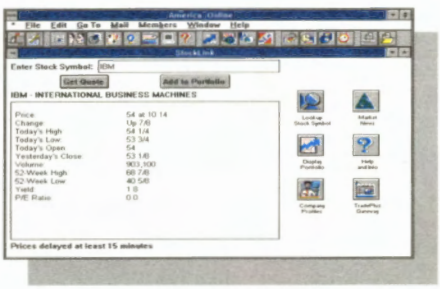

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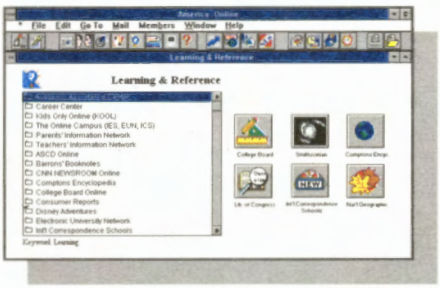

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StarBridge Turbo Switch

List price: $8,500 (includes 8 ports); price per port, $1,063. **In short:** This switch is quite approachable, with numerous status LEDs and easy port access. The Chipcom StarBridge Turbo Switch offers a full set of switching features, including support for the 802.1D Spanning Tree Algorithm and filtering by single MAC address, a range of addresses, or by protocol. It also uses store-and-forward switching, which includes error correction capabilities. It is also one of the highest priced units without a high-speed port. A Chipcom product since the February merger with Artel, the StarBridge offers a good set of basic features. But you cannot expand your port connections or scale to 100 Mbps.

Chipcom Corp., 118 Turnpike Road, Southborough, MA 01772; 800-228-9930, 508-460-8900; fax, 508-460-8950.

487 on reader service card

SUITABILITY TO TASK	
Plug-and-play	EXCELLENT
Scalability	POOR
Management	GOOD





Chipcom's StarBridge Turbo Switch is approachable in design and provides a full set of switching features.

either a single address, a range of addresses, or protocol. The StarBridge also supports the 802.1D Spanning Tree Algorithm and uses store-and-forward packet switching to provide error correction.

This hub, which became a Chipcom product in February when the company merged with Artel Communications, has a decidedly approachable design. For starters, all eight 10BaseT ports are well situated on the face of the switch for easy connecting and disconnecting.

In addition, Chipcom's StarBridge offers five LEDs for each of those eight ports. The lights signal link established, receive, transmit, collision, and port status; there's also an LED to indicate power on. In addition to the large number of LEDs, every port and switch on the StarBridge is clearly labeled with its number and medium type.

You can rack-mount the StarBridge or use it as a free-standing box—at 3.5 inches in height, it's the right size for either. The StarBridge is also well designed electrically. If you need to replace a fuse, for example, you can easily access it from the back of the switch.

The StarBridge Turbo includes a serial management port on the front of the unit, which is a real plus. But it does not support any third-party SNMP management applications.

You can purchase Chipcom's Galactica Management (GMAN) software for another $1,500. Galactica, however, runs only on Unix workstations and integrates with the SunOS operating system. It does

Think It's Time for a Switch?

By Frank J. Derfler, Jr.

How can you tell if you need a switch for your network? What will drive you to spend thousands of dollars on a switching hub when a $500 standard 10BaseT wiring hub might do? Are there alternatives? Is segmentation one? For the answers, consider *average utilization.*

Ethernet was designed for the bursty communications common to most PC applications. Typically, a network node requests a file or print service, generating a brief flurry of activity, and then goes silent for long periods of time.

Because of the bursty nature of networking, overall average utilization is very low—from 9 to 20 percent. Low average utilization is just the right environment for the listen-before-transmitting cable-sharing scheme used in Ethernet. But when average utilization increases—because of numerous nodes becoming active or a few nodes using applications that constantly move data—the efficiency of the cable-sharing scheme decreases.

Network analyzers (such as those from Network General Corp. or Tritticom) or hubs with sophisticated management provide a direct readout of average utilization. When average utilization is 50 percent or more, you should do something.

You can get some idea of network efficiency less directly by watching the collision lights on your wiring hub. If these lights stay on more than 20 percent of the time, it's time for action. You can also check the response times for specific tasks, such as loading a large file when the network is busy and when it is not. If the difference is on the order of 2 to 1, it's time to make a move.

MOVE WHERE?

Particularly if you use NetWare, your first move should be segmenting the cable system. Split the system into separate active pieces with each piece connected to its own adapter in the server. You might even put a single highly active node on its own segment or with just a few other less-active nodes. This would require a small, inexpensive hub.

NetWare works well with segmentation because it includes a router that moves IPX packets between cable segments as needed. IPX-based applications such as terminal emulation, print services, or program-to-program messaging need to communicate beyond the server, so they also require routing.

When you run out of server slots or logical combinations of nodes on segments, it's time to (buy a) switch. Segmenting is more economical than switching, but switching is more economical than high-speed networking alternatives such as 100BaseVG-AnyLAN or ATM. □

support SNMP and MIB II. You can use the Galactica software to configure ports, view real-time data, set alarms, and create virtual workgroups. You can create as many as 16 port groups and can include up to 16 filters for each port.

Remember that scalability and expandability are not part of the StarBridge switching package. This model does not include a high-speed port, and the number of ports it has is fixed. Still, the StarBridge does execute the basics, and its user and reference documentation is highlighted by a very useful troubleshooting chapter. It's a reasonable though pricey choice for your workgroup.

Cisco Systems Inc.

• Catalyst Workgroup Switch

BY TIM CRAWFORD AND LESLIE WYGANT

Cisco's entry sits decidedly at the high end of this segment of the switching-hub market. The Catalyst Workgroup Switch, a Cisco product since Cisco's acquisition of Crescendo Communications in September of 1993, is one of the highest-priced of these switches—$9,600 for eight fixed ports (over $1,000 per port). For 100-Mbps high-speed scalability, you'll need to purchase either a CDDI option for $995 or an FDDI option for $1,995.

▶ FACT FILE

Catalyst Workgroup Switch

List price: $9,600; CDDI option, $995; FDDI option, $1,995. **In short:** A design that is not optimal, slower performance, and a high price take the Cisco Catalyst out of the front running in this roundup of switching hubs. Unlike most of the other switching hubs in this review, this product has its port connections on the back of the unit. This makes connecting and disconnecting difficult, especially if you rack-mount the switch. The Catalyst, which has been a Cisco product since Cisco acquired Crescendo Communications in September of 1993, offers 100-Mbps high-speed scalability options, so it is a flexible switching solution. The Cisco Catalyst Workgroup Switch also has extensive documentation—even a road map—and optional high-end management software.

Cisco Systems Inc., 170 West Tasman Dr., San Jose, CA 95134; 800-553-6387, 408-526-4000; fax, 415-326-1989.

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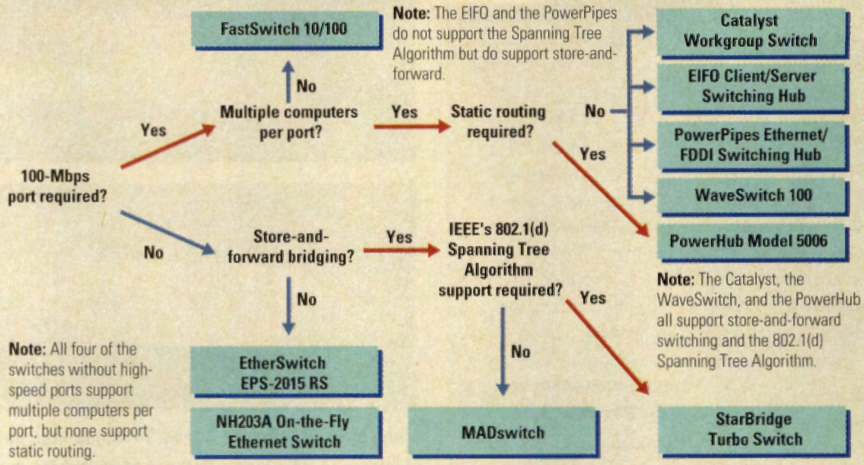
SUITABILITY TO TASK	
Plug-and-play	FAIR
Scalability	GOOD
Management	GOOD

Ethernet Switches: The Buying Decision



• **100-Mbps port.** An excellent way to connect servers to your switch or your switch to a backbone. Current prices for FDDI modules and adapters range from $2,000 to $5,000, but prices are dropping.

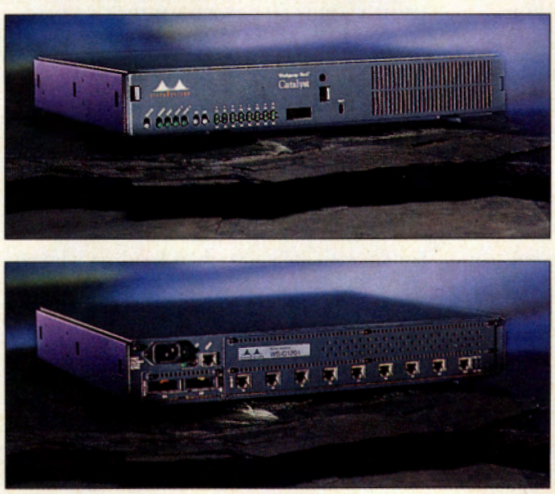
• **Multiple computers per port.** Most Ethernet switches can accommodate many PCs off one switch port using a connected hub: The switch functions as a hub of hubs. Grand Junction markets the FastSwitch 10/100 as a replacement for your 10BaseT hubs.

• **Static routing.** For more security and control, some Ethernet switches offer routing functionality.

• **Store-and-forward bridging.** Most Ethernet switches use this method of handling packets rather than Kalpana's cut-through method. Cut-through switching provides lower latency through the switch, but it does not provide MAC-level CRC error checking to safeguard your network from broadcast storms.

• **Spanning Tree Algorithm.** You will need this if you want to build fault tolerance into your switched network by connecting switches with redundant paths.

The Catalyst has a few other disadvantages. It did not perform well on our performance tests, turning in the lowest throughput numbers among the switches with high-speed ports. And unlike most other switching hubs here, the port connections are on the back instead of the front. This is a problem if you decide to rack-mount the Catalyst. The fuse is also on the rear—not easily accessible unless you're using the switch as a standalone unit.



Even though the ports are on the back of the Cisco Catalyst Workgroup Switch, there are LEDs for each port.

Fortunately, the Catalyst does have two LEDs that show transmission and link status for each port and a reset button on the front. It also has eight LEDs on the front panel to help you use the FDDI port, including lights that indicate status, operation, port connection, and port wrapping.

On another structural matter, the switch includes additional bezels that you can attach whether the unit is rack-mounted or freestanding. But these covers are attached with plastic tabs that can break off easily.

Interestingly, Cisco includes an unusually large amount of documentation with the Catalyst Workgroup Switch. You even receive a road map to the manuals. The manuals provide a wealth of information, including an "Internetworking Terms and Acronyms" manual and a booklet called "Internetworking Applications: Case Studies."

Another feature that places Cisco's Catalyst Workgroup Switch at the high end of switches in this roundup is its optional



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Adapters: *The State of Affairs*

By Frank J. Derfler, Jr.

The primary appeal of Ethernet switching is that it significantly improves network throughput while using the LAN adapters and cabling already installed. But with or without switching, you've got other options for improving throughput—if you're willing to take the cabinets off your PCs and change the LAN adapters.

We put some of the new network adapters through their paces to evaluate speed-up techniques that work inside the PC and to test full-duplex Ethernet technology. We like the PCI bus and have high hopes for a new technology called plug-and-play, as well as for 25-Mbps ATM. Some other technologies only make sense in a limited number of applications.

INTERNAL TRANSFERS

Several companies, including Cogent Data Technologies, 3Com Corp., Racal InterLan, and Standard Microsystems Corp. (SMC), offer twists on the otherwise ho-hum 10-Mbps LAN adapter market. 3Com started by giving its EtherLink III family of adapters a technology called Parallel Tasking.

Parallel Tasking allows an adapter to begin processing a packet as it comes off the wire and to put the packet on the PC's data bus with optimal handling. SMC responded with SimulTasking, and Cogent developed Predictive Pipelining—all techniques with similar functionality.

As the performance chart here shows, these products provide marginal benefits when running typical PC applications. These special data-handling techniques make a significant difference when there is a lot of data to move and no other bottlenecks—such as a busy Ethernet cable or perhaps a competing background application that ties up the PC.

The Peripheral Component Interconnect (PCI) bus found on Pentium-capable motherboards offers a better way to improve PC-to-adapter efficiency, this time by using 32-bit bandwidth. Advanced Micro Devices and Digital Equipment Corp. are shipping chips for PCI adapters; Cogent, Linq Systems, Racal InterLan, and Znyx Corp. led the pack in shipping PCI adapters based on those chips. According to our tests, 32-bit PCI adapters move data significantly faster than 32-bit EISA adapters.

PCI adapters offer throughput up to twice as fast, particularly with the small data blocks typically used by PC-based applications. These adapters carry $200-plus price tags—about $50 more than EISA competition—but they are worth it if you have lots of data to move.

FULL-DUPLEX OR FULL-DUPE

Not content simply to enhance the interface between the adapter and the PC, companies such as Cogent, Compaq, IBM, SMC, and 3Com support a technology developed by Kalpana called full-duplex Ethernet.

The full-duplex concept is pretty simple. In a standard Ethernet network, the adapters share a cable system using a listen-before-transmitting scheme but still sometimes experience collisions. The delays and retransmission in the sharing scheme can result in a 20 percent or greater loss in throughput if many busy nodes are on the same cable.

Full-duplex adapters transmit and receive on separate wire pairs connected to a hub, so there is no waiting for a clear channel and no collisions. Sometimes a full-duplex Ethernet is described as "20 Mbps," but that's misleading at best. It's actually two separate, one-way 10-Mbps conflict-free channels. However, it requires a sophisticated full-duplex switching hub, such as the Kalpana EPS-2015 RS, that offers 15 ports with various features at $8,500.

Full-duplex Ethernet doesn't shine in most PC-based applications. Most LAN transmissions are still primarily one-way, with only short acknowledgements coming back in reply. But the value of full-duplex in applications such as videoconferencing is another story. When nodes are sending out nearly continuous streams of data, as they do in videoconferencing or other full-motion video applications, the elimination of channel conflict makes a significant difference. The bottom line is that you cannot expect full-duplex networking to give you 20-Mbps throughput—but do use it for appropriate applications.

in-band management application, Workgroup Director, which works only on Unix platforms. This SNMP-based management software, which costs an additional $1,995, lets you enable and disable ports, view statistics, and see a graphical representation of your network.

Cisco includes a stackable unified management (SUM) port for out-of-band Ethernet access via telnet, FTP (File Transfer Protocol), or SNMP-based management applications. The SUM port includes four LEDs. There is also an administration port that you can connect to either a modem or a console terminal.

Cisco is well known for its internetworking prowess. Its acquisition of Crescendo has provided it an entry into this Ethernet switching-hub market that has some good points—flexible high-speed scalability and voluminous, helpful documentation. Still, its combination of design, performance, and pricing is not the best of this roundup.

Grand Junction Networks Inc.

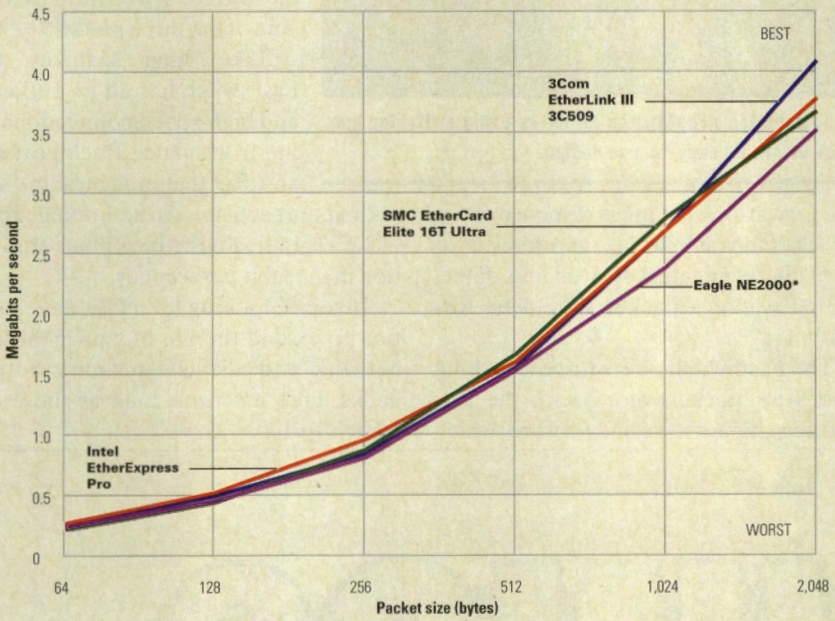
• FastSwitch 10/100

BY PADRAIC BOYLE

In today's networked world, speed is the name of the game; Grand Junction's FastSwitch 10/100 offers you just that. Not only did the FastSwitch have the fastest showing on our performance tests, it also has one of the best price-per-port ratios in this roundup. There's just one (big)

File Transfer Rates

This chart shows the throughput rates we measured at ZD Labs using the NIC Throughput test, from NetBench 3.0, on three Ethernet adapters that use special data-handling capabilities, such as streaming between the adapter and the PC s bus. We also report the throughput of an Eagle NE2000 for comparison. We tested with a heavy level of background traffic (40 percent) generated by an Expert Sniffer, a network analyzer from Network General Corp. The differences among the adapters show up more with bigger packets, such as those generated by IP, not the smaller packets typically found in PC-based networks using NetBIOS or IPX. With the smaller packet sizes, the differences between the special adapters and the reference product are not enough to create a significant difference in performance.



• Reported for comparison.

INNOVATION CENTRAL

Other exciting things happening with LAN adapters include faster signaling, easier connection schemes, and plug-and-play. Some steam seems to have gone out of products offering 100 Mbps over unshielded twisted-pair wiring (UTP), which were announced with much fanfare in 1993. Companies have been slow to deliver products and doubts remain over the real practicality of using wiring already in place. Incompatible technical architectures and the booming hype for ATM have combined to sap confidence in 100 Mbps.

Moreover, IBM made ATM market waves by releasing a 25-Mbps ATM adapter as part of a large family of ATM products that included 100-Mbps and 155-Mbps hardware. Although 25-Mbps ATM isn't widely supported yet, it has a "just right" feel for people who want ATM—but with reasonable costs and cabling requirements.

In even more useful developments, Farallon's unique EtherWave adapters provide a practical way for you to expand networks without buying more 10BaseT wiring hubs. EtherWave adapters—standard 3Com chip sets with Farallon's transceiver technology—can daisy-chain nodes on a standard 10BaseT port, so you can add another computer or printer without pulling more cable or buying another hub.

The next interesting technology for network interface cards that you'll want to invest in is plug-and-play. Plug-and-play will be a part of Microsoft's Chicago and of BIOS systems coming out later this year; it provides a way for adapters to identify themselves and to be configured by the BIOS, as much as possible, to avoid IRQ and memory conflicts. Many vendors may ship products with plug-and-play technology that, if successful, will eliminate many installation headaches.

If you are willing to change LAN adapters and hubs, you have many options for new networking technology that will improve throughput and flexibility. But if you don't have the stomach to open your users' PCs and change adapters, see the main product roundup here to give your network a throughput boost simply by adding a piece of external hardware. □

caveat: Only one workstation can be supported per switched port. This means that the FastSwitch is best suited for replacing Ethernet hubs in a network that requires high bandwidth to the workstations.

Also note that Grand Junction began shipping its latest model—the FastSwitch 10/100 AG—in late May, but we did not receive it in time for testing. The FastSwitch 10/100 AG offers 25 switched 10-Mbps ports, 1 switched 100-Mbps Fast Ethernet port, and 4 shared 100-Mbps Fast Ethernet ports.

Priced at $7,250, the rack-mountable FastSwitch comes with a total of 27 ports, carrying a cost of $268 per port. Of these ports, 24 are switched 10-Mbps Ethernet; another is a switching 10-Mbps port that can be used to connect to an Ethernet backbone, a workstation, or another FastSwitch 10/100.

Two Fast Ethernet ports are also available. To achieve a high-speed, dedicated connection between a workstation and a Novell server, you can purchase a 100-Mbps Fast Ethernet adapter, with NetWare drivers, for $399.

Unlike the other switching hubs tested, the FastSwitch supports just a single MAC address for each port. This limits you to 24 workstations for each installed unit and virtually kills expandability, since you cannot daisy-chain multiple nodes off of a port.

At the core of the FastSwitch's speed is its ClearChannel architecture. Clear-

FACT FILE

FastSwitch 10/100

List price: $7,250; price per port, $268. **In short:** Grand Junction's FastSwitch 10/100 offers you not only good performance and high-speed ports, but one of the best prices per port in this roundup. Grand Junction knows how to create a speedy switching hub—the FastSwitch had the fastest showing on our performance tests. But with its limitation of one MAC address per port, the FastSwitch is best suited for replacing Ethernet hubs. Grand Junction has released its new FastSwitch 10/100 AG Switch, which offers 25 switched 10-Mbps ports, 1 switched 100-Mbps Fast Ethernet port, and 4 shared 100-Mbps Fast Ethernet Ports. This product was not, however, released in time for testing.

Grand Junction Networks Inc., 47281 Bayside Parkway, Fremont, CA 94538; 800-747-3278, 510-252-0726; fax, 510-252-0915.

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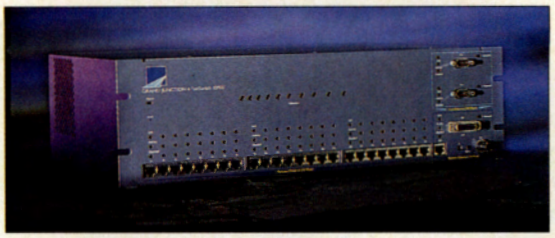
SUITABILITY TO TASK	
Plug-and-play	GOOD
Scalability	FAIR
Management	GOOD





Grand Junction's FastSwitch 10/100 is a fast switching hub, which offers an easy-to-use design.

Channel consists of 3MB of shared RAM for packet receiving and sending, a 1.04-Gbps bus that moves data between the ports, and a forwarding engine, which is the intelligence that pulls it all together.

The forwarding engine is responsible for such activities as learning the addresses of all of the connected devices and determining where a packet should be forwarded to.

The FastSwitch offers three switching modes for packets along with the forwarding engine: store and forward, which is the most common mode among switches and offers the most reliable transmission; FragmentFree, which reads the first 64 bytes of a packet before releasing it; and FastForward, which is similar to Kalpana's cut-through mode. Once a packet's destination address has been read, the packet is immediately forwarded without any error checking. Cut-through is the fastest but also the least reliable of the three modes.

Like other switches, the FastSwitch has all its 10BaseT and high-speed connections on the front panel. Each port has an LED that indicates link status and port activity. An additional group of LEDs indicate the backplane utilization in megabit per seconds.

If you're looking for a fast, easy solution to extend the life of your Ethernet network and alleviate network bottlenecks, take a serious look at the FastSwitch 10/100.

MOVING?

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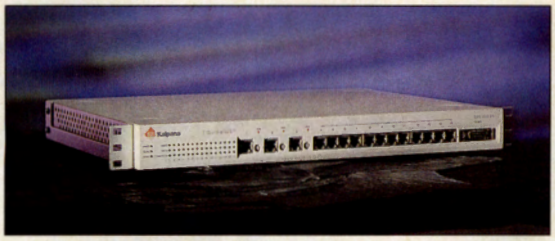
Kalpana Inc.

• EtherSwitch EPS-2015 RS

BY PADRAIC BOYLE

From the pioneer in Ethernet switching technology, Kalpana, comes the EtherSwitch EPS-2015 RS. This easy-to-use, stackable switch offers many options found in higher-end switching hubs, including a flexible high-speed connection solution, per-port filtering, and virtual networking. Its biggest drawback is its cut-through method of packet switching. This switch achieves an improvement in speed through its full-duplex scheme.

The EtherSwitch lists at $8,500 for either 15 10BaseT ports or 14 10BaseT ports and 1 AUI port. At $567 per port, the EtherSwitch is at the high end for switches offering only 10-Mbps ports, but it is well priced compared with switches featuring high-speed ports.





Kalpana's streamlined design provides ports on the front for easy access to the EtherSwitch EPS-2015 RS.

You can use the EtherSwitch in several ways: You can allow each port to be switched to each other, or you can configure the switch by setting up partitions, or what Kalpana calls *virtual networks.* This allows you to segment the ports to create up to seven virtual LANs, each acting as its own local segment, in a single hub. Another option available from Kalpana is Switch.NLM, priced at $495 per NetWare server. Switch.NLM eliminates bottlenecks by offering multiple

FACT FILE

EtherSwitch EPS-2015 RS

List price: $8,500; price per port, $567. **In short:** Though it lacks error-checking capability, the EtherSwitch's fast cut-through switching technique delivers better bandwidth for a good price and good port density. Kalpana is a pioneer in Ethernet switching technology and it shows in this easy-to-use, compact, stackable switch. The EtherSwitch provides flexible configuration options for expansion, including setting up virtual networks and using Kalpana's Switch.NLM to create multiple connections between a NetWare server and an EtherSwitch. Kalpana uses its own EtherChannel technology to make a high-speed connection, so you can dedicate one or more ports on each switch for the high-speed connection.

Kalpana Inc., 1154 East Arques Ave., Sunnyvale, CA 94086; 800-488-0775, 408-749-1600; fax, 408-749-1690.

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SUITABILITY TO TASK	
Plug-and-play	GOOD
Scalability	GOOD
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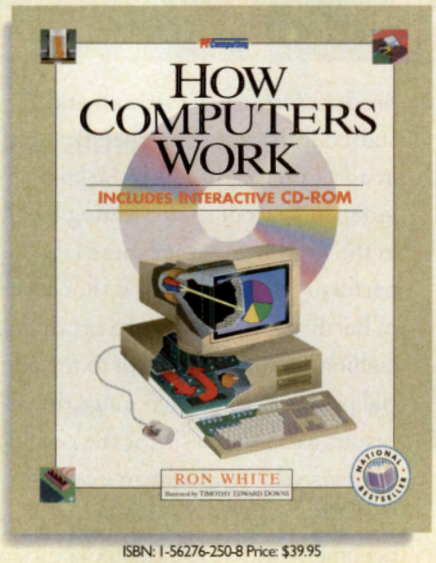

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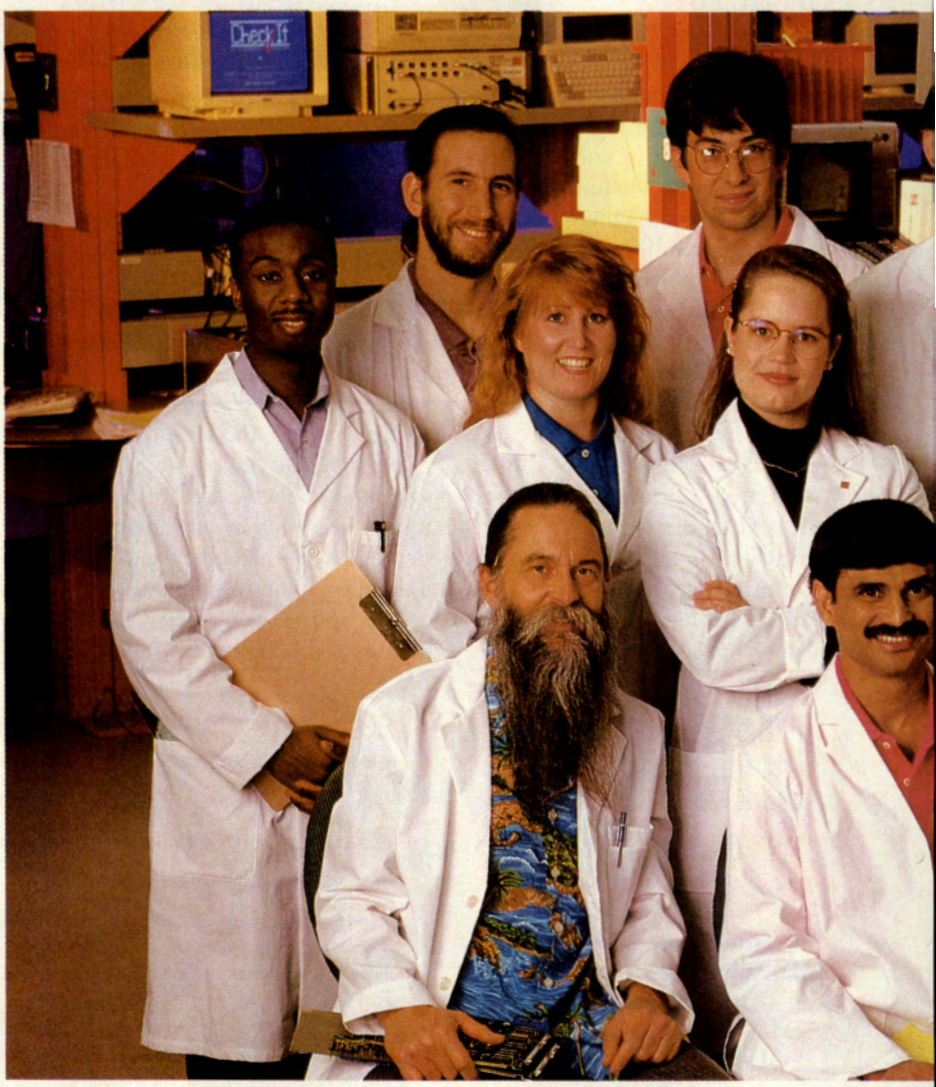

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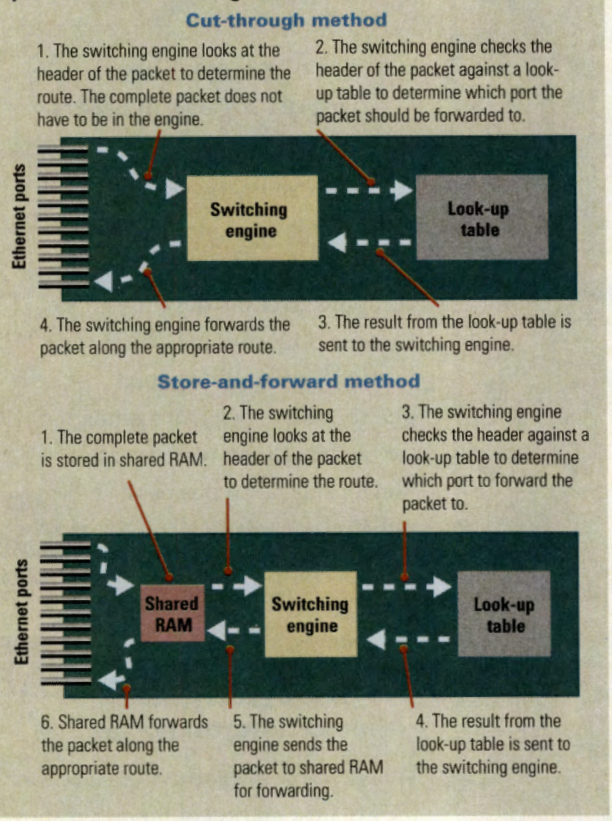
Inside an Ethernet Switch

Switches employ one or both of two methods of packet switching: cut-through or store-and-forward. The store-and-forward method introduces more aggregate latency into the handling of the packet, but the payoff is that error checking is performed on the packet as it enters the switch. Cut-through is faster, but it provides no error checking.



connections between a NetWare server and an EtherSwitch.

The EtherSwitch is the only switch we reviewed without high-speed ports that uses multiple ports to connect other units to create a large switched environment. Where others use Fast Ethernet or FDDI to do this, Kalpana uses its EtherChannel technology. This lets you dedicate one or several ports on each switch to make a high-speed connection, or Fat Pipe, between switches. Three ports can be configured for MDI (end-station connections) or MDIX (hub or end-station connections), so crossover cables are not needed.

Kalpana's EtherSwitch offers the unique EtherChannel technology to achieve high-speed connections without a high-speed port.

The EtherSwitch performed well on our tests, besting all switches without a high-speed port. When the EtherSwitch was tested in full-duplex mode, it matched some of those switches that include a high-speed port—because of its cut-through method of packet handling. Your throughput increases because of lower latency, but you forfeit error-checking capabilities. It's a trade-off.

The EtherSwitch supports all SNMP management platforms, including HP OpenView and Sun NetManager. It is MIB II compliant, provides its own extensions, and supports Novell's NMS. From the management console, you can view statistics and restrict specific ports from communicating with other workstations. As many as 30 Ethernet addresses can be filtered on a port-by-port basis.

Like many of the switches tested here, the EtherSwitch is very much a plug-and-play device. Ports are located on the front panel with status LEDs for each port. Documentation is clear and provides many examples of switched environments.

Kalpana's EtherSwitch EPS-2015 RS was not only the top performer of the switches without high-speed ports but also fared well against the higher-end switches. Its flexibility includes support for multiple management platforms and not one, but three configuration options.

NBase Switch Communications

• NH203A On-the-Fly Ethernet Switch

BY VISHY NARAYAN

This is an approachable, plug-and-play compact switch aimed at very small multimedia/CAD-intensive workgroups. Its features are on the light side, though, and its price of $499 per port is a bit high considering it lacks management capabilities.

In addition, the NBase NH203A turned in the slowest performance on our tests, most likely because of its small number of ports. A lower price, more features, and better documentation would boost the NBase NH203A into a competitive spot in the low-end, departmental switch market.

In its favor, the NBase NH203A is truly a plug-and-play switching hub. You can connect it into the network right out of the package. This switch doesn't require lengthy installation or configuration procedures.

The documentation did not appear to be in final form. With the NBase NH203A, we received a 12-page manual for a different switching product, plus a 3-page supplement—of which two pages

FACT FILE

NH203A On-the-Fly Ethernet Switch

List price: $1,994; price per port, $499. **In short:** With just four ports, the NBase NH203A On-the-Fly Ethernet Switch is an approachable, plug-and-play basic switching hub—you can connect it to your network and run without any time-consuming, difficult installation or configuration procedures. The NBase NH203A is geared to a specific small kind of installation, such as a very small multimedia/CAD-intensive workgroup. The switch turned in a slow performance on our tests, which is probably due to its small number of ports. The NBase NH203A would need a better price per port, better management, some expandability, and better documentation to be a leader among low-end departmental switches.

NBase Switch Communications, 8943 Fullbright Ave., Chatsworth, CA 91311; 800-858-7815, 818-773-0900; fax, 818-773-0906.

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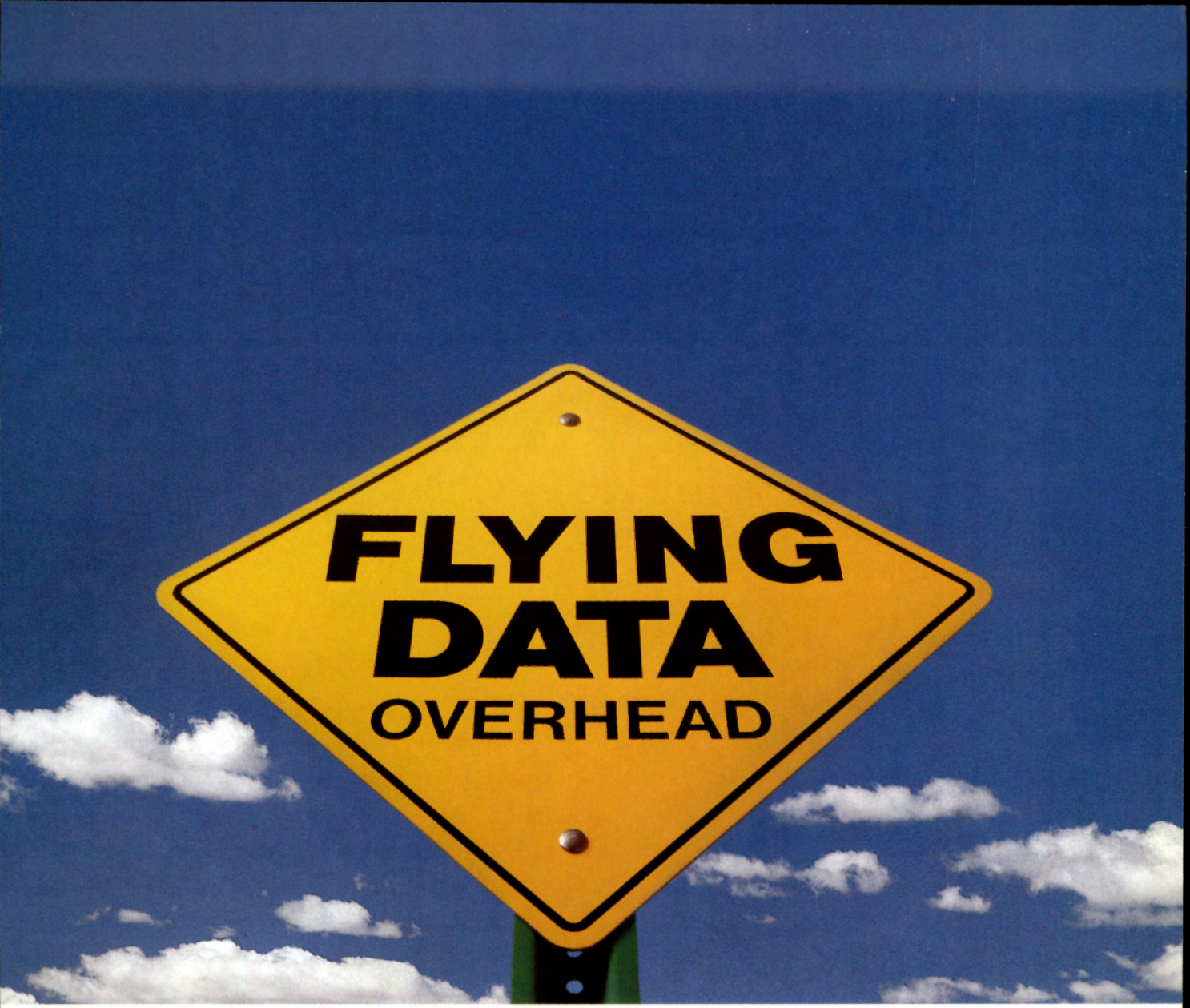
SUITABILITY TO TASK	
Plug-and-play	EXCELLENT
Scalability	FAIR
Management	N/A

N/A—Not applicable: The NBase does not have a management port.



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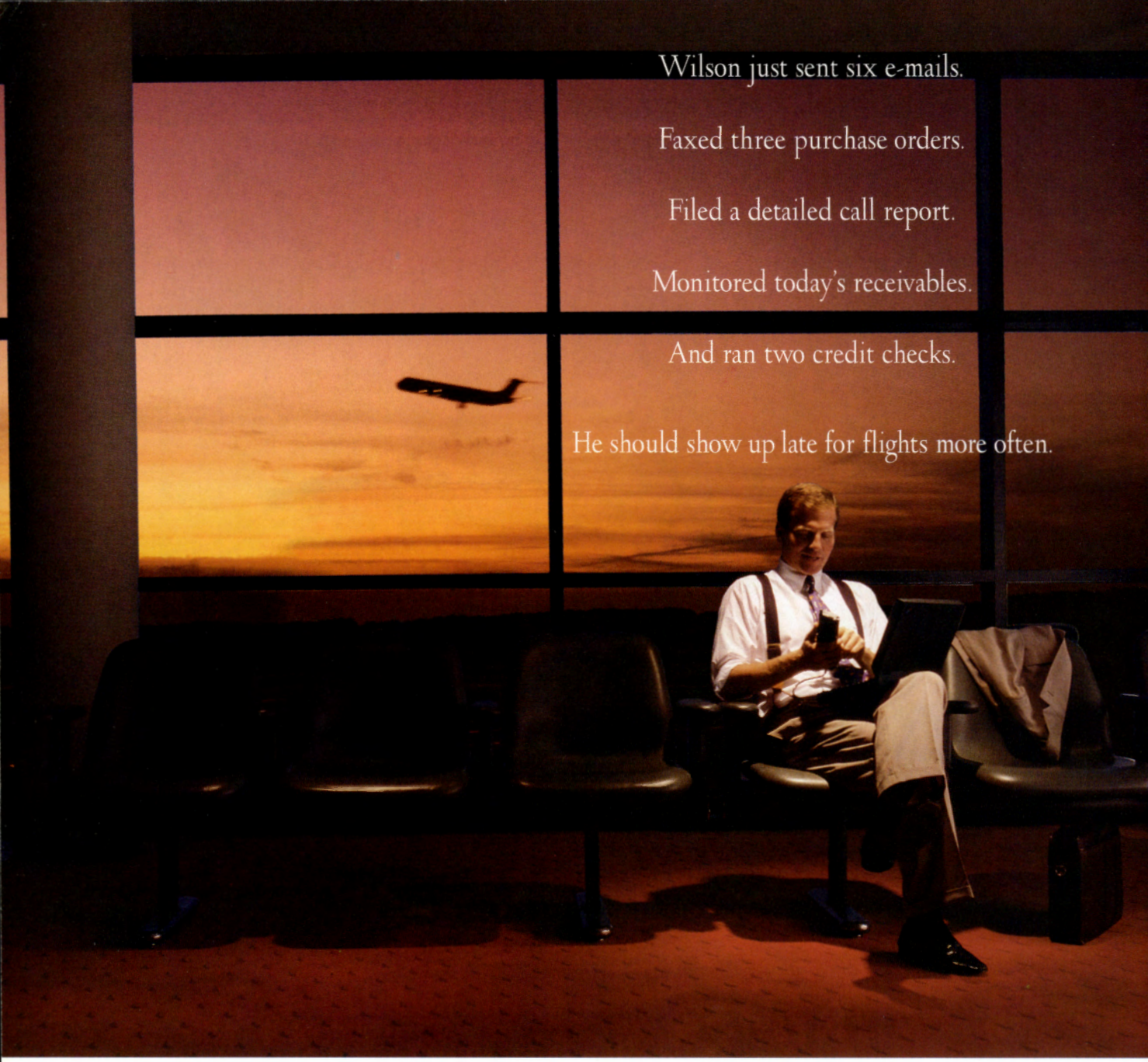

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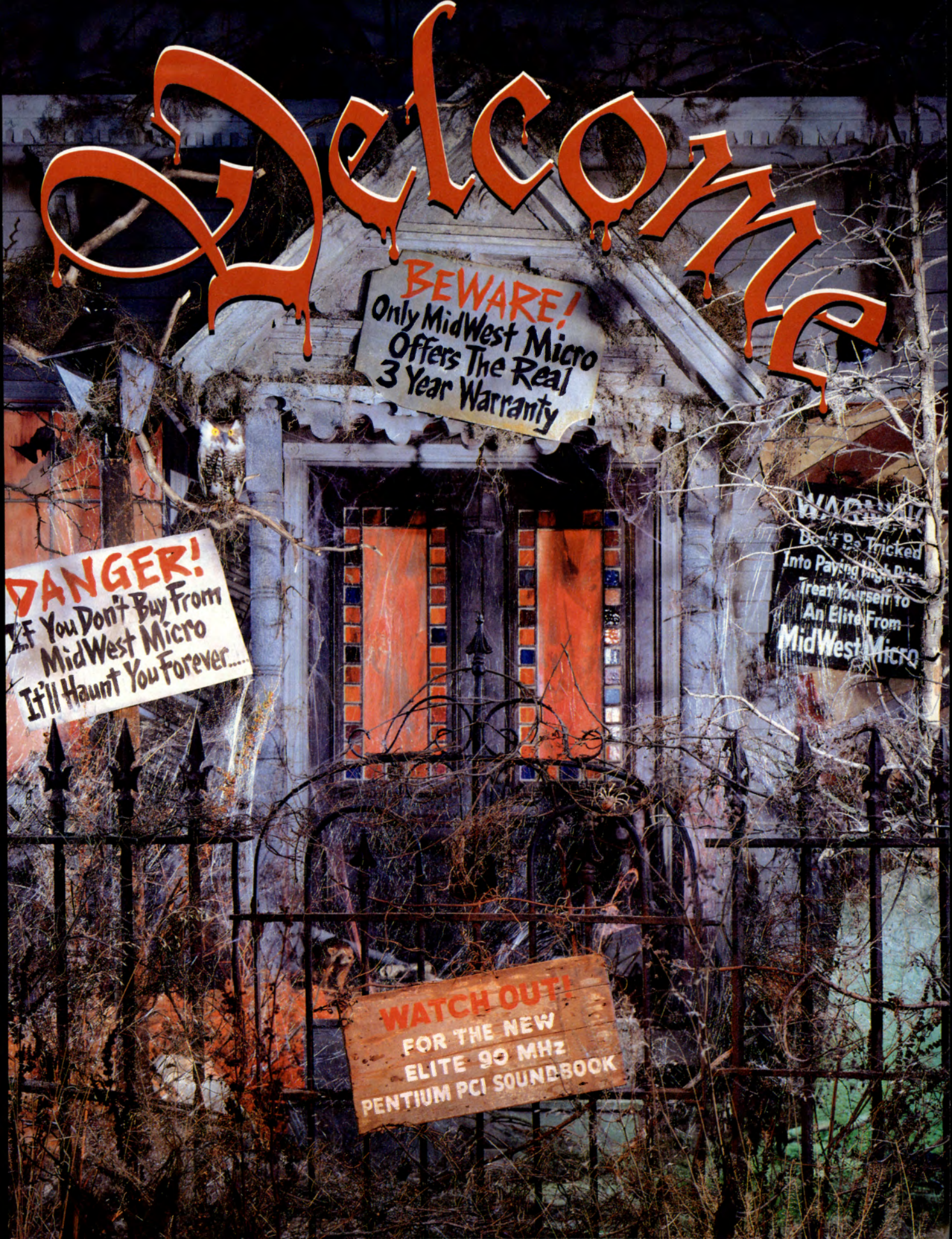
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```
Sub MAIN
WordLeft 1, 1
x$ = Selection$()
EditClear
On Error Goto TryAutoText
ToolsMacro .Name = x$, .Run, .Show = 0
Goto Finish
TryAutoText:
EditAutoText .Name = x$
Finish:
End Sub
```

Figure 3: **Attach this macro to a shortcut key and then you can either run a macro or enter an AutoText abbreviation by simply typing the macro or AutoText name and hitting the shortcut key.**

■ **WORD PROCESSING**

Improving AutoText in WinWord

TIP Microsoft Word for Windows' AutoText entries are a dream come true for anyone who needs to use boilerplate text repetitively. But it's still a tedious chore to expand abbreviations after entering them in the text. The three-line macro (minus the Sub MAIN statement at the beginning and End Sub statement at the end) shown below will considerably facilitate the task.

```
Wordleft 1,1
x$=Selection$()
EditAutoText .Name=x$,
```

The first line selects the word to the immediate left of your cursor, which is where the abbreviation will be if you've just typed it. The second assigns the selected text to the variable x$. The third line is equivalent to giving the Edit AutoText command, using the selected text as the abbreviation to expand. Assign the macro to a keystroke and you can then insert AutoText simply by typing the abbreviation and pressing the assigned key.

Frank Pearson
Richmond, California

▶PC MAGAZINE: The feature that lets you type the abbreviation and then expand it with a single keystroke is actually built into WinWord. The relevant WordBasic command is InsertAutoText, which WinWord assigns to F3 by default. But Mr. Pearson's ingenuity in designing this macro isn't wasted: The same approach will also work for running macros. And the equivalent feature for macros is *not* built into the program.

If you used Word for DOS before moving to WinWord, you may remember that the DOS version of the program treats macros and glossary entries—the equivalent of WinWord 6.0's AutoText entries—in much the same way. If you type a macro or glossary name and then press F3, Word for DOS will immediately run the macro or insert the glossary entry, as appropriate.

This option for running macros in Word for DOS lets you assign easily remembered names to macros, then run them simply by typing the name and pressing F3. For example, I've always used a macro in Word for DOS that automatically sets the print options the way I generally want them and then proceeds to print. By naming the macro Print, I could always print by typing "print" and then pressing F3.

RUNMAC lets you either run a Word for Windows macro or insert AutoText by typing the appropriate name and then the shortcut key.

For a touch typist, this can be faster than taking a moment to remember a mnemonic and then typing a shortcut key; it's far faster than taking your hand from the keyboard, reaching for the mouse, and clicking on a toolbar button. Touch typist or not, this approach will always be faster than choosing Tools | Macro , entering the name in the Macro Name text box, and choosing Run.

To add this feature to WinWord 6, you need only apply Mr. Pearson's logic to the ToolsMacro command and add an EditClear command to delete the name of the macro. Here is the resulting four-line macro, again minus the Sub MAIN statement at the beginning and the End Sub statement at the end:

```
WordLeft 1, 1
x$ = Selection$()
EditClear
ToolsMacro .Name = x$,
  .Run, .Show = 0
```

This macro, like Mr. Pearson's, selects the word to its immediate left and assigns it to a variable name. It then deletes the selection and runs the macro. Or if you mistyped the name, it yields the WordBasic error message, "Unable to run. . . ." the macro specified.

To use the macro, simply attach it to a shortcut key and then run any other macro by entering that macro's name. (You must make sure that the other macro is separated from the immediately preceding text by a space, paragraph end, or the like. Then hit your shortcut key.) I'll take this one step further, however, because there's an enticing elegance to the Word for DOS approach of using the same shortcut key both for running macros and expanding abbreviations.

Figure 3 lists RUNMAC, a macro that essentially re-creates the Word for DOS approach. (You can download it from PC MagNet as RUNMAC.DOC.) As with the macros we've already discussed, RUNMAC first selects the word to the immediate left and assigns it to a variable name. It then deletes the text and tries to run a macro of that name. If such a macro exists, RUNMAC runs it, goes to the Finish label, and ends. If a macro with that name doesn't exist, RUNMAC reacts to the resulting WordBasic error by jumping to the TryAutoText label (because of the On Error Statement). It then tries to insert an AutoText entry of the same name.

If RUNMAC can't find an AutoText entry with that name either, you'll get Word's standard error message stating that the name is not a standard AutoText entry. Attach this macro to F3, and you'll be able both to run macros and insert AutoText by typing the appropriate name and pressing F3—the same way you can in Word for DOS.

—M. David Stone

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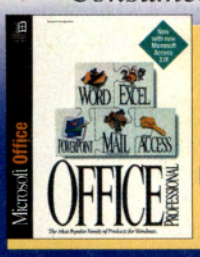

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```
@ECHO OFF
IF '%Up%'=='' GOTO Out
IF NOT '%1'=='' GOTO Do
%Ø %path%

:Do
REM Convert the value of Up to uppercase
PATH %Up%
SET Up=%Path%
REM Now restore the path from the command line
PATH=%1

:Loop
SHIFT
IF '%1'=='' GOTO Out
PATH=%Path%;%1
GOTO Loop

:Out
```

Figure 1: **UP.BAT converts the value of environment variable Up to uppercase without requiring environment space to store a copy of the path.**

```
@ECHO OFF
SET Up=%1
CALL UP
ECHO "%1" in uppercase is "%Up%"
SET Up=
```

Figure 2: **TESTUP.BAT shows how easy it is to capitalize parameters using UP.BAT.**

▶PC MAGAZINE: The technique Mr. Martin mentioned uses command line parameters as variable names to recognize parameters regardless of case. The usual method for actually converting parameters to uppercase takes advantage of the fact that DOS automatically capitalizes the value of the path environment variable. Save the existing path, put a value into it, copy the capitalized result, and then restore the path. That's how it's done.

The usual method assumes, however, that the user has enough free environment space for a copy of the path. If not, it trashes the path. The batch file listed in Figure 1 illustrates a new technique that doesn't have that problem. Set the environment variable Up to any value and call UP.BAT. The value of Up will be converted to uppercase. Here's how it works:

The first IF line simply skips to the end of the file if the e-var Up is empty. The second IF line does nothing, since there are no command line parameters. The next line reexecutes the batch file, passing the path on the command line. That's the key: The path is *stored* on the command line.

When the batch file is reexecuted, there are command line parameters, so the second IF test jumps to the label Do. Commands at this label convert the value of Up to uppercase by storing its value in the path variable and then copying it back to the Up variable. Finally, UP.BAT rebuilds the old path by appending each command line parameter to it in turn. TESTUP.BAT (Figure 2) demonstrates how easy it is to use UP.BAT.

You can download the batch files mentioned here from PC MagNet's Utilities/Tips Forum, archived as UP.ZIP.

—Neil J. Rubenking

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■ **OPERATING ENVIRONMENTS**

Windows Déjà Vu?

❓Every time I load Microsoft Windows 3.1 from the DOS prompt, I get a message that says I'm already running Enhanced-mode Windows, the same message you get if you try to start Windows from a DOS box in Windows. But that's not the case. When booting up, I first turn on the computer and then type WIN at the DOS prompt. The Windows 3.1 logo appears, the message is displayed, and then the boot process continues without further interruption.

Why is this message appearing? Is there something wrong with my system files? How can I fix it so that the message will not appear?

Paul E. Pennebaker
Slidell, Louisiana

▶**PC MAGAZINE:** The explanation for this behavior doesn't lie in AUTOEXEC .BAT, CONFIG.SYS, or the Windows .INI files but in the little-known batch file, WINSTART.BAT. Commands included in WINSTART.BAT are executed during the Windows start-up sequence. The symptoms you've described are generally caused by attempting to run WIN.COM from within WINSTART .BAT. There's no harm or corruption to the system, but you'll speed your start-up by opening WINSTART.BAT and deleting the line that attempts to run WIN.COM. Note that if you're running in a networked environment, you may have to seek WINSTART.BAT on the server.

It's conceivable that a line in WINSTART.BAT may run WIN.COM indirectly or that another program loaded from WINSTART.BAT could cause the same problem. If you don't find a line in WINSTART.BAT that clearly loads WIN.COM, try commenting out one line at a time by putting two colons at the start of the line.

The purpose of WINSTART.BAT is to give you more memory in Windows DOS boxes. When a TSR is loaded before Windows starts, it's accessible to Windows applications and to all DOS boxes, but it also uses up memory in all DOS boxes. For that rare TSR that's useful in Windows applications but not in DOS applications, loading in WINSTART.BAT will save valuable memory. Also, TSRs loaded in WINSTART .BAT can take advantage of Windows' expanded-memory emulation.
—*Neil J. Rubenking*

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Do you have a hardware, software, or systems problem you can't solve? Do you have a tip you think other readers could use? Perhaps you'd like a better understanding of how something works. If so, we invite you to tell us about it. Our experts can give you practical solutions to your problems, provide techniques for using your software and hardware more productively, and help you grasp computer concepts and understand the latest technology.

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For any tip we print, you'll receive $50 plus a *PC Magazine* T-shirt. We regret that we cannot answer letters individually.

Converting Batch File Parameters to Uppercase

❓I want to write a batch file that can handle parameters, and I want the parameters to be uppercase characters. Some time ago I saw a batch file that converted parameters to uppercase by first using the parameters as variable names. Can you tell me how to do this?

Ed Martin
Chicago, Illinois

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PC Solutions

TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

HARDWARE

Speaker Silencing Sequel

TIP I found a clean and cheap solution for silencing my computer speaker without having to buy a switch (Solutions, April 12, 1994). I simply used the keyboard lock switch, since I have no need to lock the keyboard on my computer. Just cut one of the speaker wires in the middle and attach the two ends to the connections on the keyboard lock switch—no ugly hole in the computer case, no switch to buy. And if you want to prevent your kids from being too noisy with their arcade games, just lock it and pocket the key!

Sylvain Rodrigue
Mirabel, Quebec, Canada

▶**PC MAGAZINE:** This is an excellent improvement on my original suggestion. Some people may not want to rely on a locking switch, however, since there is the risk of losing the removable key. In that case, you can probably get a switch that will fit the same threaded hole as the keyboard switch; take the switch to your local Radio Shack or other electronics supply store to make certain you get a correct match. And you can replace the lock with either a switch or a 100 kilohm potentiometer; the potentiometer has the added advantage of providing volume control instead of simply an on/off choice.—*Alfred Poor*

Can My Old CD-ROM Do Multimedia?

? I have a 386 system (upgraded with a Cyrix Cx486 processor) with an external Hitachi CDR-1700S CD-ROM drive that uses a proprietary (not SCSI) interface adapter in the computer. I can use it to play audio CDs, but I have been unable to take advantage of the digitized sound files offered by multimedia programs.

What do I need to add to my system? The CD-ROM drive does have a headphone jack in the front and audio connections in the back. Can I connect it to a sound card somehow? I've been asking people about this for more than two years but haven't been able to get a straight answer.

Abigail Gregory
Sunnyvale, California

▶**PC MAGAZINE:** It's a shame that it has taken so long to get an answer, since there are many sound cards on the market that can solve your problem. The multimedia market has moved on a bit since you got your CD-ROM drive, and though there are products you can use, you may find that your system performance falls short of what many new multimedia titles require.

The easy part is adding a sound card. You don't need to worry about connecting the CD-ROM drive to the sound card: Your CD-ROM drive is already hooked up to the computer. What you need is simply a separate sound card that will output the digitized sound data your CD-ROM drive sends to the computer. There are dozens of choices on the market, and you can find plenty that do not include a CD-ROM drive interface (which you already have). For a review of the top-end sound cards, see "Sound Boards: Big Audio Dynamite" in our April 12, 1994, issue.

The problem you face is performance limitations. The Hitachi CDR-1700S is a single-speed drive, which means that it transfers data at about 150K per second. This is the speed required for audio-CD playback but is only half the velocity of the double-speed drives that have become common (and relatively inexpensive) in today's market.

Your CPU may also be too slow for multimedia. The current specification for Multimedia PCs is MPC Level 2, which calls for a 486 processor, at least 4MB of system memory, a 160MB hard disk, and a 16-bit sound card. In addition, MPC Level 2 calls for a double-speed CD-ROM drive and graphics support for 64,000 colors at 640-by-480 resolution. You don't mention how fast your Cyrix CPU is, but the complete package may be underpowered for today's multimedia titles.

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PC DIRECT

PC DIRECT starts here with exciting offers from top direct vendors.

See index, page 361.

GetEntries returns the number of entries in the section.

ONE FINAL POINTER These routines should make WinPointer attractive to many VB programmers. It often makes sense to download *PC Magazine*'s utilities even if you don't think you'll need them as a user. Their programming code can make them invaluable. Neil Rubenking's INIBACK utility (May 17, 1994) includes a reusable About box, which I used in WinPointer. Why reinvent the wheel?

For teachers or presenters, WinPointer should satisfy a real need. For Visual Basic programmers, WinPointer should put a few frequently asked questions to rest. If you encounter any difficulties with WinPointer or have questions about the program code, you can reach me by posting a message in the Utilities/Tips Forum or the Programming Forum of PC MagNet on ZiffNet. □

JONATHAN ZUCK IS THE VICE PRESIDENT FOR CLIENT/SERVER TECHNOLOGY AT ADVANCED PARADIGMS INC., A WASHINGTON, D.C.–BASED CONSULTING FIRM SPECIALIZING IN WINDOWS APPLICATIONS DEVELOPMENT AND TRAINING. HIS COMPUSERVE ID IS 76702,1605.

GUIDE TO OUR UTILITIES & HOW TO GET THEM

WinPointer

PURPOSE: This Windows utility enhances demonstrations, presentations, and training sessions that rely on projected computer screens. Activated by a hotkey, WinPointer freezes the screen and lets you highlight areas of interest by drawing on the desktop with the mouse.

SETUP: To install WinPointer on a system that already contains VBRUN300.DLL, simply copy WPNTR.EXE into the directory of your choice and add it to a Program Manager group. If you don't have the Visual Basic runtime engine, you need to copy VBRUN300.DLL to your Windows system directory.

REMARKS: When first launched, WinPointer appears as a minimized icon. The WinPointer configuration screen is opened by double-clicking on the program icon. You can specify the hotkey used to shift into draw mode, as well as the thickness and color of the drawing line. When you have finished making your selections, click Ok, and WinPointer will again be minimized.

When you press the hotkey, the cursor will change to a large arrow pointing straight up to indicate you are in draw mode. You can then draw on the screen as you would in Windows Paintbrush—that is, by pressing down on the left mouse button and moving the mouse. When you press Esc, you are returned to live mode.

You can use the keyboard to draw if you are working with an awkward pointing device on a laptop. Use the arrow keys to move the cursor around the screen and use the Shift key in place of the left mouse button.

PC Magazine's utilities are available by modem from PC MagNet, our on-line service. PC MagNet is part of ZiffNet, a group of on-line services from Ziff-Davis Publishing Company. ZiffNet is hosted by CompuServe Information Service.

THE FIRST TIME If you've never used ZiffNet, you'll need to find the access number nearest you. Set your communications software to 7 data bits, even parity, no stop bits, and full duplex. Then dial 800-346-3247 with your modem. When the modem connects, press Enter. At the HOST NAME prompt, enter PHONES. Follow the menus and note the closest access number. Or dial 800-635-6225 (voice) for instructions.

HOW TO JOIN ZIFFNET Dial the local access number. At the HOST NAME prompt, enter CIS. At the USER ID prompt, type 177000,5000. When you see the PASSWORD prompt, enter PC*MAGNET. Finally, when you see the ENTER AGREEMENT NUMBER prompt, enter PCMAG94. Current CompuServe members can type GO PCMAG at any CompuServe ! prompt. Once you enter your billing information, you'll see your personal user ID and temporary password.

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Prodigy members can download the utilities from ZiffNet selections on Prodigy for a transfer fee of $3 per program. Jump 'ziff select' and browse the computing topics for programs.

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```
Option Explicit

DefInt A-Z


Declare Sub WritePrivateProfileString Lib "Kernel" (ByVal Section$, ByVal Entry As Any, ByVal Default As Any, ByVal IniFile$)
Declare Function GetPrivateProfileString Lib "Kernel" (ByVal Section$, ByVal Entry As Any, ByVal Default As Any, ByVal mzBuff$,
ByVal mzBuffLen, ByVal IniFile$)

Dim mzBuff As String

Sub DeleteEntry (IniFile$, Section$, Entry$)
    WritePrivateProfileString Section$, Entry$, 0&, IniFile$
End Sub

Sub DeleteSection (IniFile$, Section$)
    WritePrivateProfileString Section$, 0&, 0&, IniFile$
End Sub

Function GetEntries (IniFile$, Section$, Entry$())
    Dim nChars
    Dim nEntries
    Dim nStart
    Dim nPos

    If Len(mzBuff) < 255 Then
        mzBuff = Space(255)
    End If
    nChars = GetPrivateProfileString(Section$, 0&, "None", mzBuff, 255, IniFile$)
    If nChars > 0 Then
        nEntries = 1
        nPos = InStr(nStart, mzBuff, Chr$(0))
        While nPos > 0
            ReDim Entry$(nEntries - 1)
            Entry$(nEntries - 1) = Mid(mzBuff, nStart, nPos - nStart)
            nStart = nPos + 1
            nPos = InStr(nStart, mzBuff, Chr$(0))
        Wend
    End If
    GetEntries = nEntries
End Function

Function GetIniLong& (IniFile$, Section$, Entry$, Default&)
    GetIniLong& = Val(GetIniString$(IniFile$, Section$, Entry$, Format$(Default&)))
End Function

Function GetIniString$ (IniFile$, Section$, Entry$, Default$)
    Dim nChars

    If Len(mzBuff) < 255 Then
        mzBuff = Space(255)
    End If
    nChars = GetPrivateProfileString(Section$, ByVal Entry$, ByVal Default$, mzBuff, 255, IniFile$)
    If nChars > 0 Then
        GetIniString$ = Left(mzBuff, nChars)
    Else
        GetIniString$ = ""
    End If
End Function

Sub SetIniLong (IniFile$, Section$, Entry$, ByVal Default&)
    SetIniString IniFile$, Section$, Entry$, Format$(Default&)
End Sub

Sub SetIniString (IniFile$, Section$, Entry$, Default$)
    WritePrivateProfileString Section$, Entry$, Default$, IniFile$
End Sub
```

Figure 7: **The WPINI.BAS module contains generic .INI file processing routines that you can use in your Visual Basic programs. GetEntries() gives you easier access to the items in an .INI file entry. GetIniLong and SetIniLong are wrappers around GetIniString and SetIniString which in turn are wrappers around the Windows GetPrivateProfileString and RightPrivateProfileString API functions.**

passing a null pointer, we simply pass "0&". The ampersand forces Visual Basic to treat the 0 as a long integer. This is the technique that DeleteEntry uses to delete an .INI file entry. Similarly, the DeleteSection routine passes a null pointer as the Entry name to delete the entire section.

The last routine, GetEntries, gives you easier access to the items in an .INI file entry. The Microsoft Windows SDK help file indicates that if you pass a null pointer as the Entry to GetPrivateProfileString, your buffer will be populated with a list of entries in the specified section. This is true, but the list is returned as a string with null characters between the entries—a straightforward string array in C but difficult to work with in Visual Basic. GetEntries, however, takes an empty Visual Basic string array as a parameter. The string array is populated with the entries and resized as the program walks through the result buffer.

```
Sub Form_MouseMove (Button As Integer, Shift As Integer, X As Single, Y As
Single)
    If mbDrawing Then
        Me.DrawMode = 13
        Me.Line (miOldX, miOldY)-(X, Y)
        miOldX = X
        miOldY = Y
    End If
End Sub
```

Figure 5: **The MouseMove event handler is responsible for the drawing as well as cursor movement.**

_MouseUp event—determines whether a line should be drawn. If mbDrawing is True, the _MouseMove event handler draws a line from the old mouse coordinates (preserved in miOldX and miOldY) to the new coordinates, which are provided as parameters to the event handler. The new coordinates are then saved like the old ones.

The keyboard interface is just a wrapper around the mouse interface. The central routine is the _KeyDown event handler (Figure 6). This routine begins by retrieving the current cursor location with the Windows API function GetCursorPos. It then tests KeyCode. If KeyCode is the Shift key, the MouseDown event handler is called with the appropriate cursor coordinates. If KeyCode is one of the arrow keys, the cursor is moved using the Windows API function SetCursorPos, which triggers the _MouseMove event. This tactic prevents duplication of code and ensures that changes made to the mouse interface are reflected in the keyboard interface.

MANAGING .INI FILES One of Visual Basic's most frequently encountered problems is how to use the Windows API's .INI-file-management functions—GetPrivateProfileString and WritePrivateProfileString. In order to make life a little easier and the code a little tighter, I have created a reusable module called WPINI.BAS to manage .INI files (Figure 7). WPINI.BAS contains all the routines you need to read and write .INI files.

The SetIniString subroutine is a wrapper around WritePrivateProfileString that standardizes the procedure name and calling conventions for you. When you call a Windows API function, Visual Basic automatically converts your strings to null-terminated strings in the form expected by the API—LPSTRs (long pointer to a string). LPSTRs are long integers comprising a segment number and offset; they represent the address of the string data. The terminating null character is a C convention that signals the end of the string. You don't have to append the Chr(0), since Visual Basic does this for you when you pass a string by value. Keep in mind when we discuss null pointers that an LPSTR is actually a long integer.

For teachers, WinPointer should satisfy a real need. For Visual Basic programmers, WinPointer should put a few frequently asked questions to rest.

The GetIniString function is a wrapper around GetPrivateProfileString. This API function can be confusing for VB programmers, because it requires that a string be presized to receive characters—a task handled invisibly by VB for string assignments. Using the Space function, we first size a string called mzBuff to 256 characters. This buffer string is passed to GetPrivateProfileString and becomes a place to copy string data. The return from the API function contains the number of characters actually copied. If the buffer was too small, the return value is 1 less than the buffer size. If this is the case, we keep adding 256 bytes to our buffer until the buffer is large enough. The extra space is trimmed using the Left function. The string is then returned as the GetIniString result.

The GetIniLong and SetIniLong routines are wrappers around their string counterparts, which use Val and Str, respectively, to perform their conversions. You can see GetIniLong in use in Sub Main (Figure 3).

WinPointer uses only two of the .INI file functions—SetIniLong and GetIniLong—but I have provided the rest to make WPINI.BAS a general-purpose module. There are three additional routines of interest: DeleteEntry, DeleteSection, and GetEntries. The DeleteEntry and DeleteSection routines are exceedingly simple but prevent some common mistakes.

The documentation for the Windows API specifies that if a null LPSTR is passed as the value for an entry, that entry will be deleted. It is natural to assume, then, that we should pass a null string from Visual Basic, but this is not what is required. Instead, we must pass a 0 as the address of our string. In other words, we don't need a long pointer to a null string but quite literally a null pointer itself.

The Entry parameter in WritePrivateProfileString is defined as

```
ByVal Entry As Any
```

so we can choose to pass either a string or a long integer. When

```
Sub Form_KeyDown (Keycode As Integer, Shift As Integer)
    Dim P As APIPOINT

    GetCursorPos P
    Select Case Keycode
        Case KEY_SHIFT
            Form_MouseDown 1, 0, CSng(P.X), CSng(P.Y)
            Exit Sub
        Case KEY_LEFT
            P.X = P.X - 5
        Case KEY_DOWN
            P.Y = P.Y + 5
        Case KEY_UP
            P.Y = P.Y - 5
        Case KEY_RIGHT
            P.X = P.X + 5
    End Select
    SetCursorPos P.X, P.Y
End Sub
```

Figure 6: **The KeyDown event handler is a wrapper around the mouse interface; arrow keys are translated into mouse actions.**

```
Sub Main ()
    Dim zIniFile As String, zSection As String
    Dim bHotkey As Integer

    'First read values from WINPNTR.INI
    zIniFile = "WINPNTR.INI"

    zSection = "Hotkey"
    giVKCode = GetIniLong(zIniFile, zSection, "VKCode", Asc("C"))
    giVKMask = GetIniLong(zIniFile, zSection, "VKMask", 2)

    zSection = "Line Draw"
    glLColor = GetIniLong(zIniFile, zSection, "glLColor", 0)
    giLSize = GetIniLong(zIniFile, zSection, "giLSize", 3)

    'Show our main form
    frmMain.Show
    DoEvents

    'This loop runs for life of app
    Do
        'Poll for the bHotkey
        bHotkey = False
        Do
            DoEvents
            If GetAsyncKeyState(giVKCode) Then
                If GetCurrentMask() = giVKMask Then
                    bHotkey = True
                End If
            End If
        Loop Until bHotkey

        'Save the screen and show the form
        Load frmSave
        ScreenCapture frmSave
        frmSave.Show 1
        'SavePicture frmSave.Image, InputBox("File Name")
    Loop
End Sub
```

Figure 3: **WinPointer's polling loop is found in Main(). The DoEvents command allows other Windows programs to execute while WinPointer is loaded.**

Polling works for WinPointer but is not a good substitute for a keyboard hook if you want to override the functionality of an application with your own routine. Polling also entails some overhead due to the repeated calls to GetAsyncKeyState. These minor limitations notwithstanding, polling allows us to implement systemwide hotkeys using only Visual Basic—not third party add-ons.

CAPTURING THE SCREEN The ScreenCapture routine shown in Figure 4 takes a form as its single parameter and then copies the bitmap version of the desktop to the form background. This routine begins by using the Move method to size the form to fill the entire screen. Next, the screen Width and Height are converted from twips to pixels using the TwipsPerPixelX and TwipsPerPixelY properties of the screen object, because the relevant Windows API functions require pixels.

Once the form is ready, the ScreenCapture routine employs the CreateDC function with the reserved "DISPLAY" parameter so that the source device context—the device context from which to copy—is a bitmap version of the screen display. The form's AutoRedraw property is set to True, because this is required when copying to a hidden form. The copy is performed using the Windows API function BitBlt, and then the AutoRedraw property is reset and the device context is deleted. That's all there is to taking a screenshot! When the ScreenCapture routine returns, Sub Main simply displays the form and you are ready to draw.

If you wanted to modify WinPointer to be a simple screen-capture utility, all you would have to change is a single line of code in Sub Main. Instead of the line

```
frmSave.Show 1
```

you would execute the line

```
SavePicture frmSave.Image,
 InputBox("File Name")
```

which is shown commented out in Figure 3. This line of code would prompt the user for a filename and then would save the picture just copied as a .BMP file.

DRAWING ON THE FORM Though drawing may seem like a difficult programming task, this is the easiest part of WinPointer. First, the MousePointer property of the form is set to 10, which causes the cursor to change to an up arrow. This lets the user know that the system is in draw mode. No magic there. I chose the Up Arrow cursor because it is so rarely used in normal Windows applications and thus can unambiguously indicate draw mode.

The actual drawing takes place in the _MouseMove event handler Sub Form_MouseMove (Figure 5) and relies on three variables—mbDrawing, miOldX, and miOldY. The Boolean mbDrawing—set to True in the _MouseDown event and to False in the

```
Sub ScreenCapture (F As Form)
    Dim iDC
    Dim iScrnW As Integer, iScrnH As Integer
    Dim iAdjustX As Integer, iAdjustY As Integer

    'adjust the position of the form by one pixel
    iAdjustX = Screen.TwipsPerPixelX
    iAdjustY = Screen.TwipsPerPixelY

      F.Move -iAdjustX, -iAdjustY, Screen.Width + iAdjustX, Screen.Height +
iAdjustY
    DoEvents
    iScrnW = CInt(Screen.Width \ Screen.TwipsPerPixelX)
    iScrnH = CInt(Screen.Height \ Screen.TwipsPerPixelY)
    iDC = CreateDC("DISPLAY", 0, 0, 0)
    F.AutoRedraw = True
    BitBlt F.hDC, 1, 1, iScrnW, iScrnH, iDC, 0, 0, &HCC0020
    F.AutoRedraw = False
    DeleteDC iDC
End Sub
```

Figure 4: **ScreenCapture first creates a device context using the reserved "DISPLAY" parameter and then employs the function BitBlt to perform the copy.**

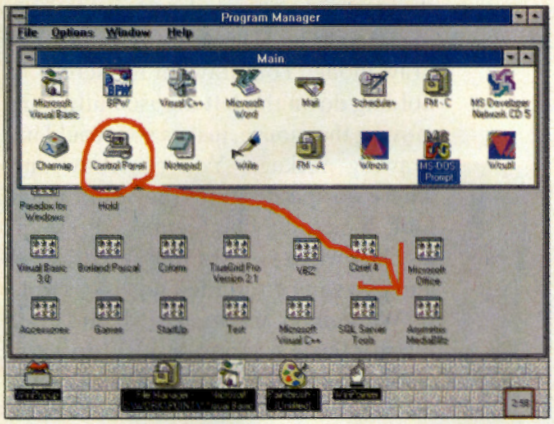

Figure 1: **Here is an example of what you might see when you draw on the Windows desktop with WinPointer.**

palette with the mouse. Keyboard users can tab to the color palette (a dotted outline surrounds the palette when it has the focus) and cycle through the color choices using the arrow keys.

The last setting is line thickness, which is described in pixels; enter a number between 1 and 9. When you click Ok, WinPointer will store your choices in the WINPNTR.INI file (found in your Windows directory) and once again minimize itself. If you wish to terminate WinPointer, select Close from the system menu or click the Exit button in the configuration dialog.

PROGRAMMING WINPOINTER When you press the hotkey, the first thing WinPointer does is save the desktop as a bitmap with Visual Basic's SavePicture command. It then places the bitmap on a Visual Basic form. The powerful VB drawing tools make the rest easy. The most interesting aspect of the WinPointer program is actually the setup of the systemwide hotkey.

Hotkeys are commonly used under DOS to bring up TSR (terminate and stay resident) utilities. This particular use has almost vanished with Windows, since Windows is multitasking; an application can be activated simply by double-clicking its icon.

One common Windows application that does use systemwide hotkeys is the Macro Recorder. You record macros to work with a particular application in a particular state, so they must be launched from within the application. If you had to reactivate the Macro Recorder to run a macro, you would really see the observer-modifying-the-observed principle at work.

Similarly, with WinPointer you need to be able to freeze the screen in any state and draw on it. If you had pulled down a menu in your application, activating WinPointer normally would close it. Thus WinPointer, like the Macro Recorder, must be activated with a systemwide hotkey.

SYSTEMWIDE HOTKEYS The Macro Recorder monitors user activity through the use of a keyboard hook. Installation of this type of hook using the Windows API (application programming interface) function SetWindowsHookEx lets a program monitor and filter all the keystrokes generated on the system. A C or Pascal programmer would pass this function the address of a callback function to be used by Windows for notification. One of the limitations of the pseudo-code architecture of Visual Basic is the inability to implement callback functions, so SetWindowsHookEx cannot be used directly from Visual Basic. There are some third-party products that solve this problem, such as SpyWorks, from Desaware, which provides a keyboard hook VBX; and VBZ, from Foxhall Publishing, which provides a hotkey DLL (dynamic link library). For demonstration purposes, I chose a VB-only solution.

In the absence of some sort of notification mechanism, WinPointer repeatedly checks the state of the keyboard to see whether the hotkey is pressed—a technique called *polling*. The polling code is in Sub Main (Figure 3).

Sub Main begins by loading .INI file information into global variables (more on managing .INI files later) and then displaying the main form. It then starts a Do Loop that is continually executed.

The Do Loop first initializes a variable that indicates whether the hotkey is currently pressed. Next is another Do Loop whose first action is DoEvents. This function allows the loop to execute in the background while other applications are running on the desktop. DoEvents causes a "gasp" in your code that allows the rest of the applications on the system to process their event queues. It then returns when other applications have gone idle again. A C programmer would use an empty PeekMessage loop to serve the same function.

The next task is to check whether the hotkey is pressed. This is done using the Windows API function GetAsyncKeyState. Consistent with VB conventions, a hotkey is defined by a KeyCode and a Shift state. WinPointer calls these variables giVKCode and giVKMask, respectively. If the key defined in giVKCode is currently pressed, the GetCurrentMask function is called to see which shift keys are currently pressed as well. GetCurrentMask uses the GetAsyncKeyState function to check the state of each of the shift keys, adding up the values of the keys that are pressed. If the result matches the mask defined in giVKMask, then the hotkey has been pressed and control falls through the loop. Then the drawing form frmSave is loaded, the bitmap version of the screen is copied to the form, and the form is displayed. If the hotkey is not pressed, the program returns to polling for the giVKCode.

When you press the hotkey, the first thing WinPointer does is save the desktop as a bitmap with Visual Basic's SavePicture command.

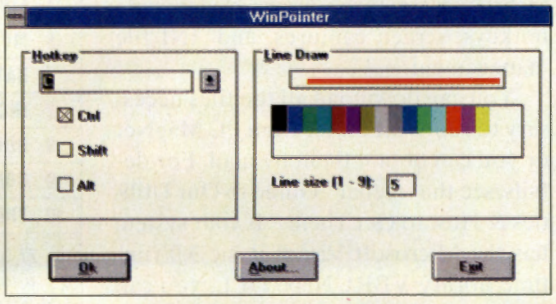

Figure 2: **The WinPointer configuration dialog box lets you select the line color, the line width, and the key and shift state of the hotkey that triggers draw mode.**

Utilities

BY JONATHAN ZUCK

WinPointer Highlights Your Presentations

If you have ever taught a computer class or given a computer-based presentation, you have faced the problem of trying to point something out on a projected monitor. You have three choices: You can try to describe the object of interest. You can move the mouse pointer there and jiggle it. Your last resort is to walk over to the screen and point with your finger. If you watch football or pool on television, you know that sports commentators have solved this with an expensive piece of hardware called a Telestrator. For about $2,000, you can pick up one of these items yourself, but thanks to this issue's utility, you won't have to.

I do plenty of teaching and presenting in my work, so I created WinPointer, a software-only solution to this problem for Windows users. Activate the program with a hotkey, and it lets you draw on top of any window. If you are a presenter, WinPointer should make your job a little easier. If you are a Microsoft Visual Basic programmer, the code will demonstrate techniques in three areas: systemwide hotkeys, screen captures, and .INI file management.

You can download all the files necessary to run WinPointer from PC MagNet or you can obtain them by mail. For details, see the sidebar "Guide to Our Utilities & How to Get Them." If your system has the Microsoft Visual Basic 3.0 runtime library VBRUN300.DLL, you can simply download WPNTR.EXE from Library 2 (PCMag Utilities) of the Utilities/Tips Forum on PC MagNet. Otherwise, you will also need to download VBRUN300.DLL (VBRUN3.ZIP), which can be found in Library 15 (Windows & OS/2 Utils) of the Utilities/Tips Forum. Complete source code for WinPointer is in the file WPNTR.ZIP.

To install WinPointer on a system that already contains VBRUN300.DLL, simply copy WPNTR.EXE into the directory of your choice and add it to a Program Manager group. If you don't have the Visual Basic runtime engine, you will also need to copy VBRUN300.DLL to your system directory. Now you are ready to go!

USING WINPOINTER When you first launch WinPointer, it is minimized and ready for drawing. Hit Ctrl-C from anywhere within Windows and you will see the cursor change to a large arrow pointing straight up. This indicates you are in draw mode. You draw on the screen by holding down the left mouse button and moving the mouse, just as you would in a drawing package. You can draw anywhere on the desktop; the result might look something like Figure 1. Press the Esc key when you are finished drawing, and you will be returned to "live" mode.

WinPointer also has a keyboard interface for those working on a laptop with a trackball. For those users, underlining or drawing is much easier with the keyboard than with the mouse. When using WinPointer's keyboard interface, you can move the cursor 5 pixels in any direction with the arrow keys. To draw using the keyboard, hold down the left mouse button or the Shift key. For curved lines, however, you'll find the mouse much easier to use; the keyboard was never meant for art.

CONFIGURING WINPOINTER To configure WinPointer, double-click on the minimized application icon to view the configuration screen (Figure 2). First determine which key you want to use as a hotkey for entering draw mode. Selection of the hotkey works just as it does in the Windows Macro Recorder. To select the primary key, press the key or select it from the drop-down list. One-character keys can also be typed directly into the list box.

To select the shift state of the hotkey, simply click on the appropriate check boxes. For example, if you select F1 from the drop-down list and check the boxes labeled Ctrl and Alt, your activation key combination will be Ctrl-Alt-F1. You can click a check box that has focus by pressing the Spacebar. Your selections take effect immediately, so you can test the hotkey right away.

Note that the hotkey is not "swallowed" by WinPointer; it will be passed to the underlying program when you go back to live mode. Be sure you don't choose a hotkey that has meaning to the underlying application, because that action will still be performed.

Next, you will want to define your line characteristics. At the top of the Line Draw box, there is a sample of the line you will create when in draw mode. You set the color by selecting from the color

Top 10 Utilities

Rank	Utility
1	**WINCMD** - *Command file interpreter*
2	**WCLIB** - *DLL for WINCMD*
3	**WTIME** - *Keeps PC clock accurate*
4	**FINDIR** - *IRQ line analysis*
5	**MONTOR** - *Monitors system resources*
6	**BAT2EX** - *Compiles batch files*
7	**INCTRL** - *Controls Windows installation*
8	**BUGS** - *Windows 3.1 screen saver*
9	**CONFIX** - *Issues commands at boot time*
10	**THINDI** - *Windows file analysis*

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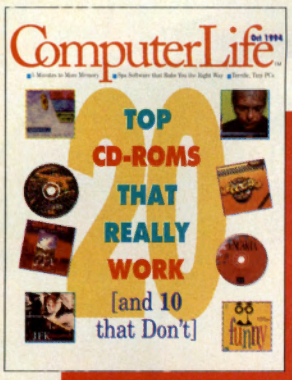













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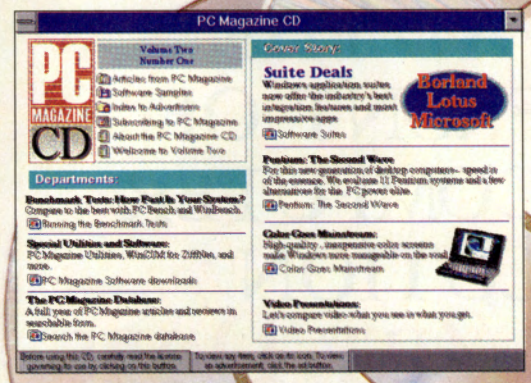

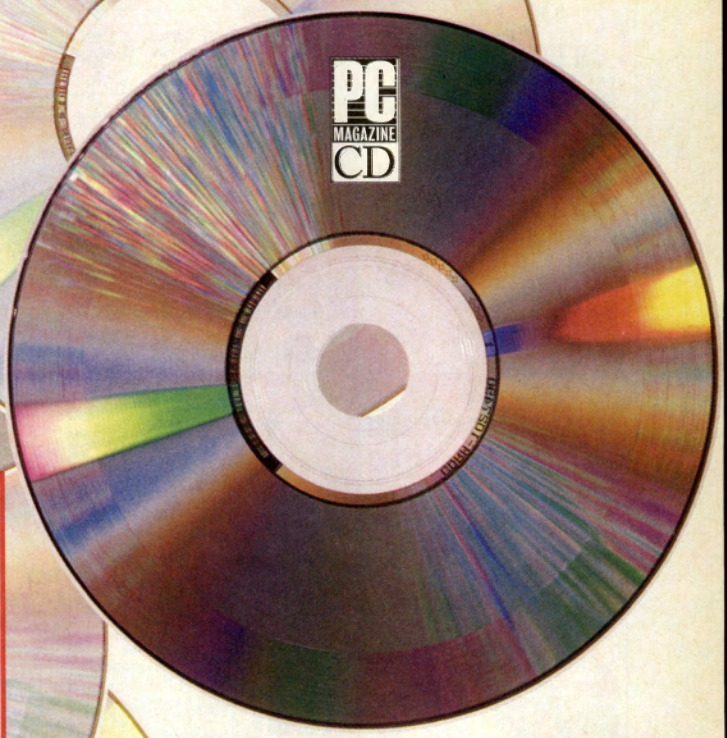

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```
0000  01 00 00 00 7C 00 00 00 64 00 00 00 64 00 00 00  ....|...d...d...
0010  C7 00 00 00 C7 00 00 00 A6 0E 00 00 A6 0E 00 00  ................
0020  27 1D 00 00 27 1D 00 00 20 45 4D 46 00 00 01 00  '...'... EMF....
0030  CC 02 00 00 03 00 00 00 01 00 00 00 12 00 00 00  ................
0040  58 00 00 00 00 00 00 00 80 02 00 00 E0 01 00 00  X...............
0050  F0 00 00 00 B4 00 00 00 45 00 4D 00 46 00 34 00  ........E.M.F.4.
0060  00 00 45 00 4D 00 46 00 20 00 44 00 65 00 6D 00  ..E.M.F. .D.e.m.
0070  6F 00 20 00 23 00 34 00 00 00 00 00 4D 00 00 00  o. .#.4.....M...
0080  3C 02 00 00 64 00 00 00 64 00 00 00 C7 00 00 00  <...d...d.......
0090  C7 00 00 00 64 00 00 00 64 00 00 00 64 00 00 00  ....d...d...d...
00A0  64 00 00 00 20 00 CC 00 00 00 00 00 00 00 00 00  d... ...........
00B0  00 00 80 3F 00 00 00 00 00 00 00 00 00 00 80 3F  ...?...........?
00C0  00 00 00 00 00 00 00 00 FF FF FF 00 00 00 00 00  ................
00D0  6C 00 00 00 68 00 00 00 D4 00 00 00 68 01 00 00  l...h.......h...
00E0  24 00 00 00 12 00 00 00 28 00 00 00 24 00 00 00  $.......(...$...
00F0  12 00 00 00 01 00 04 00 00 00 00 00 68 01 00 00  ............h...
0100  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0110  00 00 00 00 00 00 00 00 80 00 00 00 00 80 80 00  ................
0120  80 00 00 00 80 00 80 00 80 80 00 00 80 80 80 00  ................
0130  C0 C0 C0 00 00 00 FF 00 00 FF 00 00 00 FF FF 00  ................
0140  FF 00 00 00 FF 00 FF 00 FF FF 00 00 FF FF FF 00  ................
0150  88 88 88 88 88 88 88 88 88 88 88 88 88 88 88 88  ................
0160  88 88 00 00 88 88 88 88 88 88 88 88 88 88 88 88  ................
0170  88 88 88 88 88 88 00 00 88 88 88 88 88 88 88 88  ................
0180  88 88 88 88 88 88 88 88 88 88 00 00 88 88 88 88  ................
0190  88 88 88 88 88 88 88 88 88 88 88 88 88 88 00 00  ................
01A0  88 88 88 88 88 88 88 88 88 88 88 88 88 88 88 88  ................
01B0  88 88 00 00 88 88 88 88 88 88 88 88 88 88 88 88  ................
01C0  88 88 88 88 88 88 00 00 88 88 88 88 88 88 88 88  ................
01D0  88 88 88 88 88 88 88 88 88 88 00 00 88 87 77 77  ..............ww
01E0  77 77 77 77 88 88 88 88 87 77 77 77 88 88 00 00  wwww.....www....
01F0  88 00 00 00 00 00 00 07 88 88 88 88 00 00 00 07  ................
0200  88 88 00 00 88 0F FF FF FF FF FF 07 88 88 88 88  ................
0210  0F FF FF 07 88 88 00 00 88 00 00 00 00 00 00 08  ................
0220  88 88 88 88 00 00 00 00 88 88 88 00 00 88 88 88  ................
0230  88 88 88 88 88 88 88 88 88 88 88 88 88 88 00 00  ................
0240  88 88 88 88 88 88 88 88 88 88 88 88 88 88 88 88  ................
0250  88 88 00 00 88 88 88 88 88 88 88 88 88 88 88 88  ................
0260  88 88 88 88 88 88 00 00 88 88 88 88 88 88 88 88  ................
0270  88 88 88 88 88 88 88 88 88 88 00 00 88 88 88 88  ................
0280  88 88 88 88 88 88 88 88 88 88 88 88 88 88 00 00  ................
0290  88 88 88 88 88 88 88 88 88 88 88 88 88 88 88 88  ................
02A0  88 88 00 00 88 88 88 88 88 88 88 88 88 88 88 88  ................
02B0  88 88 88 88 88 88 00 00 0E 00 00 00 14 00 00 00  ................
02C0  00 00 00 00 10 00 00 00 14 00 00 00               ............
```

Figure 7: **This is a hexadecimal dump of the EMF4.EMF file created by the EMF4 program.**

METAFILES AND BITMAPS Let's try something a little more complex now—drawing a bitmap in a metafile device context. This is shown in EMF4 (Figure 5). For convenience, EMF4 loads a system bitmap indicated by the constant OEM_CLOSE. On a standard VGA, this bitmap is 36 pixels wide and 18 pixels high with 16 colors. The bitmapped image contains two close boxes side by side—the one used for the system menu of normal windows and a smaller one used for some other windows (for example, child windows in a multiple document interface).

The customary way of displaying a bitmap in a device context is to create a memory device context compatible with the destination device context (in this case, that's the metafile device context). You use CreateCompatibleDC for this. Then you select the bitmap into that memory device context using SelectObject and call BitBlt or StretchBlt from the memory-source device context to the destination device context. When you're finished, you delete both the memory device context and the bitmap.

You'll note that EMF4 also calls GetObject to determine the size of the bitmap. This is necessary for the SelectObject call. As you can see in Figure 6, the program displays the bitmap from the metafile just fine. At first, the storage of this code in a metafile seems like a real challenge for GDI: No function leading up to the StretchBlt call involves the metafile device context at all. So let's see how it's done by taking a look at EMF4.EMF, which is shown in Figure 7.

This metafile contains just three records—a header, a 0x4D (or EMR_STRETCHBLT) record that is 0x023C bytes long, and an end-of-file record. I haven't deciphered what each and every field of this metafile record means. That's a job I leave for you. But I will point out the crucial key to understanding how GDI can translate the series of function calls in EMF4.C to a single metafile record.

GDI converted the original device-dependent bitmap to a device-independent bitmap (DIB). The entire DIB is stored in this record, which accounts for its size. I suspect that when it comes time to play the metafile and display the bitmap, GDI actually uses the StretchDIBits function rather than StretchBlt. Or GDI could convert the DIB back to a device-dependent bitmap using CreateDIBitmap and then use a memory device context and StretchBlt for displaying the metafile.

The EMR_STRETCHBLT record begins at offset 0x007C in the metafile. The DIB starts at offset 0x00E8 in the metafile and continues to the end of the record at 0x02B8. The DIB begins with a 40-byte structure of type BITMAPINFOHEADER that is followed by a 64-byte color table consisting of 16 structures of type RGBQUAD at offset 0x0110. This table is followed by 18 rows of pixels at offset 0x0150, beginning with the bottom row (as is common with DIBs). Because this is a 16-color DIB, each row requires 4 bits per pixel, so the 36-pixel width of the image requires 20 bytes per row (rounding up to the next highest multiple of 4). A value of 0 is black, 7 is dark gray, 8 is light gray, and F is white.

I'm not sure whether I would have figured out that the EMR_STRETCHBLT record includes an entire embedded DIB had I not looked at so many DIB hex dumps in the past. The patterns of data found in 16-color DIBs kind of jumped out at me when I looked at EMF4.EMF. The hard part of decoding this metafile record involves the wealth (or waste) of data preceding the DIB—much more than seems necessary to display the bitmapped image.

Unless you're writing a metafile disassembler—a program that converts a metafile into C code that reproduces all the GDI function calls encoded therein—you don't really have to know what each and every bit and byte means. That's why I haven't taken the time to figure it all out. In my next column, I'll show you how to get access to individual metafile records without digging into the actual file. □

```
/*--------------------------------------
   EMF4.C -- Enhanced Metafile Demo #4
             (c) Charles Petzold, 1994
  --------------------------------------*/

#define OEMRESOURCE
#include <windows.h>

LRESULT CALLBACK WndProc (HWND, UINT, WPARAM, LPARAM) ;

int WINAPI WinMain (HINSTANCE hInstance, HINSTANCE hPrevInstance,
                    LPSTR lpszCmdLine, int nCmdShow)
     {
     static char szAppName[] = "EMF4" ;
     HWND        hwnd ;
     MSG         msg ;
     WNDCLASS    wndclass ;

     wndclass.style         = CS_HREDRAW | CS_VREDRAW ;
     wndclass.lpfnWndProc   = WndProc ;
     wndclass.cbClsExtra    = 0 ;
     wndclass.cbWndExtra    = 0 ;
     wndclass.hInstance     = hInstance ;
     wndclass.hIcon         = LoadIcon (NULL, IDI_APPLICATION) ;
     wndclass.hCursor       = LoadCursor (NULL, IDC_ARROW) ;
     wndclass.hbrBackground = GetStockObject (WHITE_BRUSH) ;
     wndclass.lpszMenuName  = NULL ;
     wndclass.lpszClassName = szAppName ;

     RegisterClass (&wndclass) ;

     hwnd = CreateWindow (szAppName, "Enhanced Metafile Demo #4",
                          WS_OVERLAPPEDWINDOW,
                          CW_USEDEFAULT, CW_USEDEFAULT,
                          CW_USEDEFAULT, CW_USEDEFAULT,
                          NULL, NULL, hInstance, NULL) ;

     ShowWindow (hwnd, nCmdShow) ;
     UpdateWindow (hwnd) ;

     while (GetMessage (&msg, NULL, 0, 0))
          {
          TranslateMessage (&msg) ;
          DispatchMessage (&msg) ;
          }
     return msg.wParam ;
     }

LRESULT CALLBACK WndProc (HWND hwnd, UINT message, WPARAM wParam, LPARAM
lParam)
     {
     BITMAP        bm ;
     HBITMAP       hbm ;
     HDC           hdc, hdcEMF, hdcMem ;
     HENHMETAFILE hemf ;
     PAINTSTRUCT   ps ;
     RECT          rect ;

     switch (message)
          {
          case WM_CREATE:
               hdcEMF = CreateEnhMetaFile (NULL, "emf4.emf", NULL,
                                           "EMF4\0EMF Demo #4\0") ;

               hbm = LoadBitmap (NULL, MAKEINTRESOURCE (OBM_CLOSE)) ;

               GetObject (hbm, sizeof (BITMAP), &bm) ;

               hdcMem = CreateCompatibleDC (hdcEMF) ;

               SelectObject (hdcMem, hbm) ;

               StretchBlt (hdcEMF, 100, 100, 100, 100,
                           hdcMem,   0,   0, bm.bmWidth, bm.bmHeight,
                           SRCCOPY) ;

               DeleteDC (hdcMem) ;

               DeleteObject (hbm) ;

               hemf = CloseEnhMetaFile (hdcEMF) ;

               DeleteEnhMetaFile (hemf) ;
               return 0 ;

          case WM_PAINT:
               hdc = BeginPaint (hwnd, &ps) ;

               GetClientRect (hwnd, &rect) ;

               rect.left   =     rect.right  / 4 ;
               rect.right  = 3 * rect.right  / 4 ;
               rect.top    =     rect.bottom / 4 ;
               rect.bottom = 3 * rect.bottom / 4 ;

               hemf = GetEnhMetaFile ("emf4.emf") ;

               PlayEnhMetaFile (hdc, hemf, &rect) ;

               DeleteEnhMetaFile (hemf) ;

               EndPaint (hwnd, &ps) ;
               return 0 ;

          case WM_DESTROY:
               PostQuitMessage (0) ;
               return 0 ;
          }
     return DefWindowProc (hwnd, message, wParam, lParam) ;
     }
```

***Figure 5:* EMF4.C shows how to display a bitmap from a metafile.**

That's the array passed to the last parameter of ExtCreatePen, and the value of the second-to-last parameter is 6.

In the metafile, the three fields describing the LOGBRUSH structure will be followed by a 4-byte field of 6, followed by six 4-byte fields with the numbers 7, 8, 9, 10, 11, and 12. The entire record is increased by 24 bytes, so the record size becomes 0x4C (or 76) bytes.

The next 12-byte field in EMF3.EMF is another SelectObject call indicating the second object—the pen. The next five records are the same as EMF2.EMF: a record type of 0x2B (EMR_RECTANGLE) and two sets of 0x1B (EMR_MOVETOEX) and 0x36 (EMR_LINETO). These drawing functions are followed by two sets of 12-byte records of types 0x25 (EMR_SELECTOBJECT) and 0x28 (EMR_DELETEOBJECT). The select-object records have parameters of 0x80000007 and 0x80000000. A set high bit indicates a stock object—in this case, 0x07 (BLACK_PEN) and 0x00 (WHITE_BRUSH).

The delete-object calls have parameters of 2 and 1 for the 2 nondefault objects used in the metafile. Although the DeleteObject function does not require a device-context handle as the first parameter, GDI apparently keeps track of objects used in the metafile that are deleted by the program.

Finally, the metafile concludes with a 0x0E record, which is EMF_EOF (end of file).

To sum up, whenever a nondefault GDI object is first selected into a metafile device context, GDI encodes a record indicating the object-creation function (in this case, EMR_CREATEBRUSHINDIRECT and EMR_EXTCREATEPEN). Each object will have a unique number beginning with 1, indicated by the third field of the record. This record will be followed by an EMR_SELECTOBJECT record referencing that number. Each subsequent time an object is selected into the metafile device context (without being deleted in the interim), only an EMR_SELECTOBJECT record is required.

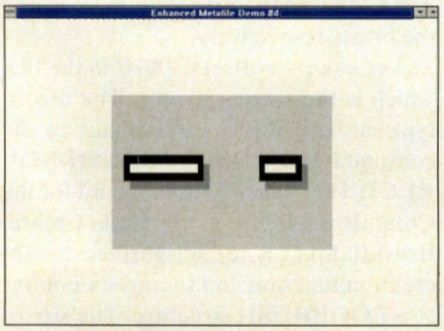

***Figure 6:* This bitmap is drawn from a metafile created by the EMF4 program.**

record in EMF3.EMF is 0x7C (or 124) bytes, and the fields of this record are defined by the ENHMETAHEADER structure, shown in Figure 1 followed by a description string.

You may want to compare this metafile with EMF2.EMF, shown in the last Environments column. The first difference you'll see in the header section of EMF3.EMF is the rclBounds field. EMF2.EMF indicated that the image was bound between coordinates (0x64,0x64) and (0xC7,0xC7). In EMF3.EMF, it's (0x60,0x60) and (0xCC,0xCC). This reflects the use of wider pen. The rclFrame field (indicating the size of the image in units of 0.01 millimeters) is also affected.



Figure 3: **This image is drawn from a metafile created by the EMF3 program using a nondefault pen and brush.**

While the nBytes field (located at offset 0x0030) of EMF2.EMF indicated the metafile was 0xE8 bytes, EMF3.EMF is 0x017C bytes. The EMF2.EMF metafile contained 7 records (the header, 5 GDI function calls, and the end-of-file record), but EMF3.EMF has 15. As we'll see, the extra 8 records are for 2 object-creation functions, 4 calls to SelectObject, and 2 DeleteObject calls.

The nHandles field (at offset 0x0038 in the file) indicates the number of handles to GDI objects. This is always one more than the number of nondefault objects used by the metafile. (The way that the *Microsoft Win32 Programmer's Reference* specifies this is "index zero in this [enhanced-metafile handle] table is reserved.") The field is 1 in EMF2.EMF and 3 in EMF3.EMF, indicating the pen and the brush, respectively.

Let's skip to offset 0x007C in the file, which is the second record. The record type is 0x27, which corresponds to the constant EMR_CREATEBRUSHINDIRECT. This is the metafile record for the CreateBrushIndirect function. CreateBrushIndirect is the all-purpose brush-creation function and requires a pointer to a LOGBRUSH structure. The size of the record is 0x18 (or 24) bytes.

Each nonstock GDI object selected into the metafile device context is assigned a number that begins with 1. This is indicated by the next 4-byte word in this record, at offset 0x0084 in the metafile. The following three 4-byte fields in this record correspond to the three fields of the LOGBRUSH structure: 0x00000000 (the lbStyle field of BS_SOLID), 0x00FF0000 (the lbColor field), and 0x00000000 (the lbHatch field).

At offset 0x009C in EMF3.EMF is the next record, which has a record type of 0x25—or EMR_SELECTOBJECT, the metafile record for the SelectObject call. The record is 0x0C (or 12) bytes long. The next field is the number 0x01, indicating that it's selecting the first GDI object, which is the logical brush.

The next record, at offset 0x00A0, has a record type of 0x5F, or EMR_EXTCREATEPEN. The record is 0x34 (or 52) bytes. The next 4-byte field is 0x02, which means this is the second nonstock GDI object used in the metafile.

Earlier, I mentioned exploring parts of Windows that are not adequately documented. I won't pretend that I know why the next four fields of the EMR_EXTCREATEPEN record repeat the record size, interspersed with 0 fields, but there they are: 0x34, 0x00, 0x34, and 0x00. I have to shrug my shoulders here. The next field is 0x010000, which is the pen style of PS_SOLID (0x000000) combined with PS_GEOMETRIC (0x010000). The width of 5 units is next, followed by the three fields of the logical-brush structure used in the ExtCreatePen function, followed by a field of 0.

As you may recall from my column where I described the ExtCreatePen function ("Extended Pen Creation Under Windows NT," January 25, 1994), you can create a custom pen style (PS_USERSTYLE) with various lengths of dashes and spaces. You use the last two parameters of the ExtCreatePen function for doing this. The last parameter is a pointer to an array of integers for the dash and space lengths, and the second-to-last parameter is the number of elements in this array.

If you take advantage of this feature, the EMR_EXTCREATEPEN record will be longer than 52 bytes, and this will be reflected not only in the second field of the record but in the repeated size fields. Following the three fields that describe the LOGBRUSH structure is a field that will not be 0 (as it is in EMF3.EMF) but will indicate the number of dashes and spaces. This is followed by that many fields for the dash and space lengths. For example, suppose you want a custom style where the first dash length is 7 units, the first space length is 8, then a dash of 9, a space of 10, a dash of 11, and a space of 12.

```
0000  01 00 00 00 7C 00 00 00 60 00 00 00 60 00 00 00  ....|...`...`...
0010  CC 00 00 00 CC 00 00 00 10 0E 00 00 10 0E 00 00  ................
0020  E2 1D 00 00 E2 1D 00 00 20 45 4D 46 00 00 01 00  ........ EMF....
0030  7C 01 00 00 0F 00 00 00 03 00 00 00 12 00 00 00  |...............
0040  58 00 00 00 00 00 00 00 80 02 00 00 E0 01 00 00  X...............
0050  F0 00 00 00 B4 00 00 00 45 00 4D 00 46 00 33 00  ........E.M.F.3.
0060  00 00 45 00 4D 00 46 00 20 00 44 00 65 00 6D 00  ..E.M.F. .D.e.m.
0070  6F 00 20 00 23 00 33 00 00 00 00 00 27 00 00 00  o. .#.3.....'...
0080  18 00 00 00 01 00 00 00 00 00 00 00 00 00 FF 00  ................
0090  00 00 00 00 25 00 00 00 0C 00 00 00 01 00 00 00  ....%...........
00A0  5F 00 00 00 34 00 00 00 02 00 00 00 34 00 00 00  _...4.......4...
00B0  00 00 00 00 34 00 00 00 00 00 00 00 00 00 01 00  ....4...........
00C0  05 00 00 00 00 00 00 00 FF 00 00 00 00 00 00 00  ................
00D0  00 00 00 00 25 00 00 00 0C 00 00 00 02 00 00 00  ....%...........
00E0  2B 00 00 00 18 00 00 00 64 00 00 00 64 00 00 00  +.......d...d...
00F0  C8 00 00 00 C8 00 00 00 1B 00 00 00 10 00 00 00  ................
0100  64 00 00 00 64 00 00 00 36 00 00 00 10 00 00 00  d...d...6.......
0110  C8 00 00 00 C8 00 00 00 1B 00 00 00 10 00 00 00  ................
0120  C8 00 00 00 64 00 00 00 36 00 00 00 10 00 00 00  ....d...6.......
0130  64 00 00 00 C8 00 00 00 25 00 00 00 0C 00 00 00  d.......%.......
0140  07 00 00 80 28 00 00 00 0C 00 00 00 02 00 00 00  ....(...........
0150  25 00 00 00 0C 00 00 00 00 00 00 00 80 28 00 00  %...........(...
0160  0C 00 00 00 01 00 00 00 0E 00 00 00 14 00 00 00  ................
0170  00 00 00 00 10 00 00 00 14 00 00 00              ............
```

Figure 4: **This is a hex dump of EMF3.EMF, a disk-based metafile created by the EMF3 program.**

```
/*--------------------------------------
   EMF3.C -- Enhanced Metafile Demo #3
             (c) Charles Petzold, 1994
  --------------------------------------*/

#include <windows.h>

LRESULT CALLBACK WndProc (HWND, UINT, WPARAM, LPARAM) ;

int WINAPI WinMain (HINSTANCE hInstance, HINSTANCE hPrevInstance,
                    LPSTR lpszCmdLine, int nCmdShow)
     {
     static char szAppName[] = "EMF3" ;
     HWND        hwnd ;
     MSG         msg ;
     WNDCLASS    wndclass ;

     wndclass.style         = CS_HREDRAW | CS_VREDRAW ;
     wndclass.lpfnWndProc   = WndProc ;
     wndclass.cbClsExtra    = 0 ;
     wndclass.cbWndExtra    = 0 ;
     wndclass.hInstance     = hInstance ;
     wndclass.hIcon         = LoadIcon (NULL, IDI_APPLICATION) ;
     wndclass.hCursor       = LoadCursor (NULL, IDC_ARROW) ;
     wndclass.hbrBackground = GetStockObject (WHITE_BRUSH) ;
     wndclass.lpszMenuName  = NULL ;
     wndclass.lpszClassName = szAppName ;

     RegisterClass (&wndclass) ;

     hwnd = CreateWindow (szAppName, "Enhanced Metafile Demo #3",
                          WS_OVERLAPPEDWINDOW,
                          CW_USEDEFAULT, CW_USEDEFAULT,
                          CW_USEDEFAULT, CW_USEDEFAULT,
                          NULL, NULL, hInstance, NULL) ;

     ShowWindow (hwnd, nCmdShow) ;
     UpdateWindow (hwnd) ;

     while (GetMessage (&msg, NULL, 0, 0))
          {
          TranslateMessage (&msg) ;
          DispatchMessage (&msg) ;
          }
     return msg.wParam ;
     }

LRESULT CALLBACK WndProc (HWND hwnd, UINT message, WPARAM wParam, LPARAM
lParam)
     {
     LOGBRUSH     lb ;
     HDC          hdc, hdcEMF ;
     HENHMETAFILE hemf ;
     PAINTSTRUCT  ps ;
     RECT         rect ;

     switch (message)
          {
          case WM_CREATE:
               hdcEMF = CreateEnhMetaFile (NULL, "emf3.emf", NULL,
                                           "EMF3\0EMF Demo #3\0") ;

               SelectObject (hdcEMF,
                    CreateSolidBrush (RGB (0, 0, 255))) ;

               lb.lbStyle = BS_SOLID ;
               lb.lbColor = RGB (255, 0, 0) ;
               lb.lbHatch = 0 ;

               SelectObject (hdcEMF,
                  ExtCreatePen (PS_SOLID | PS_GEOMETRIC, 5, &lb, 0,
NULL)) ;

               Rectangle (hdcEMF, 100, 100, 201, 201) ;

               MoveToEx  (hdcEMF, 100, 100, NULL) ;
               LineTo    (hdcEMF, 200, 200) ;

               MoveToEx  (hdcEMF, 200, 100, NULL) ;
               LineTo    (hdcEMF, 100, 200) ;

               DeleteObject (
                    SelectObject (hdcEMF,
                         GetStockObject (BLACK_PEN))) ;

               DeleteObject (
                    SelectObject (hdcEMF,
                         GetStockObject (WHITE_BRUSH))) ;

               hemf = CloseEnhMetaFile (hdcEMF) ;

               DeleteEnhMetaFile (hemf) ;
               return 0 ;

          case WM_PAINT:
               hdc = BeginPaint (hwnd, &ps) ;

               GetClientRect (hwnd, &rect) ;

               rect.left   =     rect.right  / 4 ;
               rect.right  = 3 * rect.right  / 4 ;
               rect.top    =     rect.bottom / 4 ;
               rect.bottom = 3 * rect.bottom / 4 ;

               hemf = GetEnhMetaFile ("emf3.emf") ;

               PlayEnhMetaFile (hdc, hemf, &rect) ;

               DeleteEnhMetaFile (hemf) ;

               EndPaint (hwnd, &ps) ;
               return 0 ;

          case WM_DESTROY:
               PostQuitMessage (0) ;
               return 0 ;
          }
     return DefWindowProc (hwnd, message, wParam, lParam) ;
     }
```

Figure 2: **EMF3.C shows how to create a disk-based metafile using nondefault objects.**

ing the WM_CREATE message. The CreateEnhMetaFile function returns a handle to a device context (a very special device context, because it refers to the metafile), and subsequent GDI function calls referring to that device context are stored within the metafile. Many GDI functions require a device-context handle as the first parameter, so if this handle refers to a metafile, GDI knows that the function call is to be stored in that metafile rather than rendered on the screen or printed.

There are, however, exceptions to this rule. Some GDI functions do not refer to a particular device context at all. One important category of these GDI functions are those that create graphics objects, including pens and brushes. Although the definitions of logical pens and brushes are stored in memory maintained by GDI, these abstract definitions are not associated with any particular device context when they're created.

EMF3 calls both the CreateSolidBrush and ExtCreatePen functions. These functions do not require a device-context handle, which implies that GDI will not store these calls in the metafile. This is true. When these functions are called by themselves, GDI simply creates the graphics drawing object without affecting the metafile at all. When a program calls SelectObject to select a GDI object into the metafile device context, however, GDI encodes both an object-creation function (essentially derived from the internal GDI data used to stored the object) and a SelectObject call in the metafile. Let's see how this works.

OBJECT STORAGE The EMF3 program creates a disk-based metafile called EMF3.EMF during the WM_CREATE message and displays it during the WM_PAINT message. A hexadecimal dump of this metafile is shown in Figure 4.

As I discussed in my last column, a Windows NT enhanced metafile contains a series of records. Each record begins with a 4-byte field indicating the record type. These correspond to constants defined in WINGDI.H that begin with the prefix EMR (enhanced metafile record). The second 4-byte field is the total size of the record. This is followed by one or more fields (which are very often 4 bytes in length) depending on the record type.

The metafile always begins with record type 0x01, which corresponds to the constant EMR_HEADER. The size of this

Environments

BY CHARLES PETZOLD

NT Metafiles and GDI Objects

Programming for Windows has always involved much investigation and experimentation. You get basic knowledge about the function calls, data structures, and messages from Microsoft's technical documentation, and you get information about how to put this all together from various Windows programming tutorials. But there are times when pure research is required. Being a Windows programmer is sometimes like being a natural scientist. Think about Windows as a complex biological system. It's helpful to know what's going on inside.

Back in the early days, autopsies were important to understanding the internal workings of animals and humans. Doing an autopsy on an operating system is most closely equivalent to disassembly (although fortunately it doesn't require death). Another approach is viewing the system as a black box: Something goes in and something comes out. It's not important to understand what actually happens inside to predict consequences of various actions.

In my early days of exploring Windows, I took the disassembly approach, particularly in investigating the Graphics Device Interface (GDI). Although disassembly is difficult and time-consuming, it proved to be very helpful in understanding various parts of Windows functionality—for example, how nonrectangular icons are possible when icons are bitmaps and bitmaps are always rectangular. (Seeing how this was done was my first "eureka" experience in disassembling Windows code.)

Nowadays, I tend to rely much more on the black-box approach to understanding Windows. I use the technical documentation as my basic anatomy textbook, and when that fails, I apply certain stimuli (in the form of function calls) to Windows and observe what happens. I think this is a safer approach and makes us less prone to writing code that breaks under future Windows revisions.

I think it's fairly obvious that the technical documentation to Windows can never be as precise as we'd like. Perhaps the only documentation adequately representing reality is the full Windows source code. But judging from what I hear from those few people outside Microsoft who have seen parts of the Windows source code, it's not a pretty sight.

WINDOWS NT METAFILE MYSTERIES I'm often reminded of these issues when I explore the internal structure of the Windows NT enhanced metafile. As I've discussed in the past couple of columns, metafiles describe a graphical image using records that are binary-encoded representations of graphics drawing commands. The Windows NT metafile contains a header record not found in the metafiles created by the DOS-based versions of Windows. This header (described by the ENHMETAHEADER structure defined in WINGDI.H) provides essential information concerning the size of the metafile image, among some other things. For reference, this structure is shown in Figure 1. As far as I've been able to determine, however, the rest of the Windows NT enhanced-metafile format remains largely undocumented.

In my last column, we encoded simple GDI drawing commands for rectangles and lines in a metafile. This was fairly straightforward. Basically, GDI simply stores a 32-bit code indicating the function call and the function parameters (eliminating the device-context handle, which is meaningless in a metafile) in binary form.

In this column, we're going to look at more complex encodings of GDI commands in metafiles. I won't pretend that I've been able to figure out what every byte in an enhanced metafile means, nor do I think it's necessary: Some of this information has very little practical use. Yet I believe that becoming familiar with the internals of metafiles lets us better understand how they work, and that's what we're aiming for here.

CREATING OBJECTS The EMF3 program shown in Figure 2 is very similar to the EMF2 program presented in my last column. The program draws a rectangle and two lines connecting the opposite corners of the rectangle. The difference between EMF2 and EMF3 is that EMF3 creates a nondefault pen and brush for drawing the rectangle and lines.

If you have the Microsoft Windows NT Software Development Kit installed, you can create EMF3.EXE by running

```
NMAKE EMF3.MAK
```

on a command line. Or you can download the source code and executable from PC MagNet's Programming Forum, archived as EMF3.ZIP. When you run EMF3 under Windows NT, you'll see the image shown in Figure 3.

As you can see from the source code, EMF3 creates an enhanced metafile dur-

```
typedef struct tagENHMETAHEADER
     {
     DWORD   iType ;
     DWORD   nSize ;
     RECTL   rclBounds ;
     RECTL   rclFrame ;
     DWORD   dSignature ;
     DWORD   nVersion ;
     DWORD   nBytes ;
     DWORD   nRecords ;
     WORD    nHandles ;
     WORD    sReserved ;
     DWORD   nDescription ;
     DWORD   offDescription ;
     DWORD   nPalEntries ;
     SIZEL   szlDevice ;
     SIZEL   szlMillimeters ;
     }
ENHMETAHEADER ;
```

Figure 1: **The ENHMETAHEADER structure describes the header section of an enhanced metafile.**

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Highlights of NetBench 3.0

- New Disk Mix technology accurately mimics network file usage of real applications.
- New technologies better reflect the way servers are used (but make comparisons of NetBench 3.0 results with those of previous NetBench versions meaningless).
- Windows-based controller lets testers easily control and monitor large numbers of client PCs.
- Customizable test scripts and mixes help create long tests that can run overnight if necessary.
- Results can now appear in Microsoft Excel spreadsheets for easy analysis and graphing.
- Numerous bug fixes and minor enhancements improve accuracy and ease of use.
- An extensible framework will allow the addition of other types of clients in the future, such as Windows- and Macintosh-based systems.
- Completely rewritten documentation gives detailed instructions for using NetBench 3.0 and understanding its tests and results.

network, and dedicated clients.

To get scores worth publishing, we follow strict testing methodologies. You should do the same to get the most valid and reproducible NetBench results. The manual, provided on-line with the product, outlines key testing concerns.

Measuring what you really want to measure is near the top of the list of testing concerns. Suppose you put 60 client PCs on a single Ethernet and run NetBench's Disk Mix test with no think time. You'll find that any server you test will appear to run at about the same speed. Why? Because all you've really measured is the speed of a heavily congested Ethernet; no server had a chance to strut its stuff. (In our labs, we use four Ethernet cards in the server and monitor network usage to make sure the network doesn't become bottlenecked.)

The test-bed is another crucial factor in a server's NetBench results. If you use underpowered clients, the server will generate less total throughput than if it had more powerful clients handing it more work. Also keep in mind that because the test-bed affects your results, you can't reasonably compare scores obtained from different test-beds. That's why we used standard ZD Labs test-beds for all our testing.

Similarly, comparing systems tested in different ways can be misleading. You'll glean little information about the true relative speeds of two servers if only one was tested with data compression active, for instance. On the other hand, it's fine to gauge the effect of compression on a single server by comparing the machine's scores with and without compression.

Hold the right variables constant and the new NetBench can go far beyond the usual server-in-a-vacuum performance studies. One preliminary study we ran, for example, tested the effects of client-side caching under Microsoft Windows for Workgroups (WfWG) on a Windows NT Advanced Server 3.1. Each of our 32 clients ran NetBench in a DOS box under WfWG. For a small number of clients, a 1MB cache on each client produced about a 20 percent performance increase over those that did not use caching at all. As the client count increased, however, the cache's performance advantage became negligible. Upping the client-side cache to 4MB produced only about an additional 5 percent performance boost for small numbers of clients, yet the 25 percent total improvement didn't significantly decrease as the client count increased. This data is only preliminary, but it hints at the range of studies that NetBench's Disk Mix technology allows us—and you—to conduct. □

BILL CATCHINGS AND MARK L. VAN NAME ARE CODIRECTORS OF THE ZIFF-DAVIS BENCHMARK OPERATION, A RESEARCH AND DEVELOPMENT DIVISION OF ZIFF-DAVIS THAT WORKS WITH *PC MAGAZINE* AND OTHER ZIFF-DAVIS PUBLICATIONS TO PRODUCE PUBLICLY AVAILABLE BENCHMARK TESTS.

that offer server-side disk compression.

Users tend to perform related file operations—opening, editing, and saving a document stored on the server, for instance. The Disk Mix test, therefore, does the same. Each NetBench client executes one of several groups of related file operations, pauses for a tester-specified period of time (the *think time*), then moves on to the next group of operations. (The think time option can help make the Disk Mix test behave more like real applications, and it prevents the clients from unduly saturating the network with data.) Every client executes the groups of operations in a pseudorandom order, preventing the server from performing only one kind of task at a time.

A client will repeat the complete Disk Mix test sequence for a tester-specified amount of time and then divide the total number of data bytes moved by the elapsed time to arrive at the throughput in bytes per second. NetBench sums the throughputs reported by all the clients to get the final Disk Mix score for the server.

NetBench still includes a test for measuring the speed of adapters, but we've rebuilt it with the Disk Mix engine and fixed a few bugs. During the test, participating clients read a tester-defined number of bytes from a shared server file to stress the server's adapter as much as possible.

EXECUTING A NETBENCH 3.0 TEST

NetBench 3.0 requires the same components as ServerBench 1.1: the file server to be tested, several DOS client PCs that will form the test-bed, and one additional controller PC. NetBench runs no programs on the server; instead, it uses the server as a repository for the files the clients need to run their tests and communicate with each other. The new NetBench, like its predecessors, performs the Disk Mix and all file-operation tests from the clients via the standard DOS INT 21h interface. As long as your server can provide standard DOS file services (typically through some sort of redirector on the clients), you can run NetBench 3.0.

Each PC in the test-bed runs a copy of the DOS-based NetBench client software, which executes the tests and reports the results. (NetBench currently supports only DOS PC clients, but future releases may support Windows and Macintosh clients.)

Setting up a client test-bed and network takes some effort. To get meaningful results, you need enough clients to stress the file server properly. Our tests used a standard ZD Labs test-bed of 60 PCs. You can stress many servers with a smaller number of clients by reducing the think time and spreading the clients across multiple network segments.

The Windows-based NetBench controller application (shown in Figure 1) lets you tell the clients what tests to perform and then collects and reports the results. The controller runs on its own node and communicates with the clients through files on the server that hold data or act as *semaphores* (flags that indicate what to do next). By placing specific files on the server, the controller signals clients to start or stop work, and the clients in turn inform the controller about their current statuses.

Server tests can run a long time, and we test a huge number of products, so NetBench has strong support for automated and customized testing. The controller software lets you create test mixes that run exactly the tests you designate with the parameters of your choice. For each mix, you can specify how long the tests will run before the timer starts and after it stops—quantities known as *ramp-up* and *ramp-down* time. (A server doesn't become fully loaded or fully unloaded instantly, so you need ramp times to ensure that the benchmark tests actually measure the server's steady-state operation.) You can then create a test suite that will automatically run any series of mixes with any number of client PCs.

NetBench 3.0 comes with two standard suites, NBDM_28.TST and NBDM_60.TST (used in the "Data on Demand" story in this issue). Each runs the Disk Mix test using a 2-second think time between groups of operations and measures 10 minutes of steady-state operation between 30 seconds of ramp-up and ramp-down time. NBDM_28 starts with 1 client, increases that to 4, then adds 4 at a time, up to a total of 28 clients. NBDM_60 starts at 32 clients and works its way up to 60 in similar fashion.

When testing is complete, the controller automatically gathers the results (each client puts its own result into a file on the server). At your option, the controller will also place the results into an .XLS (Microsoft Excel spreadsheet) file that contains both the overall throughput and details such as the throughput of each client.

MAKE SURE YOU TEST PROPERLY

Tools often bring rules, and NetBench is no exception. First, *never* run NetBench on a production network or a production server. NetBench stresses servers and networks alike, and other users on the network would not at all appreciate the benchmark tests' presence. You must have a dedicated test server, a dedicated

How to Get a Copy of NetBench 3.0

You can download all Ziff-Davis benchmark tests, including NetBench 3.0, from ZiffNet. NetBench 3.0 is available in the PC MagNet service (GO PCMAGNET) and in the Ziff-Davis Benchmark Operation Forum (GO ZDBENCH).

If you don't have a modem, you can request a free copy of NetBench 3.0 by sending a postcard to:

Ziff-Davis Benchmark Operation
One Copley Pkwy., #510
Morrisville, NC 27560
Attn.: Distribution Coordinator

Or you can fax your request to 919-380-2879. Make sure to include your name, address, phone number, and a request for NetBench 3.0. Please allow four to six weeks for delivery. If you'd like faster delivery, enclose your Federal Express account number and Federal Express shipping instructions.

NetBench 3.0, like all our benchmark tests, includes an on-line copy of its manual. Printed copies of each manual are also available for $10 within the United States or $20 outside the U.S. (both prices include postage).

Lab Notes

BY BILL CATCHINGS AND MARK L. VAN NAME

Testing Your Data Depository with NetBench 3.0

This issue's server roundup ("Data on Demand") introduces NetBench 3.0, a set of new benchmark tests for measuring file-server performance. NetBench 3.0 is the result of more than a year of research and development by PC Magazine Labs and the Ziff-Davis Benchmark Operation (ZDBOp). These new tests, along with the recently released ServerBench 1.1, give *PC Magazine* unparalleled ability to measure, analyze, and predict server performance.

A BREAK WITH THE PAST Technology changes, and benchmark tests must change with it. The way people and applications use file servers continues to evolve. To reflect that evolution, the latest NetBench is a measure of file-server performance completely different from previous versions. Thus, NetBench 3.0 scores are in *no way* comparable with those of its predecessors. Period. There's no secret formula or magic transformation that can turn NetBench 2.1 results into NetBench 3.0 results.

GETTING TO KNOW NETBENCH 3.0 The fundamentals of NetBench 3.0 operation are easy to grasp. You install and run the NetBench client software on several PCs connected (via one or more network segments) to the server that will be tested. The PCs pummel the server with file requests and then report how it handled the beating. An additional PC running the NetBench controller program collects the results. We'll get to the details of test setup and execution shortly, but that's the basic concept.

NetBench 3.0 is market centered (as many of our benchmark tests are). Its primary measure, the new Disk Mix test, gauges the speed of file servers as they're used in real-world situations. To do so, the test performs network file manipulations that occur when a typical user carries out common tasks in the leading applications. NetBench doesn't actually run those applications; instead, it employs special routines that accurately mimic the file operations of real applications doing real work.

When the Disk Mix test is completed, NetBench 3.0 reports the number of bytes of disk data the server was able to move per second. This figure, a system-level score, describes the file throughput of the server as a whole; anything that affects a server's performance will influence its Disk Mix score. For example, add more RAM to a NetWare server and its Disk Mix score—like its general performance—will probably improve.

OPENING THE HOOD NetBench 3.0 takes advantage of several techniques we pioneered in earlier benchmark tests. For example, we first introduced the technology used in the Disk Mix test last year in PC Bench 8.0 and WinBench 4.0.

Earlier versions of NetBench basically kept a file server's disks busy with an assortment of sequential and random reads and writes. NetBench 3.0 still offers these tests, which provide a useful measure of basic server performance, but the Disk Mix test now stands at center stage.

Writing a program that performs file operations isn't hard, but making sure that it accurately reflects file operations of real applications is. Before writing the Disk Mix test, we employed custom-built profiling software to monitor and log all network file service requests made by clients running real applications. We monitored leading DOS packages such as cc:Mail, dBASE IV, Harvard Graphics, Lotus 1-2-3, Microsoft C, Microsoft Mail, Paradox, WordPerfect, and even simple COMMAND.COM file routines (directory commands, for example). Using other proprietary tools, we turned the profiles into a script to be played back by NetBench clients when they test a server.

Because of our extensive applications profiling, the Disk Mix test uses the disk subsystem as the original applications did, performing the same broad assortment of file operations. It creates, deletes, opens, and closes files, reads from files, writes to files, and traverses directories. It moves data in chunks of different sizes, intersperses writes and reads, and even uses both private and shared server directories and files to simulate private and shared file accesses.

The files the Disk Mix test uses mirror the real world, too. They include data in both text and binary form, which makes the Disk Mix test suitable for measuring the performance of operating systems

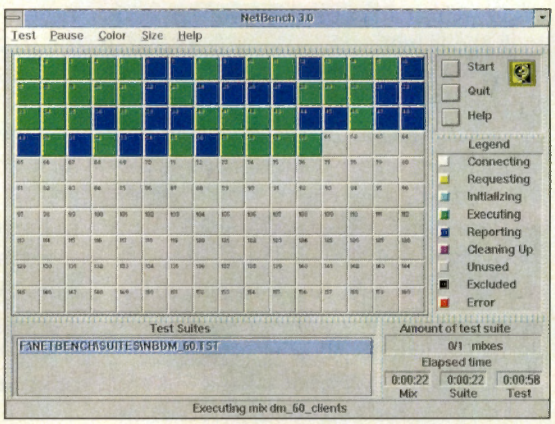

Figure 1: **The Windows-based controller screen of NetBench 3.0 lets testers easily monitor and control the potentially large number of clients working with the tested server.**

that should follow the RCX command.

The functional difference between the programs is found in the lines

```
CMP    BYTE PTR [1000],61
JB     0126
CMP    BYTE PTR [1000],7A
JA     0126
AND    BYTE PTR [1000],DF
```

STRIP.COM examined the byte value read from standard input and looped back if it was a form-feed, skipping the step that wrote the value to standard output. CASE.COM treats characters a little differently.

If the value is less than 61h or greater than 7Ah, CASE.COM branches to 0126h, which corresponds to the statement `MOV AH,40`. If the value falls between 61h and 7Ah (in other words, if the byte read from the file represents a lowercase ASCII character), CASE.COM capitalizes the character with an AND instruction that zeros bit 5. This is a convenient and often-used case conversion technique that exploits the fact that the only difference between uppercase and lowercase ASCII letters is the setting of bit 5. The upshot of all this is that if the character was a lowercase letter, it gets converted to uppercase before it is output. Otherwise, it gets written to standard output unmodified.

CASE.COM exploits the fact that the only difference between uppercase and lowercase ASCII letters is the setting of bit 5.

CONVERTING TABS TO SPACES While we're at it, let's look at one more example program: a filter that converts tab characters to spaces. This one is a little more complicated, but the basic principles still hold. We'll assume that tab stops are set every eight spaces, so any tab character (ASCII 09h) encountered in the input file should be converted to one to eight spaces in the output file, depending on where in the line the tab character occurred.

Figure 3 shows what it looks like in code. The general approach here is to initialize the DI register with the tab length (8) and work through the file byte by byte. When a nontab character is encountered, DI is decremented by 1, and the character is written to the output file. Whenever DI reaches 0 or a line-feed or form-feed character is encountered, DI is reinitialized to 8. At any given time, DI holds the number of spaces required to get us to the next tab stop. When we do encounter a tab character, we simply output the4

number of spaces in DI and then go on to the next character.

We won't take the time to analyze EXPAND.COM line by line; the comments should be enough. Do note, however, that you can change the tab length by changing the value loaded into DI at the beginning of the program. If you prefer tab stops spaced four characters apart, for example, change the line to read

```
MOV DI,4
```

Be aware that if you want tab stops spaced greater than eight characters apart, you'll have to increase the number of space characters (ASCII 20h) accompanying the DB (define byte) command by a commensurate amount. You'll also have to increase the number following the RCX command to make room for the extra data at the end of the file.

You can download all DEBUG scripts and binary files mentioned in this column from PC MagNet's Utilities/Tips Forum, archived as FILTER.ZIP.

FURTHER READING Filters are handy tools for manipulating ASCII text files. If you're interested in learning more about filter programs and the mechanisms that underlie input and output redirection, read the chapter entitled "Writing MS-DOS Filters" in Ray Duncan's *Advanced MS-DOS*. The book is showing its age, having not been updated since DOS 4.0, but it's still an invaluable reference work. You won't find any discussions of present-day versions of DOS, but the information that is there is still just as good—and just as accurate—as it was the day the book was written. □

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```
A 100
;Start
MOV   DI,08                    ;DI=Tab length (8 spaces)
;NoResetDI
MOV   AH,3F                    ;Read a byte and terminate
MOV   BX,00                    ;if the end of file is reached
MOV   CX,01                    ;or an input error occurs
MOV   DX,1000
INT   21
JB    014D                     ;Jump to End
OR    AX,AX
JZ    014D                     ;Jump to End
CMP   BYTE PTR [1000],09       ;Jump to IsTab
JZ    013F                     ;if it's a tab character
MOV   AH,40                    ;Otherwise write the character
MOV   BX,01                    ;to standard output
MOV   CX,01
MOV   DX,1000
INT   21
JB    014D                     ;Jump to End if the carry flag is set
CMP   BYTE PTR [1000],0A       ;Jump to Start and reset DI if this
JZ    0100                     ;is the end of the current line
CMP   BYTE PTR [1000],0C       ;or the end of the page
JZ    0100
DEC   DI                       ;Otherwise just decrement DI
JNZ   0103                     ;Jump to NoResetDI if DI is not 0
JMP   0100                     ;Jump to Start if DI is 0
;IsTab
MOV   AH,40                    ;Come here when a tab is found,
MOV   BX,01                    ;and write the number of spaces
MOV   CX,DI                    ;in DI to standard output
MOV   DX,014E
INT   21
JNB   0100                     ;Jump to start and reset DI
;End
RET                            ;End the program
DB    20,20,20,20,20,20,20,20

N EXPAND.COM
RCX
56
W
Q
```

Figure 3: **This DEBUG script creates EXPAND.COM, a filter that converts all of the tab characters in a file to space characters.**

dard output, whose file handle is 1. Standard output is, of course, the file or device name to the right of the output redirection operator if output redirection was used on the line that invoked the command. In the absence of an output redirection operator, standard output goes to the screen. If the carry flag is clear after the `INT 21` instruction, indicating that the write succeeded, execution loops back to the beginning of the program. If an error occurs and the carry flag returns set to 1 (again, an unlikely event), execution falls through to the terminating RET instruction.

There you have it: a complete filter program that strips form-feeds. Once the .COM file is created, the command

```
STRIP <ANYFILE.TXT >ANYFILE.OUT
```

strips the form-feeds from ANYFILE.TXT and stores the results in ANYFILE.OUT. To automate deleting the original file and renaming the output file to the original filename and to display a message if the user doesn't type a filename after the command, you could use a batch file like this one:

```
@ECHO OFF
IF "%1"=="" GOTO SYNTAX
STRIP <%1 >TMP@@@.$$$
DEL %1
REN TMP@@@.$$$ %1
GOTO END
:SYNTAX
ECHO Syntax: %0 filename
:END
```

If the batch file is named BSTRIP.BAT, then the command

```
BSTRIP ANYFILE.TXT
```

will strip the form-feeds from ANYFILE.TXT. Be careful when you use this batch file. If an I/O error prevents STRIP from processing the file properly, you'll lose the original file, because the batch file deletes it. STRIP.COM doesn't return an exit code indicating success or failure, so the batch file doesn't know any better. We could remedy this by adding a few more lines of code to the filter, but at this point we should keep things as simple as possible. Also, STRIP.COM should be used only on plain ASCII text files and not on word processing files. STRIP.COM will likely destroy a word processing file stored in non-ASCII format.

The good news is that many of the programming instructions are boilerplate and that it's easy to modify STRIP to create filters of your own. Give a man a fish and he'll eat for a day, but teach him to fish and he'll eat for life. With a little luck, you'll soon be designing filters custom fit to your needs. The next example demonstrates how.

CONVERTING CASE Suppose you wanted to modify the STRIP filter to convert lowercase characters (characters whose ASCII codes fall in the range 61h to 7Ah) to uppercase (characters with ASCII codes from 41h to 5Ah). How would you do it? The answer is shown in Figure 2.

The DEBUG script for CASE.COM differs only slightly from the script for STRIP.COM. The destinations of conditional jump instructions (JZ, JB, and so on) have been changed to reflect the changed locations of their targets, and the 24 following the RCX command near the end of the file has been changed to 30 to reflect the new .COM file length of 30h (48 decimal) bytes.

Determining jump addresses is one of the more painful parts of writing programs with DEBUG, because you don't know what address to enter if the target statement comes later in the program. One workaround is to supply dummy addresses as you enter a program, and then to go back after all the instructions are entered and substitute the correct addresses.

Determining what value to enter following the RCX command is easier. After you enter the final instruction in the program and hit Enter once more to enter a blank line, note the offset address DEBUG displays to the left of the blank line. Subtract 100h and that's the number

```
A 100
;Start
MOV   AH,3F                 ;Read one byte from
MOV   BX,00                 ;standard input
MOV   CX,01
MOV   DX,1000
INT   21
JB    0123                  ;Jump to End if read failed
OR    AX,AX                 ;Jump to End if end of file has
JZ    0123                  ;been reached
CMP   BYTE PTR [1000],0C    ;Is the byte a form feed?
JZ    0100                  ;Yes, then jump to Start
MOV   AH,40                 ;Otherwise, write the byte to
MOV   BX,01                 ;standard output
INT   21
JNB   0100                  ;Jump to Start if write succeeded
;End
RET                         ;End the program

N STRIP.COM
RCX
24
W
Q
```

Figure 1: **When entered into DOS's DEBUG program, these commands create STRIP.COM, a DOS filter that strips all of the form-feed characters from any text file.**

decimal—or base 16—numbers) from the base of the segment in which the program will be loaded. This location is standard—indeed, mandatory—for .COM files.

After this come the assembly-language instructions that make up the program. The instructions

```
MOV AH,3F
MOV BX,00
MOV CX,01
MOV DX,1000
INT 21
```

use DOS function 3Fh (Read File or Device) to input 1 byte of data (the 1 we put in CX indicates this) from the file or device whose handle (passed in register BX) is 0. DOS assigns file handle 0 to the virtual device known as *standard input.* By default, characters read from standard input come from the keyboard. When input is redirected, standard-input data comes from the file or device whose name appears to the right of the input redirection operator. The byte that is read from the file is copied to offset 1000h of the segment in which the .COM file is loaded, as specified in the DX register.

In the unlikely event that the read operation fails (in which case the INT 21 call will return with the carry flag set to 1), the instruction

```
JB 0123
```

branches to the RET instruction that ends the program (offset 0123h). The JB command is synonymous with JC (which stands for jump on carry). I use the JB here because that's how DEBUG presents it if you use the D command to disassemble the code. If you'd like, you can substitute JC for JB anywhere that it occurs.

Next come the instructions

```
OR AX,AX
JZ 0123
```

which terminate the program by branching to the RET instruction when there are no more bytes to be read. Function 3Fh returns the number of bytes that were read in register AX. If AX is 0, then we've reached the end of the file. (ORing a register with itself is a common way to check for a zero value. If the register holds a 0, then the Z flag will be set to 1, and a JZ instruction will cause a branch.) Without these instructions, the program would loop forever, not recognizing when it had reached the end of the file.

Now that STRIP has a byte of data from the file in memory location [1000h], it must decide what—if anything—to do with it. The instructions

```
CMP   BYTE PTR [1000],0C
JZ    0100
```

jump back to the beginning of the program (the `MOV AH,3F` instruction at offset 100h) if the byte is a form-feed—ASCII 0Ch. Otherwise, execution falls through to the instructions

```
MOV AH,40
MOV BX,01
INT 21
JNB 0100
```

which call on DOS function 40h (Write to File or Device) to write the byte to stan-

```
A 100
;Start
MOV   AH,3F                 ;Read a byte and terminate
MOV   BX,00                 ;if the end of file is reached
MOV   CX,01                 ;or an input error occurs
MOV   DX,1000
INT   21
JB    012F                  ;Jump to End
OR    AX,AX
JZ    012F                  ;Jump to End
CMP   BYTE PTR [1000],61    ;Jump to NoChange if the byte's value
JB    0126                  ;is less than 61h (a)
CMP   BYTE PTR [1000],7A    ;Jump to NoChange if the byte's value
JA    0126                  ;is greater than 7Ah (z)
AND   BYTE PTR [1000],DF    ;Otherwise convert to uppercase
;NoChange
MOV   AH,40                 ;Write the byte to the output
MOV   BX,01                 ;file and loop back for more
INT   21
JNB   0100                  ;Jump to Start
;End
RET                         ;End the program

N CASE.COM
RCX
30
W
Q
```

Figure 2: **This DEBUG script creates CASE.COM, a filter that converts all of the lowercase characters in a text file to uppercase characters.**

Tutor

BY JEFF PROSISE

Writing Filters with DEBUG

Even after a dozen or so years of working with PCs, I'm still amazed at the wonderful, even magical things that can be accomplished with DEBUG scripts. DEBUG is one of the most powerful tools ever shipped with DOS. Among its many talents is the ability to compile assembly language program listings into .COM files that run just like the .COM and .EXE files provided with DOS. A four-part series in last year's Tutor column (September 28, October 12, October 26, and November 9, 1993) introduced elementary assembly-language programming concepts and taught how to use this capability of DEBUG to create simple programs.

Many of the questions that come to this column month in and month out are easily solved with short DEBUG scripts. Take this letter, for example, which arrived recently from a reader in Chapel Hill, North Carolina:

Many of the shareware documentation files and other text files that I print on my computer have embedded form-feeds (ASCII 12 characters) that do little more than consume paper when they are printed. This seems a waste when a page has just two or three lines of printed text, especially when these pages occur throughout the document. Is it possible to delete these form-feeds so that printing will be continuous?

There are manual ways to eliminate unwanted form-feeds, of course. You could load the text files into a text editor or word processor and edit out the form-feeds. But doing manual work on a computer defeats the purpose of having the computer. Computers are supposed to do our work for us.

The form-feed problem is easily solved with DEBUG. To demonstrate, we'll use DEBUG to build a special type of program called a DOS filter that strips the form-feeds from a file. Then we'll generalize the approach so that you can modify the filter to perform other useful tasks, such as converting tabs to spaces and replacing lowercase characters with uppercase.

FILTERS 101 A filter is a program that has no input and output capabilities of its own but instead relies on input and output redirection from the command line. DOS includes three filter programs: FIND, MORE, and SORT. (FIND will work as a standalone program too, so it's actually two programs in one.) To sort a text file named PHONES.TXT, you can't type SORT PHONES.TXT. Instead, you must type

```
SORT <PHONES.TXT >PHONES.OUT
```

The less-than sign is an input redirection operator that tells SORT to take its input from the file named PHONES.TXT. The greater-than sign is an output redirection operator that tells SORT to write the results—the sorted output—to PHONES.OUT. It's important to give different names to the input and output files because of the limited size of SORT's input buffer. If the files are more than a few kilobytes in length, and you give the output the same name as the input, SORT will corrupt the file. If you want the sorted output to be named PHONES.TXT, simply delete the original file after SORT is finished and rename PHONES.OUT to PHONES.TXT. Users of DOS 5.0 and later can employ the command `MOVE PHONES.OUT PHONES.TXT` to replace the original with the sorted file.

Filters may be a little awkward to use, but they're simple to write. DOS manages all the file I/O itself (via the redirection operators), so the filter is responsible for little more than manipulating the I/O stream. When it comes to stripping form-feeds, a filter's task is simple. In pseudocode, the algorithm goes like this:

```
input a character
if (character = form-feed)
   do nothing
else
   output the character
```

In plain English, this translates to reading a byte from the input stream and either ignoring it (if it's a form-feed) or writing it to the output stream (if it's not a form-feed). Repeating this procedure for every byte in the input file produces a separate version of the file with form-feeds removed.

Even though they have no I/O capabilities of their own, DEBUG filters can solve many problems by manipulating file data.

Figure 1 lists the assembly language DEBUG script for STRIP.COM, a filter program that uses this algorithm to strip form-feeds from text files. To enter the script, type DEBUG at the DOS prompt to start DEBUG. Then enter the lines as shown. (You do not need to type in the comments—the text preceded by semicolons.) You must include the blank line between the RET instruction and N STRIP.COM command; otherwise, DEBUG will think N STRIP.COM is an assembly-language instruction and will reject it since no such instruction exists. A preferable alternative to typing directly into DEBUG is to enter the commands in a text file called STRIP.SCR and process the whole file at once by typing `DEBUG <STRIP.SCR`.

The first instruction in the script, `A 100`, tells DEBUG to begin assembling code at offset 100h (that is, 100 in hexa-

Clipboard by pressing Ctrl-V. After the Properties dialog box is closed, the icon label line will wrap at the chosen position. By using the line-feed character between words, the label is nicely wrapped with each word centered on its own line.

Per Balschmidt
Espergaerde, Denmark

▶**PC MAGAZINE:** Remember that to enable automatic wrapping of long icon titles, open the Desktop module in the Control Panel and mark the Wrap Title check box in the Icons pane. The Spacing spin button above the Wrap Title check box controls how close together icons will be. If you've been using nonwrapped titles, you may find you can now put the icons closer together. Note that Windows wraps titles only between words. If you have a long title with no spaces, it won't wrap.

Don't put more than one line-feed character into a title. Unless you've set the icon spacing quite high, a title on three lines or more will overwrite icons below it. Note also that the Program Manager doesn't recognize manually created multiline titles. If just the second line of such a title extends beyond the bottom of the group window, the Program Manager will not add scroll bars to the window.

The technique described here for getting a line-feed character into the Clipboard is a good one. But if you have Microsoft Visual Basic 3.0 installed on your system, you can make it even easier. Create a new project and eliminate all files from the project window except the main form. Set the form's WindowState field to 1-Minimized and give it an appropriate icon, perhaps one of the paper-clip icons from VB's icon collection. Now double-click on the form and put these three lines in its Load method:

```
Clipboard.Clear
Clipboard.SetText Chr$(10)
Unload Form1
```

That's it! Save the project, make it into an .EXE file, and quit VB. When you run the program, it will put a line-feed into the Clipboard and unload itself. If you prefer, you can download the program LF.EX from PC MagNet's Utilities/Tips Forum; note that LF.EXE requires VBRUN300-.DLL.□

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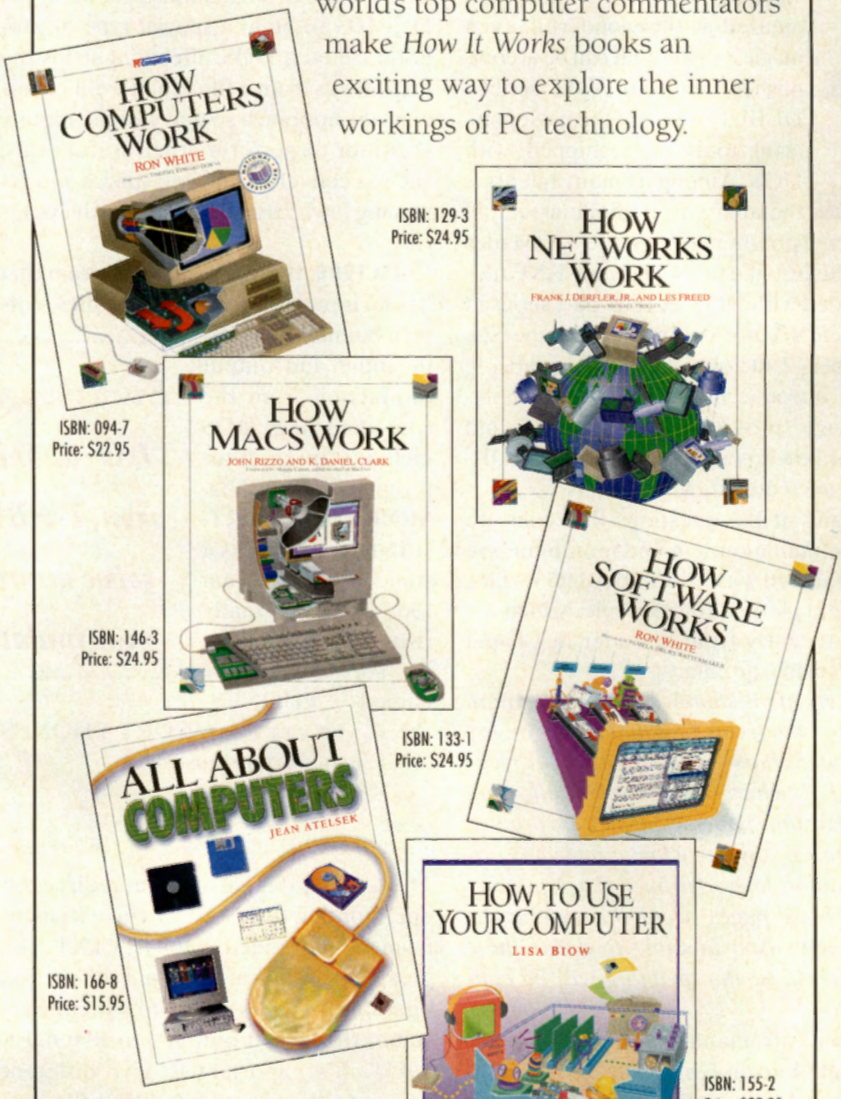

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```
@ECHO OFF
IF '%Quit%'=='YES' GOTO Done
IF NOT EXIST %1:\NUL GOTO Syntax
IF NOT '%2'=='' ECHO Starting round %2...
IF NOT '%2'=='' GOTO DoWipe
:: "degree" symbol in next line is ASCII character 248.
:: File extension is ASCII characters 243, 236, and 242.
IF NOT EXIST %1:\*.≤∞≥ GOTO GetReady
ECHO Files matching *.≤∞≥ exist in the directory %1:\
ECHO Delete or move these files before running %0.
GOTO Done

:GetReady
CALL WIPEDATA.BAT
ECHO Now overwriting data belonging to deleted files on drive %1:\.

:DoWipe
COPY WIPEDATA.DAT %1:\*.≤∞≥ > NUL
IF NOT '%2'=='' IF NOT EXIST %1:\*.≤∞≥ GOTO Quit
:StartLoop
COPY /B %1:\*.≤∞≥ + %1:\*.≤∞≥ %1:\√.≤∞≥ > NUL
IF NOT EXIST %1:\√.≤∞≥ GOTO DoneLoop
DEL %1:\*.≤∞≥
REN %1:\√.≤∞≥ *.≤∞≥
GOTO StartLoop
:DoneLoop
IF '%2'=='' GOTO Cleanup
DIR %1:\*.≤∞≥ | FIND "free"
REN %1:\*.≤∞≥ *%2.≤∞≥
GOTO Done

:CleanUp
ECHO Done overwriting empty space on drive %1:
DEL %1:\*.≤∞≥
DEL WIPEDATA.DAT
GOTO Done

:Syntax
ECHO SYNTAX: %0 d
ECHO   where d is the drive letter without colon
GOTO Done

:Quit
SET Quit=YES
:Done
```

Figure 1: **WIPEONCE.BAT overwrites all deleted file space on a disk by repeatedly doubling a 1K file. Note that WIPEONCE fails if used with a disk cache.**

```
@ECHO OFF
IF NOT EXIST %1:\NUL GOTO Syntax
:: "degree" symbol in next line is ASCII character 248.
:: File extension is ASCII characters 243, 236, and 242.
IF NOT EXIST %1:\*.≤∞≥ GOTO Ready
ECHO Files matching *.≤∞≥ exist in the directory %1:\
ECHO Delete or move these files before running %0.
GOTO Done

:==== Ready ========
ECHO Now overwriting data belonging to deleted files on drive %1:\.
CALL WIPEDATA.BAT
SET Quit=
FOR %%v IN (A B C D E F G H I J K L M N O P Q R S T U V W X Y Z) DO CALL WIPEONCE %1 %%v
SET Quit=
DEL WIPEDATA.DAT

ECHO Done overwriting empty space on drive %1:
::DEL %1:\*.≤∞≥
GOTO Done

:==== Syntax ======
ECHO SYNTAX: %0 d
ECHO   where d is the drive letter without colon
:==== Done ========
```

Figure 2: **WIPEDEL2.BAT calls WIPEONCE.BAT repeatedly to fill the target disk completely and to overwrite all deleted file space.**

WIPEDEL2.BAT calls WIPEONCE.BAT for as many rounds as necessary to fill the target drive completely. For each round, WIPEDEL2 passes one of the letters from A to Z as a second parameter to WIPEONCE.BAT. When WIPEONCE's %2 parameter is not empty, WIPEONCE.BAT behaves a little differently. It doesn't bother to create the filler file, since WIPEDEL2.BAT has done that. And rather than deleting the temporary file, it renames the file to include the letter passed as %2. If the initial attempt to copy the filler file to the target drive fails, the target drive is totally full. In that case, WIPEONCE.BAT sets the environment variable Quit to YES, which then short-circuits all remaining rounds.

```
:: WIPEDATA.BAT
:: DEBUG script creates a 1k file containing just the words
:: "No data here! ".  Feel free to change the words; use
:: any phrase in quotes.
ECHO F 100 L 400 "No data here! ">WIPEDATA.SCR
ECHO RCX>>WIPEDATA.SCR
ECHO 400>>WIPEDATA.SCR
ECHO NWIPEDATA.DAT>>WIPEDATA.SCR
ECHO W>>WIPEDATA.SCR
ECHO Q>>WIPEDATA.SCR
DEBUG < WIPEDATA.SCR > NUL
DEL WIPEDATA.SCR
```

Figure 3: **Both WIPEONCE.BAT and WIPEDEL2.BAT call this batch file to create a filler file that's exactly 1K in size.**

Don't use WIPEDEL2.BAT unless you *need* to, since it takes a lot longer than WIPEONCE.BAT. And thanks to the many readers who wrote in about the original WIPEDEL.BAT!

You can download the files mentioned here from PC MagNet's Utilities/Tips Forum, archived as WIPEDZ.ZIP.

Break Icon Label Lines Manually

The automatic line wrapping you can select from the Windows Control Panel wraps text lines under an icon when the program description is too long for one line. Sometimes you might want to divide even a short description, such as File Manager, into two lines, but Windows doesn't offer a manual line-feed option to do this. Of course, you can insert spaces until the line wraps automatically, but this is a clumsy procedure and doesn't let Windows center the text properly.

There's a much more convenient way to handle line wrapping manually. First, you need to prepare an ASCII text file containing the line-feed control character. In DOS's EDLIN text editor, the keystroke combination Ctrl-V followed by Shift-J will insert a line- feed. In *PC Magazine*'s utility TED, the keystroke combination is simply Ctrl-J. (You can't use the DOS editor EDIT.) Save the file in your Windows directory as LINEFEED.TXT.

Now start Notepad and load LINEFEED.TXT. Select the first character in the file (shown as a filled square) and press Ctrl-C to copy it to the Clipboard. In the Program Manager, select the icon whose title is to be wrapped and select Properties from the File menu. Place the cursor where you want the label to break and copy the line-feed character from the

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User-to-User

BY NEIL J. RUBENKING

Truly Overwriting Deleted Files

The purpose of WIPEDEL.BAT (July 1993) was to fill up a hard disk's unused file space, overwriting the disk space of deleted files. The idea was very useful, but the batch file did not always work. WIPEDEL first creates a 10-byte file, then repeatedly creates new files ten times as large until the drive is full. That's where the problem is: Suppose WIPEDEL creates a 10MB file, and you have only 99MB left on the hard disk. WIPEDEL will try to create a 100MB file, but since there's insufficient hard disk space, that file won't be created, and the remainder of the disk—99MB—won't be overwritten.

Using the original idea, I created a batch file that will fill all (or at least most) of a disk's space by going through five rounds of filling, with each round filling up most of the space left by the previous round.

Jason Lininger
Woodville, Texas

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WIPEDEL.BAT, presented in the July 1993 column, is unnecessarily complicated. For a simpler way to make sure no one can undelete your files, run the following batch file:

```
:START
COPY X+X XX
IF NOT EXIST XX GOTO DONE
DEL X
REN XX X
GOTO START
:DONE
```

How does it work? COPY concatenates file X with itself, creating file XX. This larger file is renamed to X after X is deleted. When all free space has been used, DOS gives the warning "Insufficient disk space" and will not create the file XX. If XX doesn't exist, the batch file exits the loop, jumping to the label :DONE. One final trick: Make file X contain the words "Nothing to find here!" After you run the batch file, anyone who looks at your hard disk will see only those words.

Petteri Jarvinen
Espoo, Finland

▶**PC MAGAZINE:** These two letters are representative of a large number of responses to WIPEDEL.BAT. Some readers complained that WIPEDEL worked too hard, others that it didn't do enough. WIPEDEL does indeed fail to overwrite small portions of the disk, because its files don't always fill complete clusters of disk space. Mr. Lininger worries that creating a 100MB file in 99MB of space will not overwrite the deleted file area.

In fact, as long as a disk cache is not running, WIPEDEL will succeed. COPY simply keeps copying clusters of information to the disk until there's no more space, at which point it deletes all references to the unfinished file. If a cache is active, though, the destination file is not written to disk if there's not enough space.

Based on the suggestions made by these two readers, I've rewritten WIPEDEL.BAT. For those who don't use a cache, WIPEONCE.BAT (Figure 1) should do the job. It addresses the problem of unfilled clusters and uses the doubling method suggested by Mr. Jarvinen. WIPEDEL2.BAT (Figure 2) calls WIPEONCE.BAT for as many rounds as necessary to fill the target disk completely with temporary files. Thus, even with a disk cache running, WIPEDEL2.BAT will overwrite all deleted file data.

To run WIPEONCE.BAT, simply pass it the letter (without a colon) of the drive whose file space you want to overwrite. WIPEONCE starts by calling WIPEDATA.BAT (Figure 3), which uses DEBUG to create a 1K filler file. The filler file contains the phrase "No data here! " repeated again and again. All hard disks and all modern floppy disks have a cluster size that's a power of 2 times 1K, so doubling this file repeatedly will always create files that use complete clusters of disk space.

Now WIPEONCE copies the filler file to the filename ° .≤∞≥ in the root directory of the target drive. It then enters a loop much like the one in Mr. Jarvinen's letter, repeatedly doubling the file's size. Eventually the disk space runs out and WIPEONCE can't double the file again, so it breaks out of the loop. It jumps to the label Cleanup, where it deletes the temporary files and reports its success.

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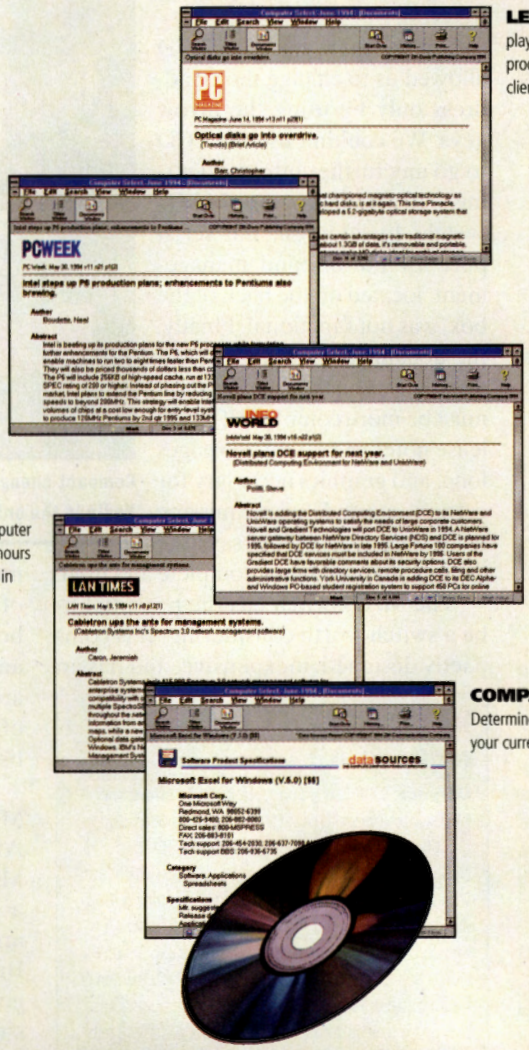

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	5:00 A.M.–7:00 P.M. M–F	8:00–8:00 M–F	8:30–5:00 M–F

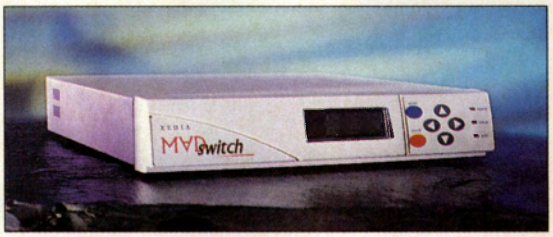
six 10BaseT ports. It is significantly more compact and less expensive than most other switches in this roundup, though it also provides nearly the smallest number of ports.

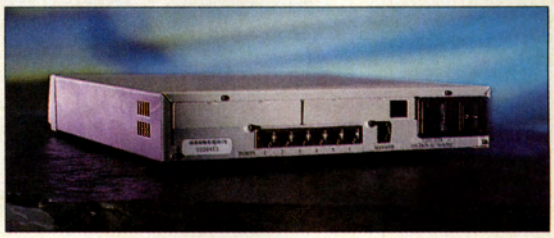
But its low price did not translate to good performance. More importantly, the MADswitch we tested was not a fully functioning switching hub. (When we raised concerns early into testing, Xedia assured us this was a shipping product. We were notified of a new unit for testing too late in the editorial process to retest.)

For one thing, the unit's LCD allowed us to change the IP address only by using the arrow keys. We couldn't use the LCD to go any further into configuring or managing the MADswitch. In addition, the serial port for out-of-band management, located on the back of the box, was not functional. Finally, the documentation was in beta format. The final documentation must be more complete: The release notes were only two pages long, and graphics necessary for getting started were missing from the guide. Xedia says the documentation is now complete and final.

The MADswitch has the potential to be a switch worth considering. It is compactly designed, inexpensive, and has an LCD. In addition to the LCD, LEDs on the front of the unit light up when you plug in the cable on the back. Although not yet in place when we tested, a 100-Mbps expansion slot is planned for inclusion. The MADswitch might support the 802.1D Spanning Tree Algorithm at some point, but such support was not present at testing time.

Xedia says the version of the MADswitch now shipping has a fully functioning LCD and support for the management port. The company plans to offer management capabilities through both an in-band management application and the LCD. When these two features are implemented, you will be able to shut off and partition ports as well as view statistics and packets received.





Compact enough to fit on your desk, the MADswitch from Xedia is the only switch in this roundup to provide an LCD.

One of the best things about Xedia's MADswitch is its simple, compact design. Although not rack-mountable, the MADswitch is small enough for the top of a desk. The LCD and the directional arrow buttons are large and easy to read. Buying this switch when it is complete will get you the basic, necessary elements—store-and-forward switching, connection ports, and an LCD.

The MADswitch has the potential to be a player in the switching market. It's inexpensive, and if Xedia can implement a high-speed expansion slot as well, the MADswitch could compete against the more expensive high-speed switching solutions. For this roundup, however, the MADswitch was not a completely functioning switch. □

FACT FILE

MADswitch

List price: $3,995; price per port, $665. **In short:** The MADswitch we were sent for testing was not a fully functioning unit. Xedia has assured us that it is a shipping product. Unfortunately, we received an updated version too late to retest. Low-priced and compact in design, the MADswitch could be a switch to watch if Xedia effectively implements a 100-Mbps expansion slot. Small enough to fit on your desk, the MADswitch is Xedia's attempt to simplify switching by designing an LCD and arrow buttons on the front of its switching hub. If Xedia implements the expansion slot and keeps the price low, the MADswitch could compete against the more expensive high-speed switching hub solutions.

Xedia Corp., 301 Ballardvale St., Wilmington, MA 01887; 800-989-3342, 508-658-7200; fax, 508-658-7204.

495 on reader service card

SUITABILITY TO TASK	
Plug-and-play	FAIR
Scalability	FAIR
Management	POOR

SUMMARY OF FEATURES

Switching Hubs

PC MAGAZINE EDITORS' CHOICE

Products listed in alphabetical order ■ = YES □ = NO	Alantec PowerHub Model 5006	Chipcom StarBridge Turbo Switch	Cisco Catalyst Workgroup Switch	Grand Junction FastSwitch 10/100	Kalpana EtherSwitch EPS-2015 RS	NBase NH203A On-the-Fly Ethernet Switch	Network Peripherals EIFO Client/Server Switching Hub
List price (tested configuration)	$30,450	$8,500	$11,595	$7,250	$8,500	$1,994	$7,495
Price per port	N/A	$1,063	$1,288	$268	$567	$499	$576
High-speed ports (100 Mbps or faster)	1 FDDI	None	1 FDDI	2 Fast Ethernet	None*	None	1 FDDI
General Features							
Cut-through packet switching	□	□	□	■	■	■	□
Store-and-forward packet switching	■	■	■	■	□	□	■
Stackable/Rack-mounted	■■	■■	■■	■■	■■	■■	■□
Port Configuration							
Number of 10BaseT ports	76	8	8	25	15	None	12
Number of 10Base2 ports	None	None	None	None	None	None	None
Number of 10BaseF ports	None	None	None	None	None	None	None
Number of AUI ports	None	None	None	1	1	4	None
Maximum MAC addresses per port	8,192	1,024	4,096	1	1,700	2,048	1,018
Maximum MAC addresses per unit	8,192	16,000	4,096	24	6,000	2,048	1,018
RAM packet buffer	1.5MB shared	512K shared	4MB shared	3MB shared	None	None	64K per port
High-Speed Port Configuration							
Supports 802.1D-compliant bridging (Spanning Tree Algorithm)	■	■	■	□	■	□	□
Filters packets	■	■	■	□	■	■	■
On MAC address	■	■	■	□	■	□	■
On protocol	■	■	■	□	□	□	□
Error checking (CRC)	■	■	■	■	□	□	■
Supports full-duplex Ethernet	□	■	□	□	■	■	□
Interswitching mechanism	Ethernet ports or FDDI module	Ethernet ports	Ethernet ports or expansion slot connection	Switching port to connect to other hubs	Multiple ports designated as EtherChannel	Ethernet port	High-speed FDDI port
Management							
LCD on front panel	□	□	■	□	□	□	□
Supports SNMP	■	■	■	■	■	□	■
Supports MIB II	■	■	■	■	■	□	■
Other MIBs supported	Bridge, Ethernet	Private	Bridge, Cisco Workgroup, Ethernet, FDDI, Interface	Private	Bridge, private	□	FDDI
Management port	■	■	■	■	■	□	■
Includes management software	■	□	■ (Unix only)	□	□	□	□
Supports third-party SNMP management software	■	□	■	■	■	□	■
Supports virtual LANs	■	■	■	□	■	□	□
Supports protocol-analyzer port	□	□	■	■	□	□	□
Technical Support							
Phone number	408-944-2337	800-228-6840	800-553-6387	510-252-0726	800-488-0775	818-773-0900	800-674-8855
Hours (eastern time)	24 hours, 7 days	8:30–8:00 M–F	24 hours, 7 days	11:00–9:00 M–F	9:00–9:00 M–F	11:00–9:30 M–F, Sun.	11:00–9:00 M–F

* The EtherSwitch's ports can be configured for EtherChannel operation and combined to make a high-speed connection.

N/A—Not applicable: The PowerHub has 76 Ethernet ports but provides 10 Mbps through 12 Ethernet collision planes; it also includes a 100-Mbps FDDI port and wiring hub capability.

and complete management. The SMC Elite supports not only Ethernet networks, but also Token-Ring and FDDI. The Elite Switching Hub offers you a lot of reliability with store-and-forward switching and support for the 802.1D Spanning Tree Algorithm, plus a unique multicast storm prevention capability.

SMC's DOS-based software, EliteView, runs on both PCs and Unix-based systems. It is priced from $995 to $2,950, depending on the platform. EliteView includes auto-discovery for inventorying of all devices that are IP-, SNMP-, or IPX-addressable, plus trap/event notification. It also includes source routing and filtering on destination addresses and ports. The software has a graphical interface and provides on-line help.

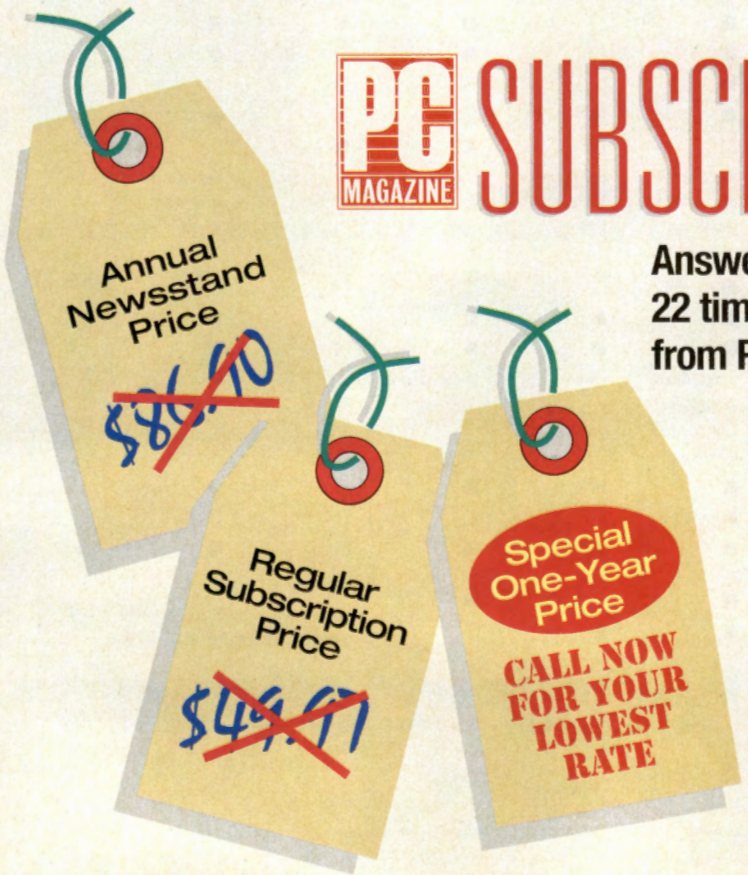
3Com's LANplex 6012 weighs in at 100 pounds (compare this with the PowerPipes' 18 pounds). Pricing on the LANplex line starts at $16,073 for a four-slot unit—but the larger the chassis, the more modules you can install. The LANplex is full of features, such as the unique Express-Switching function, which eliminates multicast messages. It is hot-swappable, has optional dual-redundant power supplies, and provides you with an LCD. It, too, comes with management software.

The LANplex gives you expansion with 11 free slots for 8 ports or FDDI modules. For reliability, the LANplex 6012 includes support for 802.1D Spanning Tree Algorithm. In addition to its full management system, its two-line, 20-character LCD panel can be used for configuring IP addresses and setting up parameters. The LANplex includes software for PC or Unix workstations that lets you filter on input or output for ports and fields and set multicast thresholds.

Chipcom's Galactica Network Switching Hub is also a chassis-based switch; it weighs in at 88 pounds and starts at $1,480 per port. The Galactica provides store-and-forward switching and support for the 802.1D Spanning Tree Algorithm; it also lacks IP routing. Although the Galactica has dual power supplies, it is not completely redundant. The Galactica's backplane can hold up to four modules, plus a system management module. Galactica's management software runs only on Unix workstations.

Á LA CARTE SWITCHING

Hybrid switches offer you expandability and flexibility—and a choice between the stackable workgroup models in the main roundup and the high-end chassis systems. If you want to consolidate your router and switch, a hybrid switch provides you with features and capabilities to do the job. □



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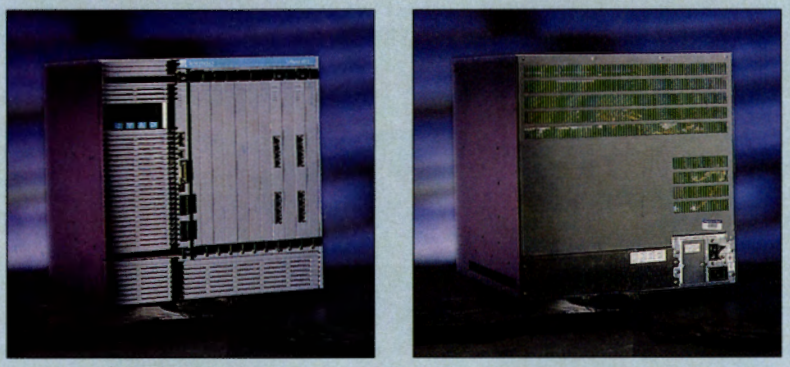
Switchin' Cousins

By Tim Crawford and Leslie Wygant

You may decide that you need more "room" in your network switch than is provided by those that we looked at in the main roundup. Yet you don't really need a high-end, enterprise, chassis-based hub either. Between those two classes of switch, you will find another group that offers some of the best aspects of both: good pricing, modularity, features, flexibility, and real scalability.

These "hybrid" switches are fully functional switching hubs with support for 100-Mbps or faster ports. They generally go one step further than the switches in the main roundup and use routing instead of bridging to deliver increased throughput. In fact, they can replace high-end routers at the center of collapsed-backbone networks.

Their modular design and high-speed connections deliver a lot of flexibility, so you also have a good route to ATM. The switches in the main roundup are better suited for smaller sites where extensive expandability and flexibility are not as critical. Chassis-based hubs are built for enterprise WANs.



3Com's 100-pound LANplex 6012 is larger than the products in this roundup, and it's packed with features. It is hot-swappable and has optional power supplies.

THE STORY ON COST

Costs vary greatly across these three product sets, mostly according to configuration. Basically, workgroup switches cost anywhere from about $2,000 (for four ports) to $8,500; with high-speed ports, they can run $8,000 to $9,500 (even $30,000 for something like Alantec's PowerHub, which has standard hub features as well). Hybrid switches can start at $7,500 or so and run to almost $60,000. Finally, enterprise chassis-based hubs start around $14,000 and can cost hundreds of thousands of dollars.

As you keep moving up the switching ladder, you continue to gain features, such as high-speed ports, 100-Mbps FDDI ports, more complete management, and expandable, modular designs.

THE ROUTING QUIZ

How can you tell if need a switch with routing capabilities? Ask yourself the following questions:

- Do you need a product that is expandable beyond a fixed number of ports?
- Do you need a product that is specialized and does only switching?
- Do you need a product that is designed to work as a collapsed backbone, replacing your existing backbone or routers?
- Do you need a product that will bridge the gap into future technologies, such as ATM?
- Do you need high-speed FDDI ports, either for server connections or links into backbones?
- Do you want dual, redundant power supplies?
- Do you want hot-swappable switching modules?
- Do you need IPX *and* IP protocol routing?

If you answered yes to two or more of these questions, consider a hybrid switch.

SWITCHING GYMNASTICS

This class of switches delivers flexibility and expandability. Typically, other switches may expand to a maximum of only 24 ports; these products go well over that. For example, 3Com Corp.'s LANplex 6012, part of its acquisition of Synernetics, expands to more than 88 switched ports in a single chassis.

Consider cost and logistics before you decide not to buy in to expandability. Right now you may need only 8 port connections to segment your workgroups. But you might need to expand to, say, 20 in the future. It's a matter of paying now for a hybrid switch with expandability or paying later to modify your network architecture. These hybrid switches also provide WAN connections, which are important if you plan to extend your network.

Hybrid switches don't skimp on management, either. Some provide extensive monitoring, analysis, and security capabilities. Other features you'll find with these units include routing; dual, redundant power supplies; hot-swappable modules; Token-Ring support; and support for multiple network topologies.

INTERMEDIATE SWITCHES

We looked at three hybrid switches: Standard Microsystem Corp.'s Elite Switching Hub ES/1, 3Com's LANplex 6012, and Chipcom Corp.'s Galactica.

The SMC Elite Switching Hub ES/1, priced at $13,250 for a five-slot chassis, offers scalability, flexibility,

Switch ASM9108-E module. The DragonSwitch is a $9,600 eight-port module that supports up to 8,000 MACaddress-es using shared memory. Although this results in one of the highest per-port prices of the solutions we checked, the DragonSwitch does feature integration with UB Networks' Virtual Network Architecture and the Access/One's PlusBus (which comes free with all DragonSwitch chassis). This allows for creation of secure virtual workgroups, even across multiple DragonSwitches. The DragonSwitch is manageable via UB Networks' NetDirector and SNMP.

Chipcom Corp.'s Galactica Network Switching Hub ($7,350, with two power supplies) offers several switch modules in both single-media and mixed-media versions. The single-media eight-port switch modules include the 10Base5 3000ET-55 at $10,000, the 10BaseT 3000ET-TT at $11,000, the 10Base2 3000ET22 at $11,600, and the 10BaseF 3000ET-FF at $12,100.

The mixed-media versions, which offer all possible combinations of four ports of one Ethernet medium and four of another, range in price from $10,500 to $11,800. Supporting 1,024 MAC addresses per port and manageable through SNMP, these solutions offer the best approach to network administrators working in mixed-media environments when switching is required across media types.

A significantly different approach stretches the meaning of chassis to include PCs. Matrox Electronics Systems offers the $3,200 NetSwitch/16, an ISA card for a PC that includes 16 switched Ethernet ports. This card can also be stacked in Matrox's own 20-slot chassis, the NetSwitch/256.

Supporting 1,024 MAC addresses across the board's 16 ports, the NetSwitch/16 uses only a PC for power. It is manageable through an optional SNMP MIB and HP OpenView. At an astoundingly reasonable $200 per switched port, the Matrox offers an extremely cost-effective solution for small networks.

MAXIMIZING INVESTMENTS

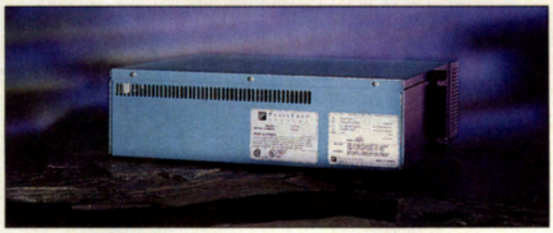
In many cases, the most difficult part of implementing switching is determining a migration path. A user may spend a lot of effort determining where to implement switching now and where to consider switching in the near future.

These chassis-based modular solutions are positioned to maximize the investment already made in networking infrastructure. After you've spent all that money on your chassis, it's nice to know you can selectively implement these solutions and adjust them when your needs change. □

ly a worthy solution for anyone looking to increase throughput on a network.

In addition to 16 10BaseT ports, the WaveSwitch has 2 expansion slots to give you both flexibility and expandability. Note that implementing them is an additional cost: PlainTree's proprietary WaveBus interface costs $1,825; the FDDI interface, which is an SAS (single attached station) port, is $3,890; and an FDDI SAS-to-DAS (dual attached station) upgrade module is $1,095. You can use the expansion slots either for 100-Mbps port connections or to expand the number of your 10-Mbps ports up to 24.





PlainTree's WaveSwitch 100 has high-intensity LEDs for each port, which offers expandability.

PlainTree's WaveSwitch 100 design carries some trade-offs. For example, the WaveSwitch has a removable power supply, but it is on the front, where real estate is at a premium. The 16 10BaseT ports and 2 high-speed ports are already tightly situated there, which hampers changing connections. In addition, the power supply is not fault-tolerant; if you need to replace it, you must still shut down the unit.

PlainTree's WaveSwitch includes a DOS-based monitoring application that displays packet information corresponding to the front-panel LEDs. A port for out-of-band SNMP-based management is located on the front of the box.

The WaveSwitch, which is packaged in an unusual teal-colored box, provides you with traditional switching features, including support for the 802.1D Spanning Tree Algorithm and store-and-forward switching to provide error correction. The WaveSwitch also provides filtering capabilities.

This switch has labels for each item on the unit. All 16 ports include three high-intensity LEDs that indicate error, link, and data. Additional LEDs indicate power on, errors, and maximum loads. The WaveSwitch can be used either rack-mounted or freestanding. If you use it as a freestanding switch, you can remove the rack-mounting attachments.

The documentation includes a chapter of configuration scenarios that are useful for getting started, including one for configuring a mission-critical WaveSwitch backbone.

The WaveSwitch performed well on our tests. It offers you two expansion slots for additional Ethernet ports or for adding high-speed ports. With its management software and removable power supply, the WaveSwitch 100 is a first-rate solution.

Xedia Corp.

• MADswitch

BY TIM CRAWFORD AND LESLIE WYGANT

At first glance, you'll be intrigued by the Xedia MADswitch, priced at $3,995 for

Got a Hub Already? Switch It

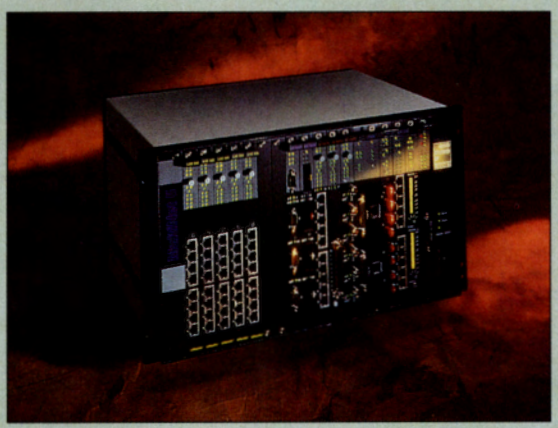
By Steve Buehler

If you've already segmented your networks with multiple server adapters but bandwidth demands still exceed supply, you're definitely a candidate for the switch approach. Many network hub providers now offer switching solutions for their installed base of chassis-based hub models in addition to the standalone switches in the main roundup here. Interestingly, although most solutions seem similar, differences show up in design and implementation that reflect each vendor's approach to architecture, product line positioning, and competitive advantages.

Chassis-based hub solutions represent the bulk of enterprise hub solutions installed in the recent past. Before the introduction of stackable hub products, savvy network managers invested in a chassis solution in order to get scalability, high port densities per box, and fault tolerance. This approach is still appropriate for environments that change slowly or for multiprotocol environments in which one chassis can support different LAN groups simultaneously.

Switching modules from the major vendors offer drop-in flexibility at competitive prices—especially if your hub has a few empty slots. Investing in a switch module could be the quickest and most cost-effective fix for increasing your network throughput. This is even more so if, like most users, you're taking an incremental approach and adding bandwidth only when sustained demand shows the need.

Here's a look at some of the chassis-based hub solutions.



Lannet's MultiNet holds a 10-Mbps, 20-Mbps, or 80-Mbps module in its chassis so you can adjust it to fit your needs.

CHASSIS PLAYERS

Cabletron Systems' MMAC hub platform ($1,200-$1,750) supports the $8,995 ESX-MIM (Ethernet Switching Media Interface Module) seven-port switch module. This module provides six Ethernet ports and one Cabletron BRIM (Bridge-Router Interface Module) port, which can support Ethernet, ATM, or FDDI links. In addition to using Cabletron's Secure Fast Packet Switching technology, the switch module supports full-duplex switched Ethernet. It is manageable through Cabletron's Spectrum for Open Systems, RMON (remote monitoring MIB), and any SNMP-compliant management software.

3Com's LinkSwitch is a $7,195 module for the highly popular $3,195 LinkBuilder MSH (Multi-Services Hub) chassis. The LinkSwitch has three switched ports. An optional $2,195 expansion module serves to add six additional switched ports with a maximum of 1,016 MAC addresses per module.

An FDDI port is standard on the LinkSwitch, allowing for easy integration into typical fiber-backbone configurations. Although the per-port price for the LinkSwitch is high ($2,400), adding the expansion module drops it to a more reasonable $1,050. The LinkSwitch is manageable through 3Com's Transcend or various Unix-based management platforms and programs supporting SNMP.

Lannet Data Communications offers three different switch modules for its family of MultiNet hubs. The $1,995 LSE-108, the $2,995 LSE-208, and the $5,995 LSE-808 are all eight-port switch modules that fit into Lannet's $4,320 LET-36 and $2,195 LET-10 MultiNet hubs. The LSE-108 spreads 10 Mbps, the LSE-208 spreads 20 Mbps, and the LSE-808 spreads 80 Mbps bandwidth across the eight ports, thereby dedicating 1.25, 2.5, or 10 Mbps per port, respectively.

These modules currently support only eight MAC addresses per bank of four ports. They were designed for server-to-server applications or high-speed client-server applications, such as video and CAD over a local area network. Segment-switching versions of these modules that allow for 64,000 MAC address per port are planned for release in the second half of 1994.

SynOptics Communications' $3,295 Model 3328 Ethernet Switching Engine is a six-port switch module for the company's $2,295 (chassis-only) LattisNet System 3000 hub. Developed jointly with switch leader Kalpana, one advantage of the SynOptics 3328 is that each port can be configured to support full-duplex Ethernet operation. But as with Kalpana's products, the use of cut-through rather than store-and-forward processing may not be appropriate for some installations.

In addition, this module has no FDDI connectivity, which reflects a design philosophy of low cost with maximum speed. The SynOptics 3328 is manageable through SynOptics' SwitchMan, Optivity, and LattisWare Solutions or SunNet Manager.

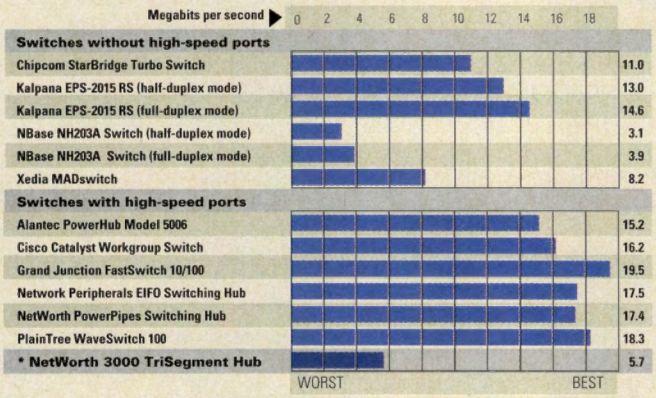
UB Networks provides the $4,145 Access/One chassis and the Dragon-

THE FULL-DUPLEX FACTOR

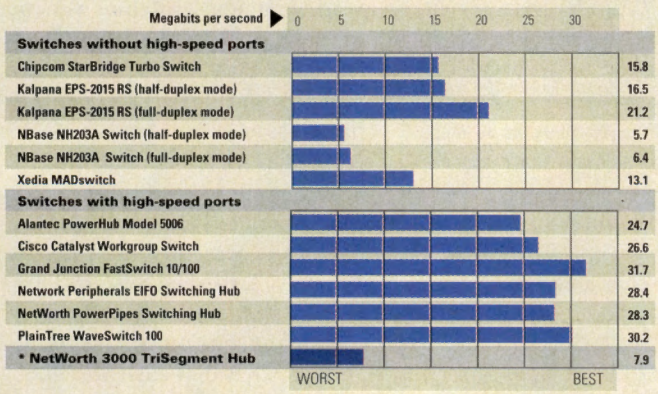
What does it buy you? The answer depends on the switch—and, again, the number of ports. In the case of the NBase NH203A, full-duplex operation did not result in much better performance. The EtherSwitch, on the other hand, got a significant boost at the 512-byte and 1,024-byte levels. The minimal differences between the NBase NH203A's full-duplex and half-duplex test scores could be attributable to the fact that it has only 4 ports, while the EtherSwitch has 15 ports.

NIC THROUGHPUT TEST

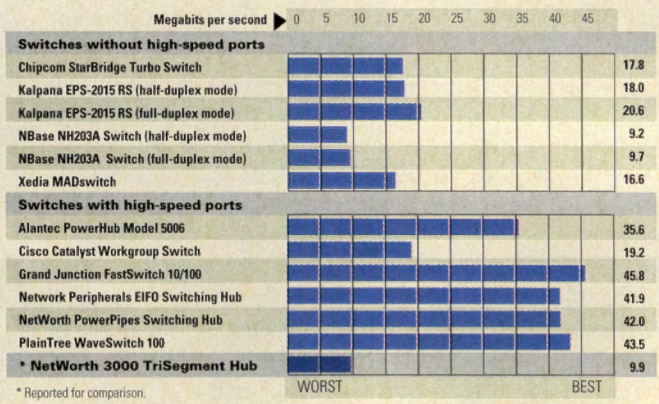
256-byte block size



512-byte block size



1,024-byte block size



* Reported for comparison.

KALPANA'S LOAD BALANCING NLM

We briefly looked at Kalpana's Load Balancing NLM, which lets you put multiple NICs in your NetWare server and connect them to a single switching hub. Typically, this would create a Service Advertising Protocol (SAP) broadcast storm, but the NLM helps. You load the NLM and load your NIC driver for one card. For each sequential card, you load the NLM's drivers. The NLM does all of the balancing of network traffic between NICs to the switching hub. The NLM takes care of your SAP traffic at the same time. Our testing (results not reported) showed that you don't lose any performance using this NLM—but you do gain the added bandwidth of multiple NICs.

CONSIDER YOUR PORTS

In evaluating your needs for today and the future, seriously consider the number of ports that you need and purchase a product that has enough 10-Mbps ports to support all of your clients. Also rest assured that you will realize a significant boost in performance by buying a switch that supports a high-speed connection to your servers.

—Analysis written by Tim Crawford

How We Tested

We used the **NIC Throughput** test from NetBench 3.0 to evaluate the amount of data an adapter can transfer across the network in 1 second. A PC equipped with the adapter issues read requests to a file stored in a server's cache. The test uses block sizes ranging from 64 bytes to 2K. Results are reported in megabits per second.

We created a network with 16 client PCs and 2 servers, which also served as control workstations. The clients were configured with NetWare's VLM client drivers and DOS 6.2. The servers ran NetWare 3.12. We made no special optimizations on either the clients or the servers. We connected all servers and clients to the same Ethernet segment using 10BaseT wire connected to the switching hub that was being tested.

For the products that support high-speed connections, we connected both servers to a high-speed port. We consider a high-speed connection one that runs at 100 Mbps or faster. Except for the FastSwitch's high-speed ports, which support 100-Mbps Ethernet, all of these connections are FDDI. For products that do not support high-speed connections, we connected each server to its own dedicated 10-Mbps port.

After connecting the servers, we distributed all 16 clients across the remaining 10-Mbps ports as evenly as possible. Grand Junction's FastSwitch has 24 ports available, so every client had its own 10-Mbps pipe. The NBase NH203A has only 4 ports total, leaving just 2 ports available after the servers were connected.

Whenever we needed to connect more than one client to a port, we used a small standard 10-Mbps nonswitching hub to consolidate the clients to the port on the switching hub. For each product we set up the best possible arrangement with our test-bed systems, and we tried to eliminate all wiring bottlenecks.

Each of the switching hubs was configured as it ships to customers, with the default settings and parameters. We did not make optimizations on the hubs to improve performance. You may, however, optimize the switching hub to provide better performance in your specific environment. For comparison, we also ran the test on NetWorth's Series 3000 TriSegment Stackable Hub, a standard 10BaseT hub.

Benchmark Tests: Switching Hubs

Our testing of switching hubs determined that performance (as well as pricing) is related to the number of dedicated ports a unit has. But test performance is not necessarily the best differentiator. You must consider all of the hub's features to find the best fit for your LAN.

What the Numbers Mean

For the most part, we saw a correlation between the number of ports a switching hub has and its performance. The more dedicated ports a switch has, the better the performance. In addition, switching hubs with high-speed ports perform much better than switching hubs without high-speed ports. The differences in the test scores were so marked that we report results for the two groups of products separately.

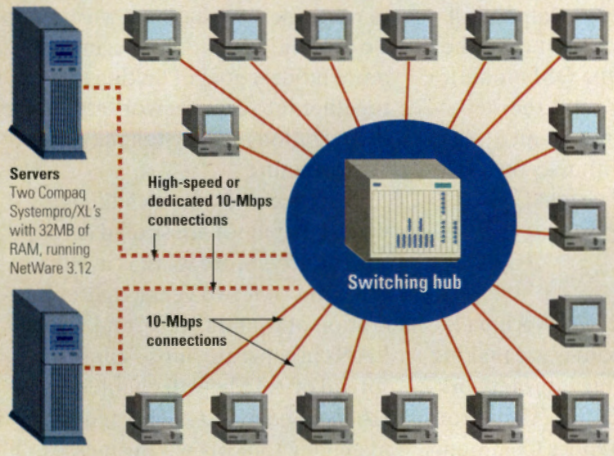
We tested each switching hub in the best possible configuration to support our test-bed of 16 client PCs and 2 servers. Each hub has a different port density; that is, each supports a different number of ports. We configured our test-bed systems with each of the products in a way to avoid bottlenecks.

On hubs that support a high-speed connection, we connected the servers to a high-speed port. On those without high-speed connections, we connected each server to a dedicated 10-megabit-per-second port. Kalpana's EtherSwitch EPS-2015 RS, for example, supports 15 ports. We connected each of the servers to its own 10-Mbps port. We then distributed the client PCs as evenly as possible across the remaining 13 ports: ten of the client PCs got dedicated 10-Mbps ports, while the other six PCs shared three ports.

Test-Bed Configuration

16 clients, evenly distributed

Four Compaq Deskpro 486/33M EISA PCs, four Dell 486D/25 EISA PCs, and four Gateway 2000 386SX/20C ISA PCs, each with 8MB of RAM and an Eagle NE2000 Ethernet adapter, running DOS. Four Infotrac 386/25 ISA PCs, each with 4MB of RAM and an NE2000 Ethernet adapter, running DOS



NBase's NH203A On-the-Fly Ethernet Switch supports 4 ports. We connected the two servers to dedicated ports and 8 clients to each of the remaining two ports. The NBase hub's performance fell below that of our reference hub, because so many of the client PCs in the test-bed had to share ports. Meanwhile, the EtherSwitch, with its 15 ports, did the best of those switching hubs without high-speed ports.

HIGH SPEED OR NOT?

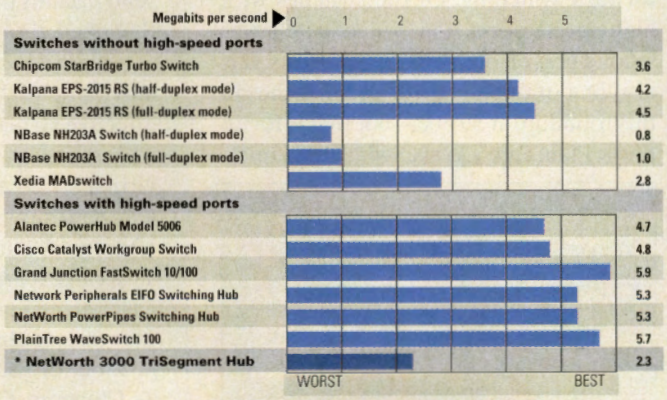
On our benchmark tests, the hubs that support high-speed connections performed much better than those that do not. This is because both servers were connected to a 100-Mbps port, giving each server 50 Mbps of bandwidth versus 10 Mbps from the products without high-speed connections.

There was little difference in performance between hubs with high-speed ports. The scoring variations show the differences in bandwidth that each switch allowed to the clients on our test-bed. If, for example, a switch had an individual 10-Mbps port available for each of the 16 client PCs, it performed better on our tests.

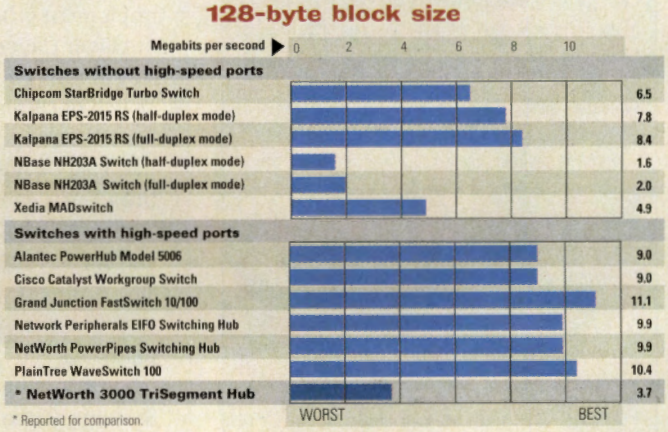
The fewer 10-Mbps ports a switch supports, the lower performance it delivered, because we had to connect more than one client to a single 10-Mbps port.

NIC THROUGHPUT TEST

64-byte block size



128-byte block size



* Reported for comparison.

ment filter is also used to determine if a source and destination address are on the same segment; it stops that traffic from needlessly clogging up the FDDI link.

The documentation is straightforward and provides you with several illustrations showing how to deploy the switches.

Even though their price-per-port ratios are higher than others, the NetWorth PowerPipes and Network Peripherals EIFO switching hubs offer flexibility, expandability, and a large number of addresses per port. For a complete switching hub solution, either of these switches is a strong contender.

PlainTree Systems Inc.

• WaveSwitch 100

BY TIM CRAWFORD AND LESLIE WYGANT

PlainTree Systems' WaveSwitch 100 offers you three features that many switches we reviewed do not: expandability, a removable power supply, and management software. It includes traditional switching features, such as support for the 802.1D Spanning Tree Algorithm and store-and-forward switching. Of the switches with high-speed ports, the WaveSwitch was second best on our performance tests. It is also one of the higher-priced switches in this roundup, at $9,500—but that is for 16 ports. PlainTree's WaveSwitch is definite-

▶ FACT FILE

WaveSwitch 100

List price: $9,500; price per port, $594; WaveBus, $1,825; FDDI single port, $3,890; FDDI dual port, $4985; FDDI SAS-to-DAS upgrade module, $1,095. **In short:** PlainTree packs a lot of switch into the WaveSwitch 100. For its higher price, the WaveSwitch includes management software, a removable power supply, and 2 100-Mbps high-speed ports; it also supports up to 24 10-Mbps ports. The WaveSwitch offers traditional switching features, including store-and-forward switching and support for the 802.1D Spanning Tree Algorithm. But PlainTree did not provide the WaveSwitch 100 with as approachable a design as some other switching hubs in this roundup. The ports and removable power supply are on the front, where space is limited, so changing connections is not easy.

PlainTree Systems Inc., 70 Walnut St., Wellesley, MA 02181; 800-370-2724; 617-290-5800; fax, 617-239-7570.

494 on reader service card

SUITABILITY TO TASK	
Plug-and-play	GOOD
Scalability	EXCELLENT
Management	GOOD

Virtual Reality Check

By David Greenfield

As companies look to an era where virtual teams of employees will work on a project and then disband, network managers are turning to virtual LANs to better control the underlying networking communications infrastructure. Virtual LANs separate the logical network from the physical network. In theory, virtual LANs let network administrators quickly set up workgroups based on need, not proximity. Groups of users can be pulled together on a segment easily and, when the group work is finished, disbanded just as easily.

But don't expect products that support virtual LANs today to give you this freedom and control. Much of its power depends on ATM products, which are not here yet. In an ATM-based network, cell-switching technology and virtual circuits would send packets only to those computers that needed to see them.

Of the products reviewed here, Alantec's PowerHub provides the most effective virtual LAN–type implementation. The PowerHub supports virtual LANs at the network layer, which means you can assign multiple IP network addresses to single ports. This can ease management, since it is easier to assign a second address to a port than to change all the port connections or your workers' locations.

Chipcom, Cisco, and Kalpana all implement virtual LANs at the Ethernet layer (layer 2 in the OSI model). They allow you to group Ethernet-switch ports and thereby limit a broadcast to ports within its own virtual LAN. (Without virtual LANs, broadcasts go to all ports.)

VIRTUAL FUTURE

The future of virtual LANs is uncertain, but many companies are making plans. Already, leading internetworking vendors such as 3Com, Cabletron Systems, Cisco, SynOptics Communications, and UB Networks have announced virtual LAN strategies.

3Com announced support for virtual LANs in its NETBuilder II router line. In 3Com's view, virtual LANs are a way of managing router security. 3Com also implements a virtual LAN approach in its Multi-Services Hub (MSH), but the two schemes are not integrated today.

To Cabletron, distributing routing into the switch may ultimately be a more effective albeit longer-term plan. Cabletron has yet to provide such hubs (although its MMAC and MMAC Plus will support virtual LANs by the first quarter of 1995). Some products—such as the System 5000 switching hub—are available from SynOptics, but they are still in an early stage.

Cisco Systems, the industry-leading router vendor, launched its Cisco Fusion architecture. It is based upon a set of components: an ATM switch called the HyperSwitch/100 that's set to ship in September, a LAN switch that is not yet announced, and a fast router—Cisco's 7000—with an ATM processor. Through this design, Cisco hopes to extend virtual LANs to non-ATM networks.

COME BACK TOMORROW

Virtual LANs let network managers establish users anywhere in the world to participate in the same workgroup. To give the network manager the more modest goal of linking a campus together into a single workgroup, the organization must install the proper infrastructure.

This becomes more challenging when companies are spread across the country. More work is in store. Over the next two years, tighter integration of routers, hubs, and virtual LANs in separate hubs—plus the spread of ATM—will enable virtual LANs to be better connected for managing tomorrow's businesses. □

Network Peripherals

EDITORS' CHOICE

EIFO Client/Server Switching Hub

NetWorth Inc.

EDITORS' CHOICE

PowerPipes Ethernet/FDDI Switching Hub

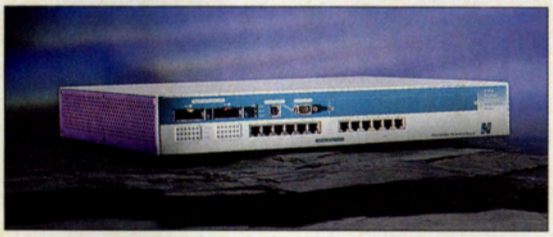
BY PADRAIC BOYLE

Two good products in this roundup—NetWorth's PowerPipes Ethernet/FDDI Switching Hub and Network Peripherals' EIFO Client/Server Switching Hub—are basically the same switch. Codeveloped by these two vendors, the switches differ only in software and some firmware. So, we looked at the two under one review. Both of the vendors plan to differentiate their switches in future versions.

The PowerPipes and the Network Peripherals EIFO are flexible and expandable, allowing you to add fast ports within the same chassis.

Priced competitively ($8,995 for the PowerPipes and $7,495 for the Network Peripherals EIFO), these switches offer 12 10BaseT ports and two FDDI high-speed ports or one dual-attached FDDI port. The 12 ports are dedicated 10-Mbps connections that support as many as 1,018 Ethernet addresses per port.

Each port can be used for client PCs that require such bandwidth, or the ports can connect several Ethernet segments to build larger, faster networks. The two FDDI ports, useful for either high-speed server connections or daisy-chaining units together, can be connected as either single- or dual-attached or dual-homed to form a redundant link.





Network Peripherals' EIFO Client/Server Switching Hub has status lights in different colors and easy-to-reach ports.





Along with LEDs, NetWorth's PowerPipes Ethernet/FDDI Switching Hub has ports on the front for ease of use.

The two switches provide different management packages. NetWorth's HubView, priced at $995, is available in two versions: Version 2.2 supports Microsoft Windows; Version 1.0 supports Novell NMS. You can manage and view statistics on the PowerPipes and other NetWorth hubs.

Network Peripherals, which supports SNMP and MIB II, provides an optional management application for an additional $995 that is compatible with SunNet Manager, HP OpenView for Unix, and Novell NMS. With it, you can view a graphical representation of the switch, with a real-time view of LEDs. You can also enable and disable ports and set port thresholds.

NetWorth has a version of the PowerPipes that plugs into Novell's NMS and, after our testing, released a version that has third-party management support and MIB II compliance. You can also manage both switches from a terminal or by dialing in via modem.

FACT FILE

EIFO Client/Server Switching Hub

List price: $7,495; price per port, $576. **In short:** The codeveloped Network Peripherals EIFO Client/Server Switching Hub and NetWorth PowerPipes Ethernet/FDDI Switching Hub are the same (except for management software) and stand out as good choices among switches with high-speed ports. In fact, we awarded the Network Peripherals EIFO and NetWorth PowerPipes a joint Editors' Choice award. Competitively priced, with good switching features and flexibility, they also offer expansion ports for two FDDI connections within the same chassis. You can use the two FDDI ports for either high-speed server connections or for daisy-chaining the units together. In the future, Network Peripherals and NetWorth plan to differentiate the two products.

Network Peripherals, 1371 McCarthy Blvd., Milpitas, CA 95035; 800-674-8855, 408-321-7300; fax, 408-321-9218.

492 on reader service card

SUITABILITY TO TASK	
Plug-and-play	EXCELLENT
Scalability	GOOD
Management	GOOD

FACT FILE

PowerPipes Ethernet/FDDI Switching Hub

List price: $8,995; price per port, $692. **In short:** The codeveloped NetWorth PowerPipes Ethernet/ FDDI Switching Hub and Network Peripherals EIFO Client/Server Switching Hub are the same (except for management software) and stand out as good choices among switches with high-speed ports. In fact, we awarded the Network Peripherals EIFO and NetWorth PowerPipes a joint Editors' Choice award. Competitively priced, with good switching features and flexibility, they also offer expansion ports for two FDDI connections within the same chassis. You can use the two FDDI ports for either high-speed server connections or for daisy-chaining the units together. In the future, Network Peripherals and NetWorth plan to differentiate the two products.

NetWorth Inc., 8404 Esters Blvd., Irving, TX 75063; 800-544-5255, 214-929-1700; fax, 214-929-1720.

493 on reader service card

SUITABILITY TO TASK	
Plug-and-play	EXCELLENT
Scalability	GOOD
Management	GOOD

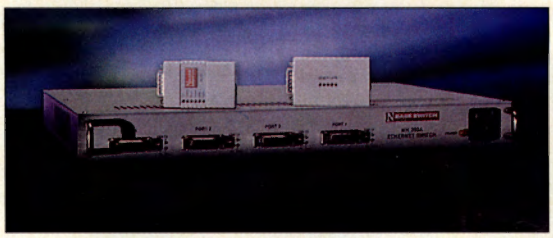
Like many of the other products tested here, all of the ports on these stackable units are located on the front, including the RS-232C ports. LEDs illuminate different colors to show port status.

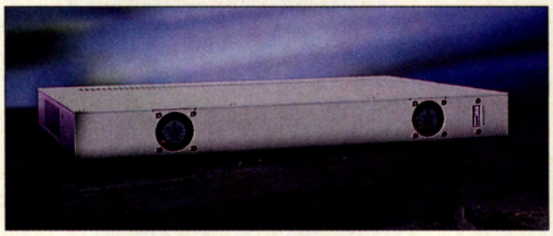
Both switches use a modified store-and-forward switching method along with 64K of RAM on each port and a 100-Mbps backplane to forward incoming packets. The available filtering eliminates broadcast and multicast packets. A seg-

are figures and tables. Information is decidedly missing. For example, you'll need to use cross-connect cables with this switch, but the manual does not include information about connections. According to NBase, there will be new documentation for the NH203A in the future.

The NBase NH203A supports full-duplex Ethernet and provides a data rate of 20 Mbps per port with a buffer size of 1,500 packets per port. NBase uses buffered on-the-fly switching, which is a modified version of store-and-forward switching. By providing a buffer, the leading bit exits the buffer after the trailing bit enters the switch. Although error checking is not provided, the NBase NH203A does filter fragmented packets.

Full-duplex Ethernet switching boosts throughput, but flow control works only with half-duplex Ethernet. NBase argues, as others do, that with full duplex you don't need flow control because of the clear two-way channel. Flow control slows the rate of multiple source ports so that the aggregate data sent to a destination port does not exceed the rated bandwidth. (NBase also offers a version of the NH203A called the NH203AT, which includes 10BaseT ports and AUI connectors for $1,894; it does not, however, include flow control.)





The NBase NH203A On-the-Fly Ethernet Switch aims for true plug-and-play; ports have four LEDs and are on the front of the unit.

NBase emphasizes ease of use in the design of this rack-mountable switch. All of the ports, including the power input, are on the front of the unit. Each port has four well-spaced LEDs, which provide information on transmit, collision, and link status.

The NBase NH203A has no management capabilities—neither SNMP support nor any sort of management port for in-band or out-of-band management. Note, however, that NBase has plans to release managed versions of their products soon (perhaps by the time you read this). The price per port is somewhat steep in this iteration, and the documentation needs some improvement. The NBase NH203A On-the-Fly Ethernet Switch will be most useful in situations where loaded networks can be further segmented into smaller ones, thereby increasing the throughput. Expandability is not part of the package.

The Inside Switch

By Vicki B. Jacobson

Network managers whose LANs need additional bandwidth can look to XNET Technology for an alternative to the standalone Ethernet switching hubs in our main roundup. The Series 1800 ParallelSwitch is a board that installs into a file server. It is designed for small- to medium-size Novell networks (from 20 to 200 users) that consist of desktop PCs and servers responsible for providing file- and printer-sharing. The board also provides an answer for network managers who are looking to increase throughput, but who do not want to deal with the higher costs or the installation and management issues typically associated with standalone switches.

The Series 1800 has six Ethernet ports as well as a high-speed ISA or EISA interface for direct connection to the server. The board actually performs two functions: It provides high-speed packet switching between the Ethernet ports without moving the packets onto the server, and it connects to the server's bus via the high-speed interface. This frees the other six ports for aggregate data-transfer rates of up to 60 Mbps. Standalone switches sometimes sacrifice throughput by needing to use some of the Ethernet ports for connections to servers. Additional advantages to implementing the Series 1800 switch-on-a-card include its reduced cost and ease of installation, as well as XNET's inclusion of management features.

XNET Technology offers a switch that installs into the file server, giving you better throughput without a lot of cost and hassle.

Many standalone Ethernet switches can run $800 per port; the Series 1800 lists between $2,000 and $3,000—or about $240 to $290 per port (depending on the server bus type and media). Users of standalone switches incur additional expenses because they must also purchase separate server adapter cards for connecting to the switch. This means that you can get the Series 1800 for about a third of the cost of implementing a standalone solution.

Installation is also easy: All you do is drop the adapter into the server. There are no external boxes or separate adapters to contend with. The board offers SNMP support for an additional $288 and includes its own NLM, called SwitchCon, which provides for management. □


Drained Darryl
~The battery life on his Elite lasted longer than he did~
Businessman Bob
~Died from
286 System
~Survived
relatives



MidWest Micro's Supernatural SubNote

Every Ghost In The Graveyard's Got One

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Available with a 260, 340 or 520 Mb hard drive, the 486SX SubNote also comes with a large 9.5" monochrome or dual-scan color screen. Perfect for word processing and DOS applications, the monochrome screen delivers spine-tingling display. But if black and white gives you the creeps, get the Elite with dual-scan color.

Bury yourself in the feature-filled Elite SubNote from MidWest Micro. Call us today....or else!



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Elite 486SX SubNote

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- Advanced Power Management with SMM
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- MS-DOS 6.22
- Weight: 3.9 lbs.
- Carrying Case
- One Year Manufacturer's Warranty

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- Advanced Power Management
- One Parallel & One Serial Port
- External VGA & Keyboard Port
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- Lotus Organizer
- Weight: Mono – 6.2 lbs. Color – 6.7 lbs.
- Carrying Case
- One Year Manufacturer's Warranty

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DX4-75 with 340 Mb HDD & 12 Mb of RAM
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#008012 **$2999**

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Options

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Car Adapter	#005979	$ 59
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PCMCIA Ethernet Adapter	#001832	$159

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AD#G10

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What? You don't believe in things you can't see?

Well, one look at the Pentium SoundBook's display and you'll be shivering with excitement. Using PCI Local Bus Video, MidWest Micro's Elite delivers colorful visions on 10.3" dual-scan and 10.4" active-matrix screens. Plus, the Pentium SoundBook's mysterious high-tech Track Point Style pointing device will thrill you with total control (maybe tomb much control)!

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intel inside pentium™

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- High Speed 16550 UART Serial Port
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- Microsoft Works for Windows™ 3.0
- Lotus Organizer™
- Weight: 6.8 lbs.
- Carrying Case
- One Year Manufacturer's Warranty

Dual-Scan Color Pentium SoundBook

P5-90 with 520 Mb HDD
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P5-90 with 720 Mb HDD
#008026 **$3999**

Active-Matrix Color Pentium SoundBook

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- Microsoft 3 Disk CD-ROM Software Library – Encarta™, Works™ & Money™
- 16-Bit Stereo Sound Card
- Digital Quality Speakers
- 14.4 Internal S/R Fax Modem
- 3.5" Disk Drive
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- Slimline Case
- 4 ISA & 1 VESA/ISA Slots
- 101-Key Enhanced Keyboard
- Microsoft Mouse
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- EPA Energy Star Compliant
- The Real 3 Year Warranty

486DX2-66 $1999
#008631
- Intel 486DX2-66 Processor
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- 545 Mb IDE Hard Drive
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- 32-Bit Local Bus IDE
- Double Speed CD-ROM Drive
- Microsoft 3 Disk CD-ROM Software Library – Encarta, Works & Money
- 16-Bit Stereo Sound Card
- Digital Quality Speakers
- 14.4 Internal S/R Fax Modem
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- Slimline Case
- 4 ISA & 1 VESA/ISA Slots
- 101-Key Enhanced Keyboard
- Microsoft Mouse
- MS-DOS 6.22 and WFW 3.11
- EPA Energy Star Compliant
- The Real 3 Year Warranty

P5-66 $2499
#008632
- Intel 66 MHz Pentium™ Processor
- 8 Mb RAM, 256 Kb Cache
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- PCI Fast IDE Interface
- ATI MACH 64 PCI Accelerator with 2 Mb
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- Microsoft 3 Disk CD-ROM Software Library – Encarta, Works & Money
- 16-Bit Stereo Sound Card
- Altec Lansing Digital Quality Speakers
- Internal 14.4 S/R Fax Modem
- 3.5" Disk Drive
- 15" SVGA.28 Digital Color Monitor w/Hitachi CRT
- 8-Bay Mini-Tower Case
- 4 ISA, 2 PCI & 1 PCI/ISA Slots
- Signature 101-Key Enhanced Keyboard
- Microsoft Mouse
- MS-DOS 6.22 and WFW 3.11
- The Real 3 Year Warranty

P5-60 $2299
#008633

P5-90 $2599
#008634
- Intel 90 MHz Pentium Processor
- 8 Mb RAM, 256 Kb Cache
- 428 Mb IDE Hard Drive
- PCI Fast IDE Interface
- ATI MACH 64 PCI Accelerator with 2 Mb
- Double Speed CD-ROM Drive
- Microsoft 3 Disk CD-ROM Software Library – Encarta, Works & Money
- 16-Bit Stereo Sound Card
- Altec Lansing Digital Quality Speakers
- Internal 14.4 S/R Fax Modem
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■ SPREADSHEETS

Formula Printouts in Excel

❓What is the cleanest and easiest way to get a printout of the formulas used in a very large Microsoft Excel spreadsheet?

Robert Powell
Midland Park, New Jersey

▶**PC MAGAZINE:** The easiest way is to use Excel's Tools | Options command. Click the View tab and select the check box labeled Formulas. Excel will display each cell's formula text (rather than the formula's result) on the worksheet grid. Next, choose the File | Page Setup command, click the Sheet tab, and select the check box labeled Row and Column Headings. You must make sure all your columns are wide enough to display your formulas completely. You can do this by clicking on the box at the intersection of your worksheet's row and column headings and choose Format | Column Autofit Selection. Then just print the sheet as you normally would.

Some Excel users, particularly those who once used Lotus 1-2-3 or VisiCalc, might prefer to have a formula printout in which each cell's contents appear on a separate line. Excel does not provide any built-in means of generating such a printout, but you can do it yourself by using a snippet of code from Microsoft Visual Basic, Applications Edition. Choose the Insert | Macro Module command and enter the code shown in Figure 4 in the blank module. (It is also available from PC MagNet's Utilities/Tips Forum as PRFORM.ZIP.)

Return to the worksheet whose formulas you want to print and select the range of cells in which you're interested. Choose the Tools | Macro command, select the name formula, print the list of macros that appears, and click OK. You'll be prompted for a filename; as a default, the macro will propose the name of the active worksheet plus the extension .PRN.

The macro will record in a text file the formulas for each cell in your selection. Each line of the file will consist of a cell address followed by a tab character followed by the cell's formula text. It will then import the text file back into Excel, send the data to the printer, and close the file. The printout produced by this macro will be comparable with what the DOS versions of 1-2-3 generate with /Print, Printer, Options, Other, Cell-Formulas.

—Craig Stinson

```
Sub formulaprint()
    filename = Application.GetSaveAsFilename(ActiveSheet.Name + ".prn")
    If filename = False Then End
    Open filename For Output As 1
    numrows = Selection.Rows.Count
    numcols = Selection.Columns.Count
    For r = 1 To numrows
        For c = 1 To numcols
            If Selection.Cells(r, c).Formula <> "" Then
                Print #1, Selection.Cells(r, c).Address&; ":", _
                Selection.Cells(r, c).Formula
            End If
        Next c
    Next r
    Close #1
    Workbooks.OpenText filename:=filename, _
        StartRow:=1, DataType:=xlDelimited, _
        Tab:=True, Comma:=False
    ActiveWindow.SelectedSheets.PrintOut Copies:=1
    ActiveWindow.Close
End Sub
```

Figure 4: **Used in conjunction with the Insert Macro Module command, this code written in Microsoft Visual Basic, Applications Edition, will cause Microsoft Excel to print out each formula in a worksheet on a separate line.**

■ DATABASES

Rebuilding FoxPro .CDXs Revisited

TIP In the Databases section of the May 17,1994, Solutions column, you presented a valuable tool for the FoxPro developer: a program that generates the source code needed to re-create an existing .CDX file. But the RECDX program doesn't generate the proper code in some circumstances—namely, if the original .CDX file includes any index tags that were created using a FOR clause or the DESCENDING or UNIQUE keywords.

Fortunately, FoxPro includes a function to return the FOR clause, so the basic RECDX program can be easily updated to support this. FoxPro's SYS(2021) function works identically to the SYS(14) function used by RECDX to read the index expression.

The latest release of FoxPro, Version 2.6, includes two new functions that can also be helpful when reconstructing .CDX files: DESCENDING() and UNIQUE(). The first returns .T. if an index tag was created using the DESCENDING keyword, and the second returns .T. if an index tag was created using the UNIQUE keyword.

Figure 5 shows a new version of RECDX.PRG updated to include support for the FOR clause and the DESCENDING and UNIQUE keywords.

Dick Whetstone
Virginia Beach, Virginia

▶**PC MAGAZINE:** Mr. Whetstone is referring to two utility programs, GENCDX and RECDX, that I presented for use by developers in the May 17 column. The GENCDX program generates code to create an index tag for every field in a table, using the field name as the tag name and index expression. GENCDX is designed to generate a new .CDX file. The RECDX program, on the other hand, is for re-creating an existing .CDX file. RECDX uses FoxPro's SYS(14) function to return each index expression and FoxPro's TAG() function to return the index tag names. From this information, it generates the source code to re-create the index file. Unfortunately, SYS(14) doesn't return *everything* needed for re-creating an exact copy of an index tag in certain cases.

The SYS(14) function returns the index expression for the specified tag number. For example, SYS(14,1) returns the index expression for the first index tag. But the expression returned by SYS(14) does not include some of the optional keywords and clauses that you can add to the INDEX command when you

```
*************************************************************************
* RECDX.PRG  v1.1                                          FoxPro 2.5
* Generate index commands to recreate all of the tags in a CDX file.
*
* Sample call: DO RECDX WITH cRetable, cRecdx, cReprg
* where cRetable is the DBF associated with the CDX
*       cRecdx is the CDX file whose tags will be recreated
*       cReprg is the file for the generated source code
*************************************************************************
PARAMETER cRetable, cRecdx, cReprg
IF EMPTY(cRetable) OR EMPTY(cRecdx) OR EMPTY(cReprg)
   ? "RECDX - Generate code to recreate existing tags"
   ? "Example: DO GENCDX WITH cGentable, cGencdx, cGenprg"
   RETURN
ENDIF
SET TEXTMERGE ON                  && Turn on textmerge
SET TEXTMERGE TO (cReprg)         && Send merged output to
SET TEXTMERGE NOSHOW              && Disable screen display of output

nWorkarea = SELECT(0)             && Save the current work area number
SELECT 0                          && Select a work area
USE (cRetable) AGAIN              && Open table
SET INDEX TO (cRecdx)             && Open cdx

\\*************************************************************************
\* <<cReprg>>
\* Program to recreate index tags for the table named <<cRetable>>,
\* stored in the CDX file named <<cRecdx>>
\*************************************************************************
\USE <<cRetable>> EXCLUSIVE       && Open table
\SET INDEX TO <<cRecdx>>          && Open cdx
\DELETE TAG ALL                   && Delete all existing tags
*
* Generate INDEX command for each existing tag
*
FOR x = 1 TO 9999999              && Loop for each tag
  IF "" = TAG(x)                  && Empty tag means we're done
     EXIT
  ENDIF
  \WAIT WINDOW NOWAIT "Indexing on << ALLTRIM(SYS(14,x)) >>
  Tag << ALLTRIM(TAG(x)) >> of << cRecdx >>"

  IF "2.5" $ VERSION()            && Use ISDESCEND for 2.5
     \INDEX ON << SYS(14,x) >> TAG <<TAG(x) >> OF <<cRecdx>>
       << IIF(EMPTY(SYS(2021,x)),"","FOR "+SYS(2021,x)) >>
       << IIF(ISDESCEND(x),"DESCENDING","") >>

  ELSE
     \INDEX ON << SYS(14,x) >> TAG << TAG(x) >> OF <<cRecdx>>
       << IIF(EMPTY(SYS(2021,x)),"","FOR "+SYS(2021,x)) >>
       << IIF(DESCENDING(x),"DESCENDING","") >>
       << IIF(UNIQUE(x),"UNIQUE","") >>

  ENDIF
ENDFOR
\WAIT CLEAR
\FLUSH
\USE
\RETURN

USE                               && Close database and cdx file
SET TEXTMERGE OFF                 && Turn off textmerge
SET TEXTMERGE TO
FLUSH
SELECT (nWorkarea)                && Return to the proper work area
RETURN

*************************************************************************
* ISDESCEND(x) - Return .T. if Tag x is descending,        FoxPro 2.5
*                .F. otherwise
*************************************************************************
FUNCTION ISDESCEND
PARAMETER nTag
cOrd = SET("ORDER")
SET ORDER TO TAG nTag
lAns = "DESCENDING" $ SET("ORDER")
SET ORDER TO &cOrd
RETURN lAns
```

Figure 5: **The RECDX program generates source code to re-create a .CDX file, duplicating the tag names and index expressions that already exist in the CDX. This version includes support for the FOR clause and the DESCENDING and (for Version 2.6 or later) UNIQUE keywords.**

create an index tag. For instance, FoxPro lets you add a FOR clause to the INDEX command. You use the FOR clause to create a filtered index, one that includes entries for only those rows whose contents match the FOR expression. For example, to create a filtered index for rows whose State field contains "NY", you could use:

```
INDEX ON State TAG NY ;
 FOR State = 'NY'
```

In this case, SYS(14) returns only "State". To get the FOR clause, you need to use the SYS(2021) function, which returns `State = 'NY'`. Because the original RECDX program uses only SYS(14), that version does not detect and generate code for the FOR clause—an oversight that is corrected in Figure 5.

Another option that you can add to the INDEX command is the DESCENDING keyword. You use DESCENDING to create a descending index—one in which entries are ordered in descending sequence based on the index expression values. For example,

```
INDEX ON STATE TAG D DESCENDING
```

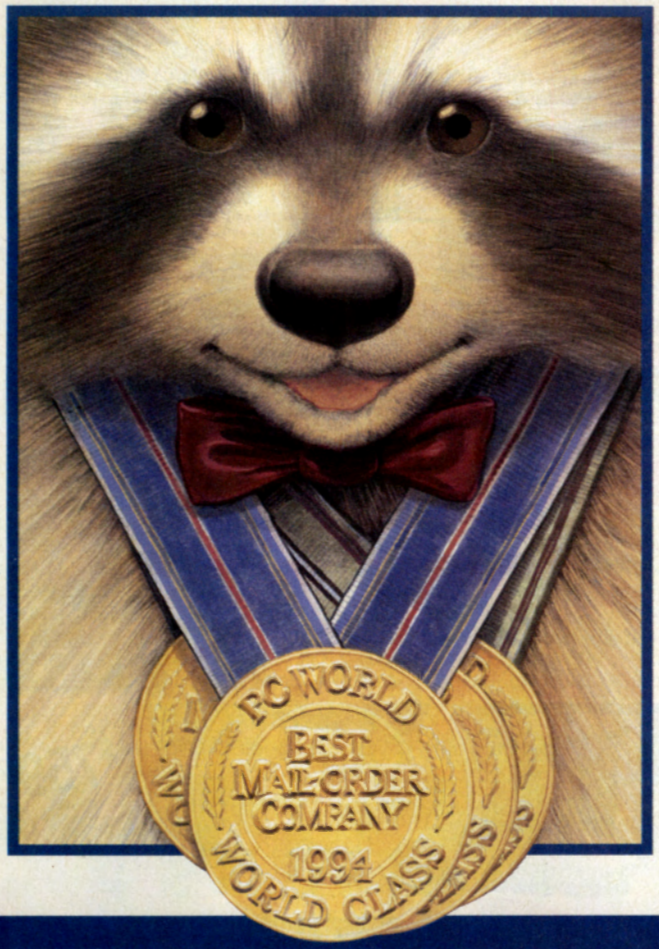
creates a descending index on the state abbreviation—"WY" first, "WV" second, and so on until it reaches "AK". Starting with FoxPro 2.6, you can use the DESCENDING() function to determine whether an index tag was created with the DESCENDING keyword. The function returns .T. if the active index tag was created using DESCENDING and .F. otherwise (which means it was created using ASCENDING, the default). For versions of FoxPro prior to 2.6, use the ISDESCEND() function shown in Figure 5.

FoxPro does not enforce uniqueness by rejecting duplicate rows with the same index expression value.

You can also add the UNIQUE keyword when creating an index tag. This tells FoxPro to create an index entry only for the first row encountered for each index expression value. Subsequent rows with the same value are ignored when creating the index. In this way, rows with duplicate index expression values are excluded when you create the index. Keep in mind, though, that unlike many other database management systems, FoxPro does not enforce uniqueness by rejecting duplicate rows with the same index expression value. You can enter as many as you want, but with UNIQUE specified, FoxPro puts only the first one in the index.

Starting with FoxPro 2.6, you can determine whether an index tag was created with the UNIQUE keyword by calling the UNIQUE() function. It returns .T. if the index tag was created using UNIQUE and .F. if not. No such function exists in early versions of FoxPro, so the RECDX program in Figure 5 will not generate the proper code for index tags created with the UNIQUE keyword if you use it with versions of FoxPro prior to 2.6.

An updated CDXCOD.ZIP file can be found in the Sol:Spreadsht/DBMS section of the Utilities/Tips Forum on PC MagNet.—*Sal Ricciardi*



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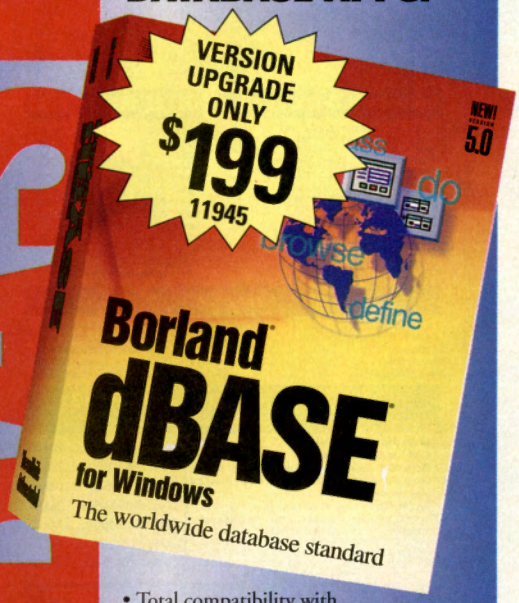

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Premium 386/33TE, 486/25TE, 33TE				
Prem. Serv., Prem II 386SX/20, 25				
Prem. II 386/25, 386/33, 486/33, 486SX/20	8Meg	500780-001	64 pin	398.00
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Prem. II 386SX/20, 25		500780-004		189.00
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6450129 (8Meg)	35SX, 40SX	339.00
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		8Meg Module	116561-001	399.00
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DeskPro 386/33L, 486/33L		(Exp Bd)	116569-001	279.00
DeskPro 386/25, 386/20		1Meg Module	113131-001	79.00
		4Meg Module	113132-001	199.00
DeskPro 386S-16MHz		1Meg Exp Bd	113633-001	149.00
		4Meg Exp Bd	113634-001	279.00
		1Meg Module	113646-001	79.00
		4Meg Module	112534-001	199.00
DeskPro 386/20E		1Meg Exp Bd	113644-001	149.00
DeskPro 386/25E		4Meg Exp Bd	113645-001	279.00
		1Meg Module	113131-001	79.00
		4Meg Module	113132-001	199.00
DeskPro 286N, 386N, 386SX20, all "M" series, sytem LT series, all "I" series		1Meg Module	118688-001	59.00
		2Meg Module	118689-001	89.00
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		8Meg Module	128877-001	339.00
M Series Exp Bd		0-64Meg	129160-001	189.00
DeskPro 386/16		1Meg Kit	108071-001	99.00
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DeskPro 286		512K Kit	113012-001	49.00
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Prolinea 386 3/25S, 3/252S		2Meg	141738-001	90.00
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T2000/T2000SX	2Meg	PC18-PA8317U	79.00
T2000SX/T1000LE	4Meg	PC-PA8314U	189.00
T2000SX/T1000LE	8Meg	PC14-PA8315U	359.00
T2000SXE/2200SX/T1800, 1850, C	2Meg	PC-PA2000U	79.00
T2000SXE/2200SX/T1800, 1850, C	4Meg	PC-PA2001U	189.00
T2000SXE/2200SX/T1800, 1850, C	8Meg	PC-PA2002U	359.00
T4400SX, SXC T6400, T6600	4Meg	PC-PA2004U	199.00
T4400SX, SXC T6400, T6600	8Meg	PC-PA2005U	369.00
T4400SX, SXC T6400, T6600	16Meg	PC-PA2010U	699.00
T4500, C, T4600, T4700, T1900, C, T1910, T1950 (3.3 v)	4Meg	PC-PA2012U	199.00
T4500, C, T4600, T4700, T1900, C, T1910, T1950 (3.3 v)	8Meg	PC-PA2013U	389.00
T4500, C, T4600, T4700, T1900, C, T1910, T1950 (3.3 v)	16Meg	PC-PA2014U	769.00
T3300SL	6Meg	PC-PA2008U	268.00
T3300SL	16Meg	PC-PA2009U	699.00
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T3400CT, T2400, T3600	8Meg	PC-PA2020U	369.00
T3400CT, T2400, T3600	16Meg	PC-PA2021U	763.00
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T1600	2Meg	PC8-PA8302U	99.00
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T3100SX	2Meg	PC15-PA8308U	109.00
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T3200SXC	4Meg	PC19-PA8319U	199.00
T5100	2Meg	PC7-PA8301U	95.00
T5200/T8500	2Meg	PC10-PA8304U	114.00
T5200/T8500	8Meg	PC10-PA8313U	419.00

NOTEBOOK, LAPTOP MEMORY

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ACER 730	2Meg/4Meg/8Meg		109/209/399
ACER 750	4Meg/8Meg/16Meg		199/459/869
ALR Venture	4Meg	12407980	249.00
AST Ascentia 900N	4Meg/8Meg/16Meg		229/469/899
AST Bravo & Explorer	4Meg/16Meg	501255-001, -002	189/789
AST Notebook Prem Exec 386SX/20/25/25L	4Meg	500814-003	189.00
AST Power Exec 3/25C, 425EL	4Meg		199.00
AST Power Exec 3/25C, 425EL	16Meg		819.00
AST Power Exec 425SL	4Meg	501166-001	199.00
AST Power Exec 425SL	16Meg	501166-003	819.00
AST Power Exec 4/33SL	4Meg/16Meg	501318-001,002	194/769
AT&T Safari NSX/20	4Meg	PEC 37651	259.00
Bondwell B310, Plus	1Meg	23050-09100	109.00
Bondwell B310V, SX	1Meg		109.00
Bondwell B310V, SX	4Meg		229.00
Canon Innova 486	2Meg/4Meg/8Meg		109/209/449
Canon Notejet 486	4Meg/ 8 Meg		199/389
Chicony, Ultra, Hyundai 386	4Meg		199.00
Epson NB3	4Meg	A808511	199.00
Everex Tempo LX, LX20, Carrier	2Meg	PCA 00053-0001	109.00
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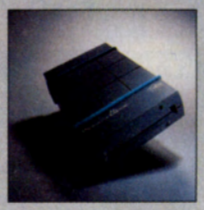

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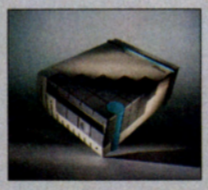

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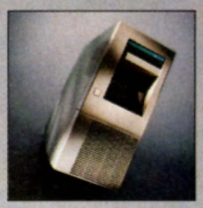

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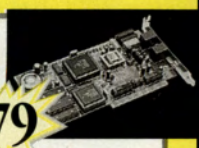

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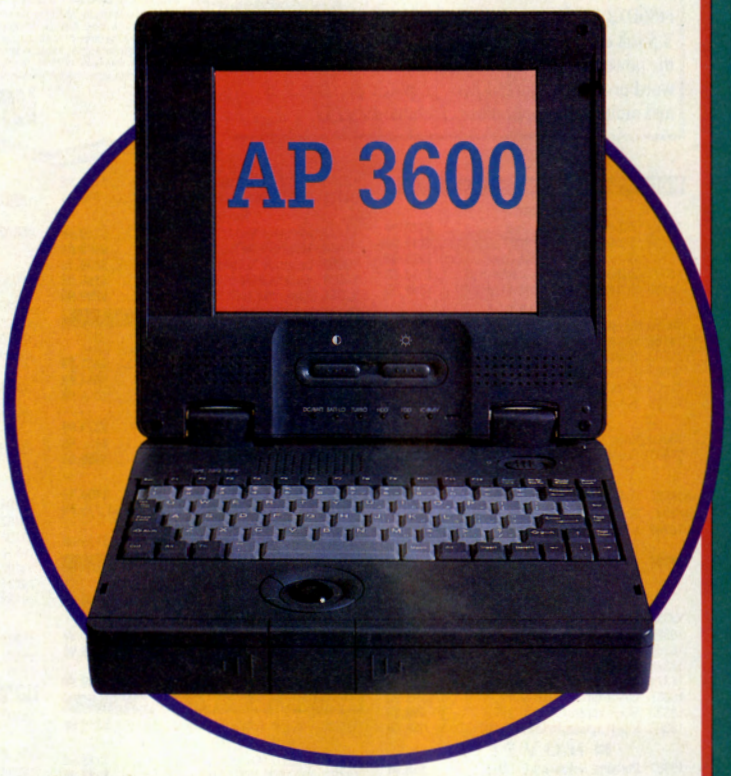

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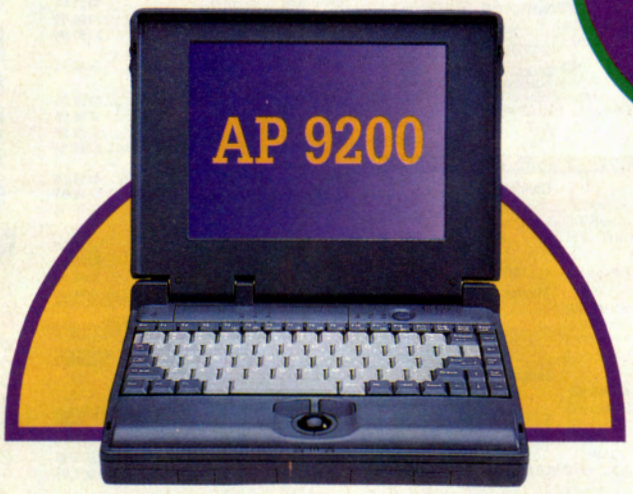

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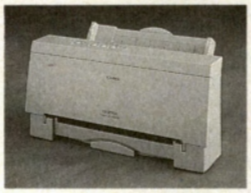

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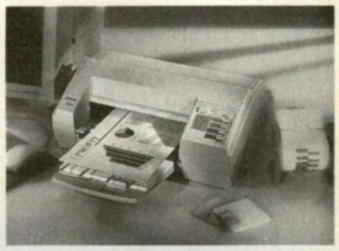

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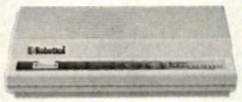

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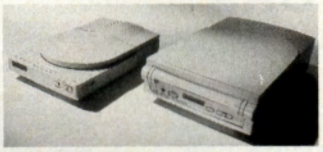

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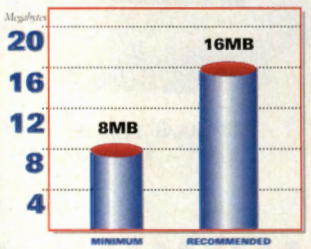

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This graph displays the amount of memory it takes to run Windows & OS/2 applications more efficiently.

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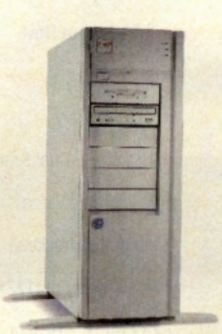

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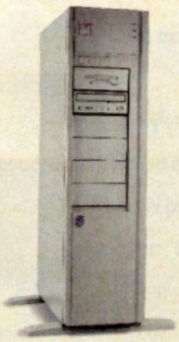

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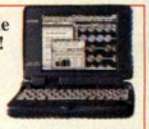

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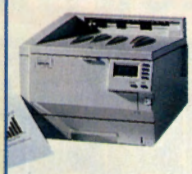

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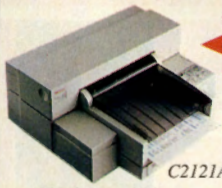

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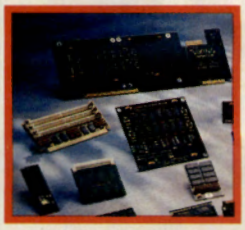

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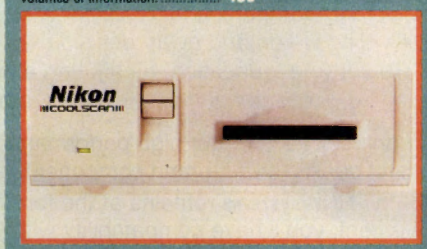

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† Source: PC Computing, April 1994, comparison of the ENV8100 and the HPScanJet IIcx™

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- ▲ 486DX4/75 processor
- ▲ 4MB RAM, expandable to 20MB
- ▲ 2 Type II PCMCIA slots
- ▲ MS-DOS 6.2, Windows 3.1, built-in trackball
- ▲ Removable hard drive
- ▲ Removable floppy – add second battery
- ▲ Removable screen
- ▲ Pen upgradable

Processor	Screen	Hard Drive	Price
DX4/75	9.5" Act.	340MB	$4259

Lease for $156/mo.

UltraLite Versa V

- ▲ 486DX2/50
- ▲ 4MB expandable to 20MB
- ▲ 2 Type II PCMCIA slots
- ▲ MS-DOS 6.2, Windows 3.1, built-in trackball
- ▲ Removable hard drive
- ▲ Removable floppy – add second battery

Screen	Hard Drive	Price
9.5" Active	250MB	$2839
9.5" Active	250MB	$3619
9.5" Active	340MB	$3799
9.5" Active	540MB	$4279

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- ▲ 486 processor
- ▲ 9.5" screen
- ▲ SurePoint integrated pointing device
- ▲ 2 Type II PCMCIA slots
- ▲ Only 4.2lbs. (mono)

Processor	Screen	Hard Drive	Price
486SX/33	9.5" M	210MB	$1889
486SX/33	9.5" D/S	210MB	$2319
486SX/33	9.5" Act.	210MB	$3219
486DX2/50	9.5" Act.	260MB	$3689

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- ▲ 486 processor
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- ▲ NEC CD-ROM drive
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- ▲ Speakers, microphone
- ▲ 24/96 fax modem
- ▲ MS-DOS, Windows, Quicken
- ▲ CD titles: Compton's Encyclopedia, PFS Window Works

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Processor	Hard Drive	Price*
486SX/33 desktop	270MB	$1349
486DX2/66 desktop	340MB	$1539
486DX2/66 minitower	420MB	$1639

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NEC

Versa V

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- ▲ Crisp, 300dpi print-quality
- ▲ 1-year warranty

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- ▲ Resolution Enhancement Technology for smooth, crisp text and graphics
- ▲ 3-Year warranty

DeskJet 520 $269.99
DeskWriter 520 $269.99

DeskJet/DeskWriter 560C

- ▲ Color 600 x 300 dpi "laser-like" print quality
- ▲ Resolution Enhancement Technology for smooth, crisp text and graphics
- ▲ 3-Year warranty

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DeskWriter 560C $569.99

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- ▲ High quality 3 PPM printing
- ▲ Low cost optional color kit
- ▲ 1-Year warranty

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DeskWriter 310 $299.99



DeskJet 310

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- ▲ 2MB RAM w/Memory Enhancement Technology
- ▲ 1-year warranty

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- ▲ Auto switching between Mac and PC environments
- ▲ 1-year warranty

LaserJet 4P $1379.99

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- ▲ 45 scalable fonts w/Adobe Postscript Level 2
- ▲ 4MB memory expandable to 20MB
- ▲ 1-year warranty

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DeskJet 1200C

- ▲ Sharp, 600x300 "laser-like" print-quality
- ▲ 2MB memory expandable to 26MB
- ▲ 180 sheet paper tray
- ▲ 1-year warranty

DeskJet 1200C Call for pricing

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- ▲ Ultra-portability at only 4.1lbs
- ▲ 4MB RAM, expandable to 20MB
- ▲ PCMCIA Type II slot
- ▲ External 3.5" disk drive
- ▲ Integrated AccuPoint pointing device

Model	Processor	Screen	Hard Drive	Price
T3400M	486SX33	8.4" Mono	120MB	$1179
T3400CT	486SX33	7.8" Active	120MB	$2299
T3400CT	486SX33	7.8" Active	250MB	$3389
T3699CT	486DX2/50	8.4" Active	250MB	$4069

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T4700 and T4800

- ▲ 8MB RAM, expandable to 24MB
- ▲ Brilliant 9.5" color display with local bus video
- ▲ 2 PCMCIA slots (Type II, Type III)
- ▲ Microsoft Sound System, built-in microphone, audio out port
- ▲ MS-DOS, UltraFont, Indeo video compression software, Windows for Workgroups 3.11

Model	Processor	Screen	Hard Drive	Price
T4700	486DX2/50	9.5" Dual scan	200MB	$3129
T4700	486DX2/50	9.5" Dual scan	320MB	$3379
T4700	486DX2/50	9.5" Active	200MB	$4549
T4700	486DX2/50	9.5" Active	320MB	$4899
T4800	486DX4/75	9.5" Active	500MB	$5599

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T4700

T2400

- ▲ 486DX2/50 processor
- ▲ 2 PCMCIA slots (Type II, Type III)
- ▲ Integrated AccuPoint pointing device
- ▲ Optional sound card
- ▲ MS-DOS, Windows for Workgroups

HOT PRODUCT

Screen	Hard Drive	Price
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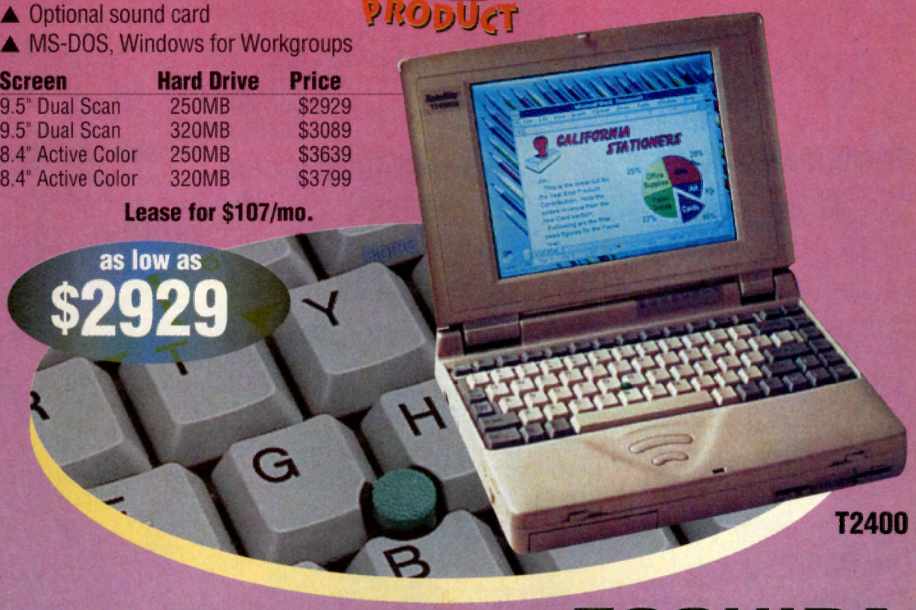

T2400

TOSHIBA

Satellite Notebooks

- ▲ 4MB RAM, expandable to 20MB
- ▲ 9.5" display
- ▲ Type III PCMCIA slot
- ▲ 82-key keyboard
- ▲ MS-DOS, Windows 3.1
- ▲ Ballpoint mouse with Quickport Enhanced power management

Model	Processor	Screen	Hard Drive	Price
T1910	486SX/33	9.5" Mono	200MB	$1499
T1910	486SX/33	9.5" Dual scan	200MB	$2039
T1960	486DX2/50	9.5" Dual scan	200MB	$2379
T1960	486DX2/50	9.5" Dual scan	320MB	$2629
T1960	486DX2/50	8.4" Active color	200MB	$3029
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XJ124FM	24/96 XJACK	$99.99
XJ1144	14.4/14.4 XJACK	$229.99
CC3144	14.4/14.4 PCMCIA	$229.99
XJ2144	14.4/14.4 XJACK GOLD	$259.99
CC4144	14.4/14.4 PCMCIA GOLD	$259.99

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15" SVGA, 1280x1024ni, .28mm	$369.99

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4MB Memory Upgrade for Toshiba 4700, 4800	$249.99
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- ▲ Auto Load/Eject feature

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TravelMate 4000M

- ▲ Brilliant color display
- ▲ 16-bit sound card
- ▲ Integrated Pointing device
- ▲ PCMCIA Type III slot

Processor	Screen	Hard Drive	Price
486SX/25	8.2" Enhanced	120MB	$2099
486SX/25	8.4" Active	200MB	$2929
486SX2/50	9.5" Dual Scan	200MB	$2759
486SX2/50	8.4" Active	340MB	$3349
486DX4/75	8.4" Active	340MB	$4939

TravelMate 4000E Color

Processor	Screen	Price
486SX/25	8.2" Enhanced Color	$1699
486DX2/40	8.2" Enhanced Color	$2069
486DX2/50	9.4" Dual Scan	$2319
486DX2/50	8.4" Active Matrix	$2819
486DX4/75	8.4" Active Matrix	$3549
486DX4/75	9.5" Active Matrix	$4489



TM 4000M

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AST Value

Ascentia 800N

- ▲ 486SX/33 or DX2/50 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 9.5" Dual scan color display
- ▲ PCMCIA Type III slot

Model	Hard Drive	Price
4/33s Model 253W	250MB	$2299
4/33s Model 343W	340MB	$2499
4/50d Model 253W	250MB	$2599
4/50d Model 343W	340MB	$2739

Lease for $84/mo.

Ascentia 900N

- ▲ 486DX2/50 or 486DX4/75 processor
- ▲ 4MB/8MB RAM exp. to 32MB
- ▲ Large dual scan or active color display
- ▲ PCMCIA type III slot

Model	Screen	Hard Drive	Price
4/50 Model 343W	10.3" Dual san	340MB	$3329
4/50 Model 343W	9.5" Active	340MB	$4869
4/75 Model 343W	10.3" Dual scan	340MB	$3969
4/75 Model 513W	10.4" Active	510MB	$5799

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Bravo LC Desktops

New Generation!

- ▲ 4/8MB RAM exp. to 64MB
- ▲ VESA local bus graphics
- ▲ 1MB video RAM
- ▲ MS-DOS 6.2, Windows 3.1
- ▲ Energy Star Compliant

Model	RAM	Hard Drive	Price
4/33s Model 173W	4MB	170MB	$1099
4/33s Model 273W	8MB	270MB	$1369
4/50s Model 173W	4MB	170MB	$1249
4/50s Model 273W	8MB	270MB	$1509
4/66d Model 273W	8MB	270MB	$1779
4/66d Model 543W	8MB	540MB	$2039
4/100t Model 273W	8MB	270MB	$2149
4/100t Model 543W	8MB	540MB	$2299

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- ▲ Detachable video display
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- ▲ Integrated trackball
- ▲ Two Type II or one Type III PCMCIA slot
- ▲ MS-DOS, Windows for Workgroups, Microsoft Sound System
- ▲ 3-Year Warranty

Processor	RAM	Screen	Hard Drive	Price
486DX2/50	4MB	10.3" dual scan	200MB	$2869
486DX2/50	4MB	10.3" dual scan	340MB	$3149
486DX2/50	4MB	9.5" active	340MB	$4339
486DX2/50	8MB	9.5" active	450MB	$4759
486DX4/75	8MB	9.5" active	520MB	$5339



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- ▲ 4 or 8MB RAM expandable to 20MB
- ▲ Modular design with removable hard drive & floppy drive
- ▲ 32-bit VESA local bus graphics, 512KB video RAM
- ▲ Two Type II or one Type III PCMCIA slot
- ▲ Modem/audio module available
- ▲ Enhanced J-Mouse pointing device
- ▲ Built-in AC adapter
- ▲ MS DOS, Windows 3.1 and CoSession Host software
- ▲ 1 Year Z-CARE on-site service

Processor	RAM	Screen	Hard Drive	Price
486DX2/50	4MB	9.5" mono	200MB	$1699
486DX2/50	4MB	9.5" dual scan	200MB	$2179
486DX2/50	8MB	9.5" dual scan	340MB	$2549
486DX2/50	4MB	9.5" active	340MB	$3309



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FLEXSHOW Multimedia Companion	$799.99
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- ▲ 3 expansion slots, 3 drive bays
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Processor	Hard Drive	Price
486SX/25	120MB	$929
486DX/33	212MB	$1249
486DX2/66	212MB	$1639

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- ▲ 2 Type II or 1 Type III PCMCIA slot
- ▲ TrackPoint II integrated pointing device
- ▲ IBM DOS 6.3, Windows 3.1, Lotus cc:Mail, Organizer, ScreenCam, Official Airline Guide FlightDisk, CoSessions Host, Prodigy, America Online, and FaxWorks 3.0
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Screen	Hard Drive	Price
9.5" Monochrome	170MB	$1939
9.5" Monochrome	340MB	$2419
9.5" Dual Scan	170MB	$2519
9.5" Dual Scan	340MB	$2999
8.4" Active Color	170MB	$3389
8.4" Active Color	340MB	$3869

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- ▲ TrackPoint II integrated pointing device
- ▲ 3.5" external floppy drive
- ▲ Weighs only 3.8 lbs.
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- ▲ Removable hard drive
- ▲ 2 Type II or 1 Type III PCMCIA slots
- ▲ Integrated trackball
- ▲ MS-DOS 6.0, Windows 3.1, MS Video for Windows Runtime

Processor	Display	Hard Drive	Price
486DX2/40	9.5" Dual scan	170MB	$3119
486DX2/40	8.4" Active	170MB	$3779
486DX2/40	8.4" Active	340MB	$4159
486DX2/50	9.5" Mono	250MB	$3299
486DX2/50	9.5" Active	340MB	$4999
486DX4/75	9.5" Active	340MB	$5669
486DX4/75	9.5" Active	510MB	$6139

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- ▲ 2 Type II or 1 Type III PCMCIA slots
- ▲ Untethered intelligent pen
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Processor	RAM	Hard Drive	Price
486SL/25	4MB	120MB	$1229
486SL/25	4MB	250MB	$1319

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- ▲ Integrated trackball
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- ▲ MS-DOS, Windows 3.1

Processor	Display	Hard Drive	Price
486SX25	8.0" Mono	87MB	$999
486SX25	8.0" Mono	170MB	$1139
486SX33	7.8" Passive Color	170MB	$1699
486SX33	7.8" Passive Color	250MB	$1889

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- ▲ 4MB RAM expandable to 100MB
- ▲ 3.5" floppy drive
- ▲ Local bus graphics
- ▲ Pentium upgradable
- ▲ Energy Star compliant
- ▲ MS DOS 6.0, Windows 3.1

Processor	RAM	Hard Drive	Price
486SX/33	4MB	200MB	$1049
486SX2/50	4MB	200MB	$1169
486DX2/66	4MB	340MB	$1489
486DX2/66	4MB	525MB	$1639
486DX4/100	8MB	340MB	$1999
486DX4/100	8MB	525MB	$2139

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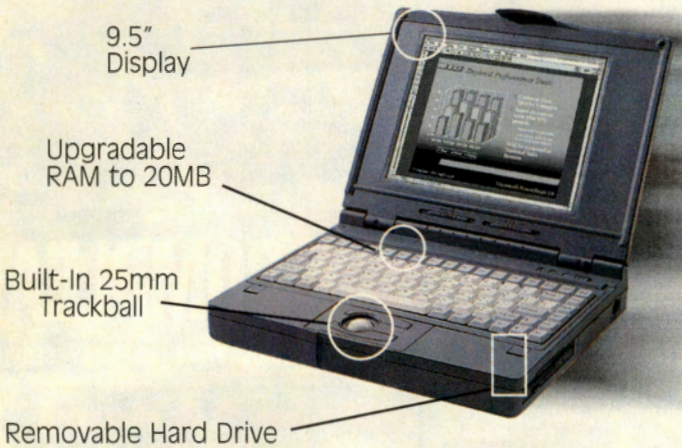

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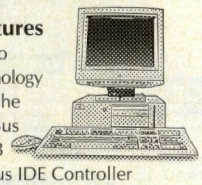

Common Features
- ▲ Upgrade Path to Pentium Technology
- ▲ 128KB L2 Cache
- ▲ VESA® Local Bus Graphics 1MB
- ▲ VESA Local Bus IDE Controller
- ▲ 3.5" 1.44MB Diskette Drive
- ▲ Lexmark™ 101-Key Keyboard
- ▲ MS-DOS® 6.2, Windows™ 3.11, Mouse

486SX/33MHz
$1299 *Model D433SXA*

Business Lease: $46/Month
- ▲ 4MB RAM
- ▲ 212MB Enhanced IDE Hard Disk Drive
- ▲ 15" FST-NI Color Monitor-LR (13.6" viewable screen size)

486DX2/66MHz
$1419 *Model D466DXA*

Business Lease: $50/Month
- ▲ 4MB RAM
- ▲ 212MB Enhanced IDE Hard Disk Drive
- ▲ 15" FST-NI Color Monitor-LR (13.6" viewable screen size)

486DX2/66MHz
$1559 *Model D466DXA*

Business Lease: $56/Month
- ▲ 4MB RAM
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- ▲ Upgrade to Mini-Tower for $25

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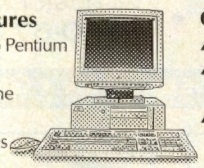

Common Features
- ▲ Upgrade Path to Pentium Technology
- ▲ 256KB L2 Cache
- ▲ Tseng W32p VESA Local Bus Graphics 1MB
- ▲ VESA Local Bus IDE Controller
- ▲ 4 ISA and 1 VL Bus Slots
- ▲ 3.5" 1.44MB Diskette Drive
- ▲ Lexmark 101-Key Keyboard
- ▲ MS-DOS 6.2, Windows 3.11, Mouse

486DX2/66MHz
$1579 *Model D466 I/VL*

Business Lease: $56/Month
- ▲ 4MB RAM
- ▲ 212MB Enhanced IDE Hard Disk Drive
- ▲ 15" FST-NI Color Monitor-LR (13.6" viewable screen size)

486DX2/66MHz
$1829 *Model D466 I/VL*

Business Lease: $65/Month
- ▲ 8MB RAM
- ▲ 420MB Enhanced IDE Hard Disk Drive
- ▲ 15" FST-NI Color Monitor-LR (13.6" viewable screen size)

486DX2/66MHz
$1879 *Model D466 I/VL*

Business Lease: $67/Month
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- ▲ 540MB Enhanced IDE Hard Disk Drive
- ▲ 15" FST-NI Color Monitor-LR (13.6" viewable screen size)
- ▲ Upgrade to DX4/100MHz for $330

PENTIUM 60'S MUST GO.



Common Features
- ▲ 256KB L2 Cache
- ▲ Enhanced PCI/IDE Controller
- ▲ 2 PCI, 4 ISA and 1 PCI/ISA Slots
- ▲ 3.5" 1.44MB Diskette Drive
- ▲ Fast Serial Ports—16550 UART
- ▲ Enhanced Parallel Port—ECP/EPP
- ▲ Lexmark 101-Key Keyboard
- ▲ MS-DOS 6.2, Windows 3.11, Mouse

PCI Pentium 60MHz
$1899 *Model DP60PCI*

Business Lease: $68/Month
- ▲ 8MB RAM
- ▲ 420MB Enhanced IDE Hard Disk Drive
- ▲ 15" FST-NI Color Monitor-LR (13.6" viewable screen size)
- ▲ PCI Graphics Accelerator 1MB

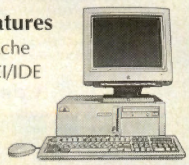
PCI Pentium 60MHz
$2259 *Model DP60PCI*

Business Lease: $80/Month
- ▲ 8MB RAM
- ▲ 720MB Enhanced IDE Hard Disk Drive
- ▲ 15" FST-NI Color Monitor-LR (13.6" viewable screen size)
- ▲ PCI Diamond Viper Graphics Accelerator 2MB VRAM

EISA Pentium 60MHz
$2989 *Model DP60 E/VL*

Business Lease: $106/Month
- ▲ 8MB RAM
- ▲ 1GB SCSI Hard Disk Drive
- ▲ 15" FST-NI Color Monitor-LR (13.6" viewable screen size)
- ▲ VESA Graphics Accelerator 2MB VRAM

PENTIUM 90'S MUST GO.



Common Features
- ▲ 256KB L2 Cache
- ▲ Enhanced PCI/IDE Controller
- ▲ 2 PCI, 4 ISA and 1PCI/ISA Slots
- ▲ 3.5" 1.44MB Diskette Drive
- ▲ Fast Serial Ports—16550 UART
- ▲ Enhanced Parallel Port—ECP/EPP
- ▲ Lexmark 101-Key Keyboard
- ▲ MS-DOS 6.2, Windows 3.11, Mouse

PCI Pentium 90MHz
$2479 *Model DP90PCI*

Business Lease: $88/Month
- ▲ 8MB RAM
- ▲ 540MB Enhanced IDE Hard Disk Drive
- ▲ 15" FST-NI Color Monitor-LR (13.6" viewable screen size)
- ▲ PCI Graphics Accelerator 1MB

PCI Pentium 90MHz
$2689 *Model DP90PCI*

Business Lease: $96/Month
- ▲ 8MB RAM
- ▲ 720MB Enhanced IDE Hard Disk Drive
- ▲ 15" FST-NI Color Monitor-LR (13.6" viewable screen size)
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- ▲ 16-bit Stereo Sound Card
- ▲ 2 Stereo Speakers

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$3459 *Model DP90PCI*

Business Lease: $123/Month
- ▲ 16MB RAM
- ▲ 720MB Enhanced IDE Hard Disk Drive
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- ▲ PCI Diamond Viper Graphics Accelerator 2MB VRAM

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- ▲ 16KB L1 Cache
- ▲ VESA Local Bus Graphics Accelerator 1MB
- ▲ Double-Speed Multisession CD-ROM Drive
- ▲ 3.5" 1.44MB Diskette Drive
- ▲ 5 Drive Bays
- ▲ Lexmark 101-Key Keyboard
- ▲ MS-DOS 6.2, Windows 3.11, Mouse

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$1359
Business Lease: $49/Month
- ▲ 486/66MHz IBM Blue Lightning™ CPU
- ▲ 256KB L2 Cache
- ▲ 4MB RAM, Max: 64MB
- ▲ 212MB Enhanced IDE Caviar™ Hard Disk Drive
- ▲ 14" SVGA Color Monitor-LR (13" viewable screen size)
- ▲ Integrated SCSI-2 Controller
- ▲ 3 16-bit ISA and 2 32-bit VESA Bus Expansion Slots
- ▲ Integrated Ethernet—10BaseT

D4100BL
$1529
Business Lease: $55/Month
- ▲ 486/100MHz IBM Blue Lightning CPU
- ▲ 128KB L2 Cache
- ▲ 4MB RAM, Max: 64MB
- ▲ 212MB Enhanced IDE Caviar Hard Disk Drive
- ▲ 15" FST-NI Color Monitor-LR (13.6" viewable screen size)
- ▲ VESA Local Bus IDE Hard Drive Controller
- ▲ 4 16-bit ISA and 1 32-bit VESA Bus Expansion Slots

D4100BL
$1899
Business Lease: $68/Month
- ▲ 486/100MHz IBM Blue Lightning CPU
- ▲ 128KB L2 Cache
- ▲ Math Coprocessor
- ▲ 8MB RAM, Max: 64MB
- ▲ 420MB Enhanced IDE Caviar Hard Disk Drive
- ▲ 15" FST-NI Color Monitor-LR (13.6" viewable screen size)
- ▲ VESA Local Bus IDE Hard Drive Controller
- ▲ 4 16-bit ISA and 1 32-bit VESA Bus Expansion Slots

DX4 NOTEBOOKS MUST GO.



Common Features
- ▲ 4MB RAM, Max: 20MB
- ▲ Integrated Audio (Speaker and Microphone)
- ▲ Type III PCMCIA Slot (1 Type III/2 Type II)
- ▲ 3.5" 1.44MB Diskette Drive
- ▲ 85-Key Keyboard
- ▲ Centered 16mm Trackball
- ▲ System Status Panel
- ▲ MS-DOS 6.2
- ▲ Windows for Workgroups 3.11
- ▲ 6.7 Pounds, Including NiMH Battery
- ▲ Includes AC Adapter and Case

N75D-340
$2599
Business Lease: $92/Month
- ▲ 75MHz Intel® DX4
- ▲ 340MB Hard Disk Drive, Upgradable
- ▲ 10.3" Dual-Scan DSTN Color Display with Local Bus Video and 1MB Video RAM

N75T-340
$3499
Business Lease: $124/Month
- ▲ 75MHz Intel DX4
- ▲ 340MB Hard Disk Drive, Upgradable
- ▲ 9.5" Active Matrix TFT Color Display with Local Bus Video and 1MB Video RAM

N100T-450
$3699
Business Lease: $131/Month
- ▲ 100MHz Intel DX4
- ▲ 450MB Hard Disk Drive, Upgradable
- ▲ 9.5" Active Matrix TFT Color Display with Local Bus Video and 1MB Video RAM

N450/N433 NOTEBOOKS MUST GO.



Common Features
- ▲ 3.5" 1.44MB Diskette Drive
- ▲ Full-Size Key Keyboard
- ▲ Integrated 16mm Trackball
- ▲ MS-DOS, Windows 3.1
- ▲ 6.6 Pounds, Including Battery
- ▲ Carrying Case

N433C-120
$1699
Business Lease: $60/Month
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- ▲ 4MB RAM
- ▲ 120MB Hard Disk Drive
- ▲ 9.5" DSTN Color Display With Local Bus Video
- ▲ Type III PCMCIA Slot (1Type III/2 Type II)
- ▲ AC Adapter
- ▲ Borland Office™* (WordPerfect® 6.0, Quattro® Pro 5.0, Paradox® 4.5 Workgroup Edition)
- ▲ Sidekick® for Windows

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Business Lease: $78/Month
- ▲ Intel 486DX2/50MHz
- ▲ 4MB RAM
- ▲ 200MB Hard Disk Drive
- ▲ 9.5" Dual-Scan DSTN Color Display
- ▲ Type III PCMCIA Slot
- ▲ Sleep Mode

N450T
$2999
Business Lease: $106/Month
- ▲ Intel 486DX2/50MHz
- ▲ 8MB RAM, Max: 12MB
- ▲ 200MB Hard Disk Drive
- ▲ 9.5" TFT Active Matrix Color Display
- ▲ Type III PCMCIA Slot

OPTIONS



- ▲ 15" FST-NI Color Monitor-LR (13.6" viewable screen size) .28dp, 1024x768, Micro Control **$299**
- ▲ 17" FST-NI Color Monitor-LR (16.1" viewable screen size) **$499**

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- ▲ Diamond Viper VL 2MB **$270**
- ▲ Diamond Viper PCI 2MB **$270**
- ▲ Matrox MGA II+ 2MB VRAM **$499**
- ▲ 2MB Upgrade for MGA II+ **$199**
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- ▲ 540MB Enhanced IDE Caviar Drive **$330**
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- ▲ 1GB SCSI-2 **$799**
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- ▲ 16MB Memory **$1149**
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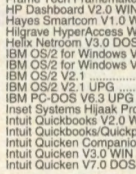

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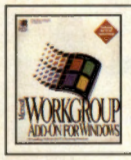

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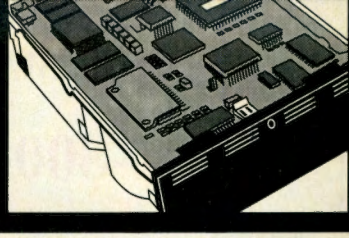

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IDE			
170MB	15ms	7171A	$172
540MB	12ms	7546A	$285

MICROPOLIS

IDE			
1050MB	10ms	MC4110A	$599
1740MB	10ms	MC2217A	$899
SCSI			
1052MB	8.5ms	MC4110	$599
1740MB	10ms	MC2217	$899
3020MB	11ms	MC1936	$1899
SCSI-AV Audio / Visual tuned drives			
1000MB	10ms	MC4110AV	$689
1700MB	10ms	MC2217AV	$989
3000MB	11ms	MC1936AV	$2049

Seagate

IDE			
213MB	16ms	ST3243A	$175
260MB	16ms	ST3290A	$192
341MB	13ms	ST3391A	$212
420MB	14ms	ST3491A	$222
545MB	12ms	ST5660A	$292
SCSI (WIDE SCSI also available)			
1690MB	8ms	ST11950N	$1249
1700MB	9ms	ST11900N	$1079
2145MB	8ms	ST12550N	$1269
2148MB	9ms	ST12400N	$1169
4290MB	9ms	ST15230N	$2299
4290MB	8ms	ST15150N	$2389

WESTERN DIGITAL

IDE			
341MB	12ms	AC2340	$218
425MB	12ms	AC2420	$220
540MB	11ms	AC2540	$310
730MB	10ms	AC2700	$420
1083MB	10ms	AC31000	$570

HARD DRIVES

Quantum

IDE			
270MB	12ms	LPS270A	$199
342MB	12ms	LPS340A	$209
541MB	12ms	LPS540A	$279
SCSI			
170MB	14ms	ELS170S	$179
270MB	12ms	LPS270S	$199
342MB	12ms	LPS340S	$239
541MB	12ms	LPS540S	$295
1080MB	10ms	IMP1080	$639
1440MB	9.5ms	IMP1440S	$829
2160MB	9.5ms	IMP2160S	$1119

IBM

IDE			
270MB	12ms	70G8487	$209
364MB	12ms	70G8488	$227
527MB	12ms	70G8486	$322
728MB	12ms	70G8511	$399
1052MB	8.6ms	70G8512	$699
SCSI			
270MB	12ms	94G2439	$220
364MB	12ms	94G2440	$239
527MB	12ms	94G2441	$339
728MB	12ms	94G2422	$449
1052MB	8.6ms	70G8492	$679
2040MB	9.2ms	70G8493	$1199
4250MB	11ms	90F0780	$2239

SYQUEST

SCSI		Drive	PC Kit	Mac Kit
44/88MB	SQ5110C	$269	$439	$415
105MB	SQ3105S	$239	$399	$329
200MB	SQ5200C	$399	$599	$519
270MB	SQ3270S	$429	$569	$489

PRINTER PORT EXTERNAL (IDE)
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PCMCIA drives — Floppy Drives
IBM PS/1, PS/2, and Tandy Drive upgrades

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NEC	CDR510	3X	195ms	$309
Plextor	PX43CH	4X	150ms	$475
Toshiba	XM3401	2X	200ms	$259
Toshiba	XM4101	2X	320ms	$215
Teac	CD50	2X	265ms	$209
Media Vis. SH93R		2X	280ms	$159

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PREM=Media Vision Premium 3D. PRO=Media Vision Pro 3D
SB= Sound Blaster 16 SCSI. SA= Sound Blaster SCSI ASP.

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XM4101	$365	$489	$359	$425
CD50	$359	$485	$359	$425
XM3401	$425	$549	$425	$479
CDR510	$499	$619	$499	$559
PX43CH	$659	$779	$659	$699
CDR900	$1129	$1249	$1129	$1189

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A1542CBASIC 16Bit SCSI	$225	$215
A2742 EISA SCSI	$319	$309
A2842 VESA SCSI	$279	$269
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S475I 32Bit Local Bus IDE	$139	$129
S485I 32Bit PCI IDE	$229	$219
S425S 16Bit SCSI	$229	$219
S475S 32Bit Local Bus SCSI	$369	$359
GSI 16Bit IDE accelerators (enhanced IDE)		
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1533-32 2IDE, 4 Floppy, IO	$129	$109
4C 16Bit supports 8 IDE	$139	$119

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750-1.5Gig	Exabyte	2501	$499	$699
2Gig	Conner	4320	$749	$899
2Gig	HP	35470	$889	$999
4-8Gig	Conner	4324	$999	$1109
4-8Gig	HP	35480	$989	$1099
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4-16Gig	Conner	4326	$999	$1139
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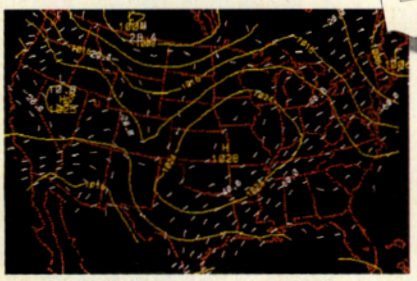



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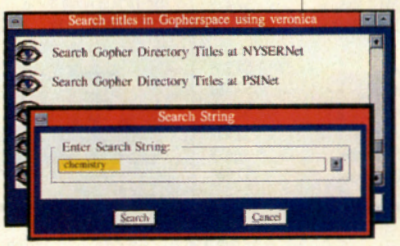

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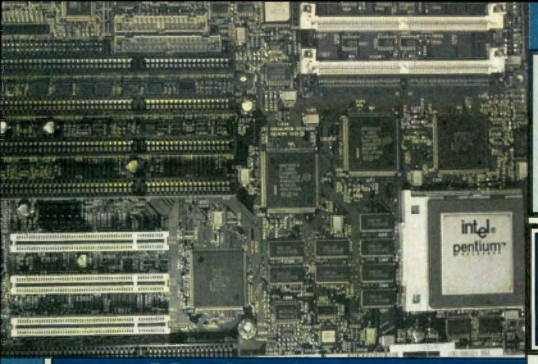

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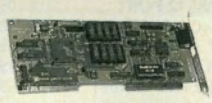

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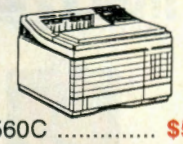

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LET'S FACE IT, today's business computer market is no picnic. In fact, with so much competition, product advertisers are finding it increasingly important to reach committed business buyers without waste. So when buyers cite certain magazines—Ziff-Davis magazines to be exact—as their preferred choice for purchasing information, advertisers take note. And action.



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How PC Direct Helped Computer Discount Wa Found "Customer Univ

All the employees at the Computer Discount Warehouse are still in school. No, they're not teenagers anymore, but they're all enrolled in a program called CDW University — which they also call "Customer U."

"We believe that the only way to grow is to make the customer #1," says Michael Krasny, the company's CEO. "That's why we established an on-going, mandatory training program that focuses on customer service and product briefings. Our employees also have personal, hands-on experience of a lot of the products they sell — and they know how to treat the customer right."

The customer support program at CDW, a ten-year-old reseller of PC hardware and software, includes free technical support from 8 a.m. to 7:30 p.m. "We guarantee that support calls will be answered within three minutes," says Krasny. He also points out that a $10 million product inventory makes it possible for the company to provide same-day order shipment.

Computer Discount Warehouse has turned their success into an opportunity to offer better customer service, and Krasny singles out his advertising in PC Magazine as the cornerstone of his success. "We've been in the PC Direct section since 1986, and we've never missed an issue. Our most loyal customers, the ones who appreciate service, come to us through PC Magazine. No matter how you look at it — closing rate, calls per ad dollar — PC Magazine is tops."

If you're a direct marketer and you're looking for one million prospects who understand value and service, look no further than PC Direct. There's no better way to attract so many loyal, repeat customers.

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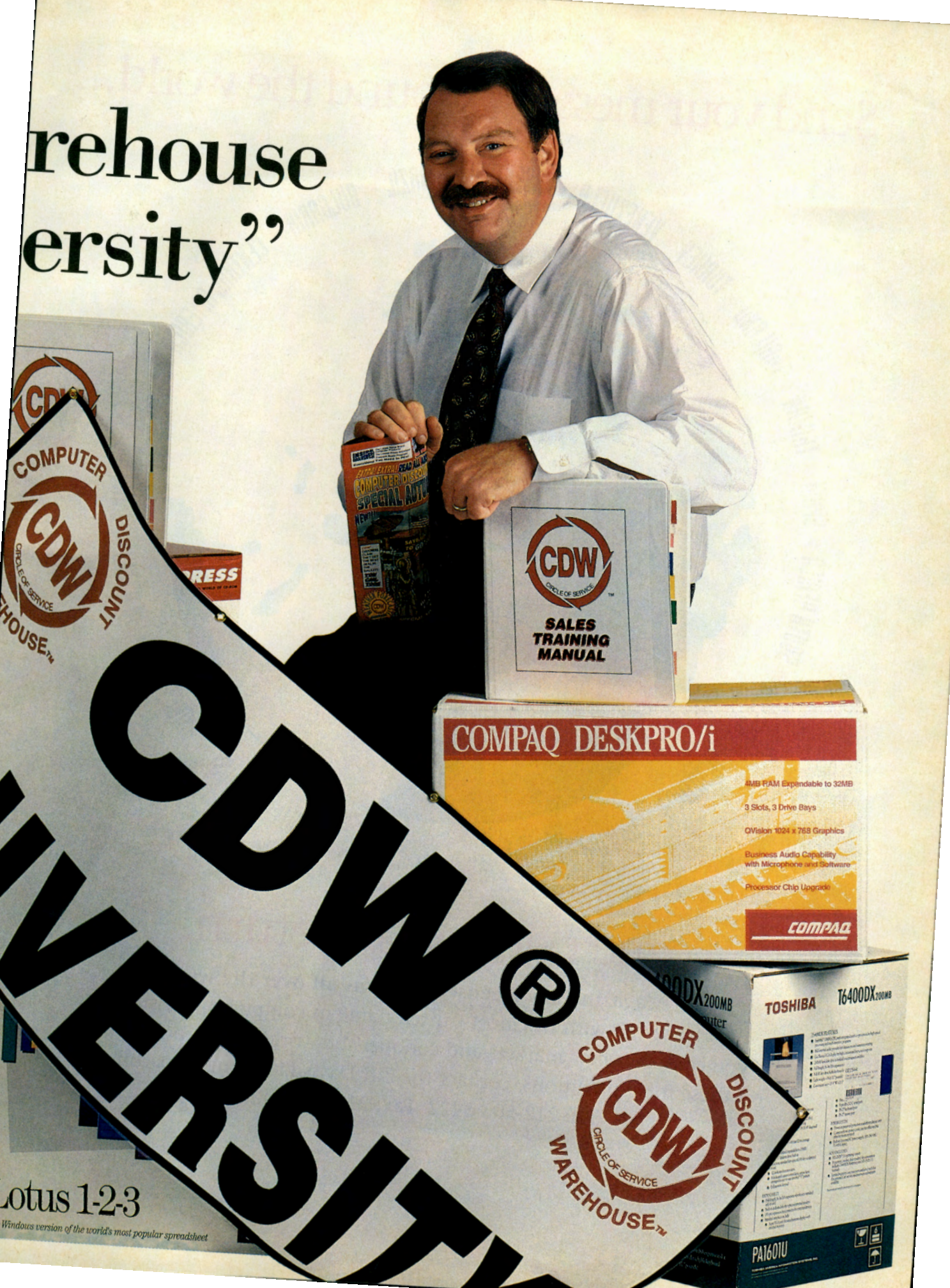
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PC MAGAZINE

Arlington Computer Took a Long Term Business Perspective but Used PC Magazine for Immediate Results.



Arly Guenther
President, Arlington Computer

When Arly Guenther started Arlington Computer, he decided to take a long term approach by taking care of his customers so they would come back and become repeat buyers. According to Arly, this long term approach pervades everything they do — customer service, technical support, and advertising.

"When we started the company in early 1984," says Arly, "we believed that our success as a direct marketer would be tied to customer satisfaction. So we attempted to go into the direct advertising arena. Our strategy was to sell branded products at competitive prices while continually responding to the changing needs of our customer base. Two or three years ago, people might wait two or three weeks for a product. Now they want it overnight, and they want much more sophisticated technical support. After ten years of being in business, we really feel that our support is among the best in the industry."

When Arly chose the direct marketing channel, he knew the best way to maximize the return on his investment was to target business buyers that have enterprise-wide buying responsibility and buy many products in volume. He selected PC Magazine back in 1986 because its readers have the knowledge and responsibility to buy products for themselves and their organizations. In fact, because of the large volume buying, "PC Magazine has become Arlington's flagship publication, because its buyers buy many different types of products resulting in high average order sizes. All of this brings more revenue to the bottom line, and has allowed Arlington to grow to its present size."

"If you're in direct marketing for the long term, PC Magazine is an excellent choice. We run ads in PC Magazine consistently and have not missed an issue since day one." As a result, "last year alone our sales from PC Magazine were up over 30%." So, if you want your advertising message to reach the broadest, most sophisticated customer base, PC Magazine is definitely the place to be.

If you're a direct marketer with a breakthrough idea, bring it to the attention of 1,000,000 of the most active and knowledgeable PC buyers. Call your PC Magazine sales representative or (212) 503-5100 and get the facts about PC Direct.

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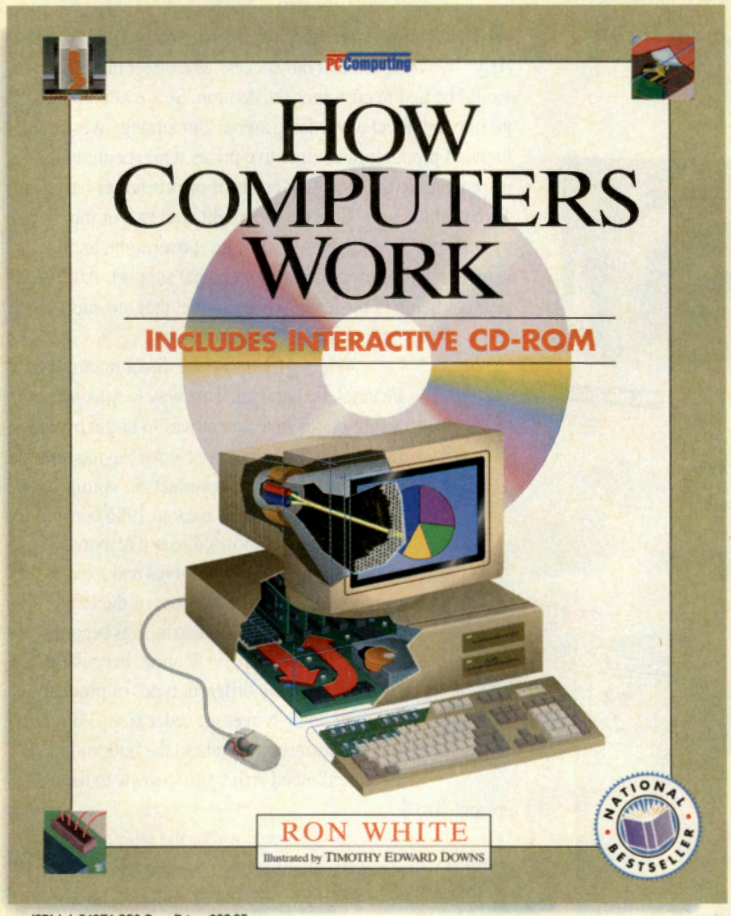

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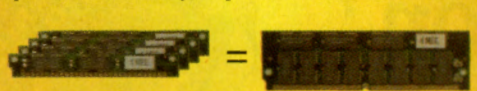

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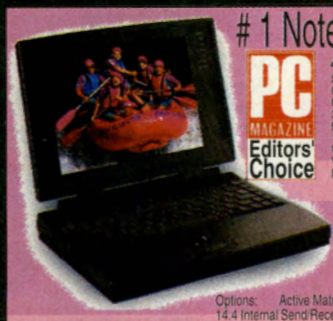

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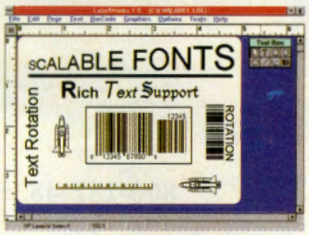

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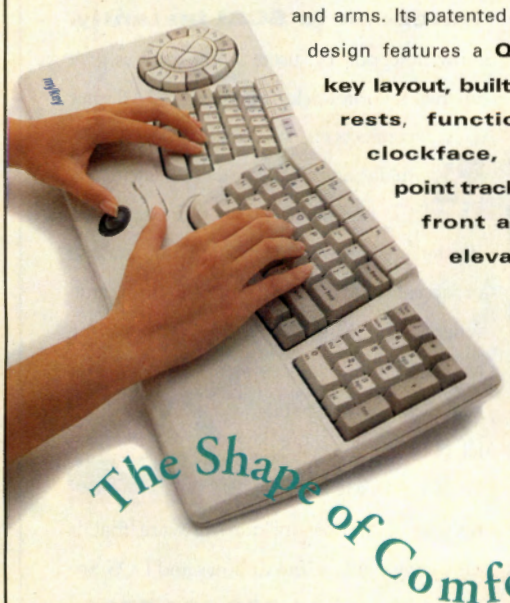

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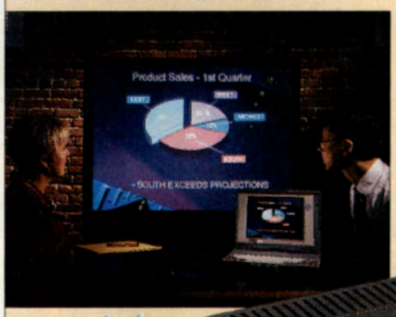



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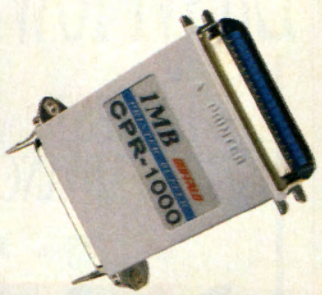

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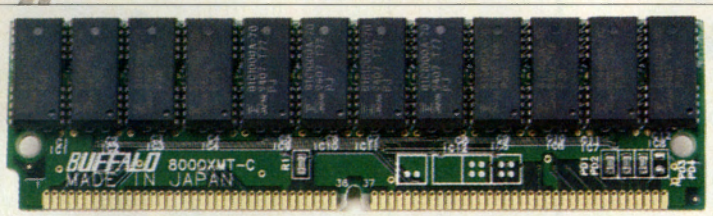

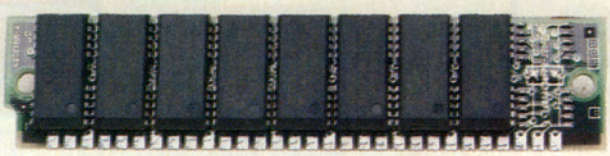

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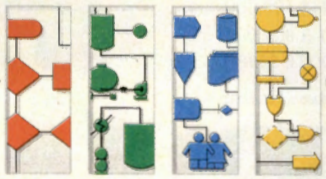

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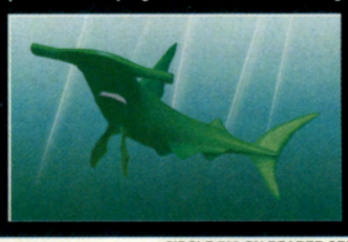

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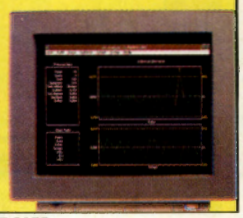

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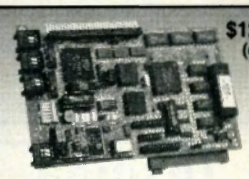

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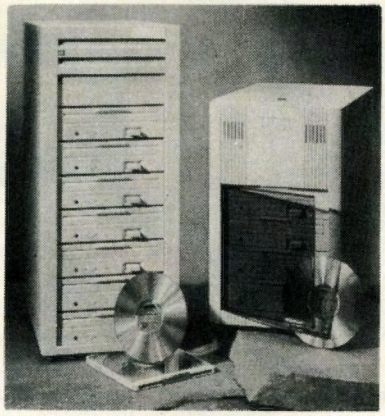

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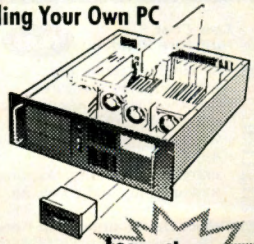

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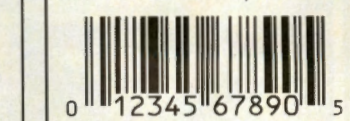

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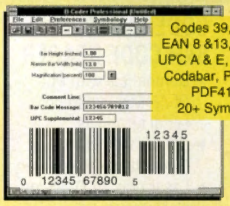

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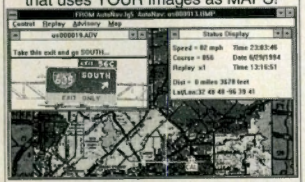

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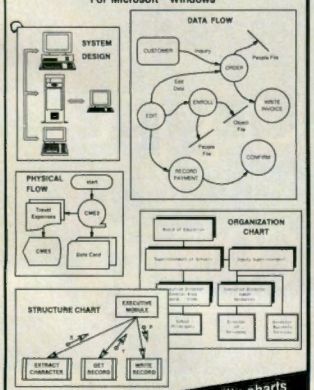

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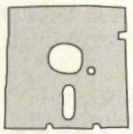

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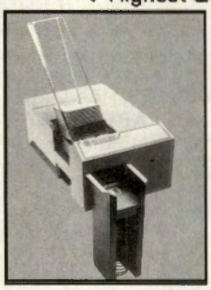

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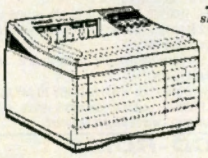

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01. ☐ Yes 02. ☐ No

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03. ☐ Manufacturer–Other
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05. ☐ Computer Consultant
06. ☐ Computer Retaierl/VAR/VAD Distributor
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14. ☐ Admin./Mgmt.

4. Is your company a reseller?
01. ☐ Yes 02. ☐ No

5. For how many IBM PCs and compatibles do you specify brands of products:
01. ☐ 10 or less 03. ☐ 26-99
02. ☐ 11-25 04. ☐ 100 or more

6. Are there any PCs in your office?
01. ☐ Linked to mainframe
02. ☐ Linked to mini
03. ☐ Networked together

7. Please check the equipment currently installed at your location: (Check all that apply.)
01. ☐ IBM or Compatible PCs
02. ☐ IBM or Compatible Mainframes
03. ☐ IBM or Compatible Minis
04. ☐ Macintosh
05. ☐ CD-ROM
06. ☐ Windows

8. Do you plan to buy any PC products?
01. ☐ Now 03. ☐ In 7 to 12 months
02. ☐ In 4 to 6 months 04. ☐ No definite plans

9. Number of employees in your entire company:
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PC MAGAZINE

Coming Up

A Suite Update

There's a new generation of suites. Microsoft Office is complete. Lotus has just shipped a new rev of SmartSuite. Novell/WordPerfect is preparing to launch its first full-scale suite offering. To greet the new generation, *PC Magazine* presents its second-generation suite comparison/preview. We examine today's individual applications and tell you which is strongest, swiftest, and most versatile—and offer an advance look at how each complete suite competes.

Multimedia Upgrade Kits

From your kids' computer games to your competition's sales presentations, multimedia is popping up everywhere. If you want to take advantage of the latest and best educational software, entertainment titles, and reference works for fun and business, then you have to wire your PC for sound and video. *PC Magazine* looks at 16 multimedia upgrade kits that give you everything you need—sound board, CD-ROM drive, and usually speakers and free CDs—in one box. We compare features and performance, and let you know about installation procedures and any pitfalls you may find. We also test four multimedia-ready systems from top vendors.

CAD's New Face

Architects and mechanical designers are getting ready to go GUI. But do users really have to pay nearly $3,000 to get all the CAD functionality they need? When CAD packages are rewritten or are ported from DOS to Windows or OS/2, the ease of use of the final product often hinges on how successfully the developer has managed to implement a robust GUI interface. *PC Magazine* takes a fresh look at the newest crop of two-dimensional Windows, Windows NT, and OS/2 CAD systems. We review 15 CAD packages—from powerhouses like AutoCAD to upstart affordables like DynaDesigner and TurboCAD.

ISDN or Not?

ISDN's popularity as a practical technology focuses on its ability to merge voice, data, and video into digital transmissions over digital telephone lines—and on its speed. Touted as being four times as fast as conventional analog, ISDN makes telecommunications much easier, including videoconferencing, linking networks by dial-up server, and transferring files at high speeds. So why isn't ISDN available to every office and household? We review six ISDN adapter solutions and also examine availability and tariff issues to see what it takes to implement ISDN on your network.

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- 8.4" Active Color
- 4MB RAM
- 200MB HDD
- Type III PCMCIA

$2,999
MAT196ØCT2



NOTEBOOK COMPUTERS

TOSHIBA

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After Hours

EDITOR'S RATINGS: ★ Poor ★★ Fair ★★★ Good ★★★★ Excellent

DOS Windows CD-ROM Resource-Intensive Adult Content Kids (Ages) Price

It Ain't Just Paint: Art for Kids

Most kids know something that adults have forgotten: Making art is fun. It's even more fun when you have computer programs that let you draw with wacky lines, mush pictures around, and experiment with sounds and animations. Four electronic painting programs for kids—Micrografx's Crayola Amazing Art Adventure and Crayola Art Studio, Microsoft Fine Artist, and Broderbund Software's Kid Pix 2—can help spark your child's creativity.

Crayola Amazing Art Adventure

Micrografx Inc.; 800-227-3283

Circle 472 on reader service card

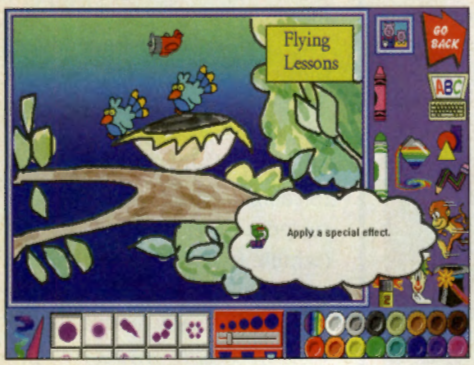
★★★★ WIN 3-6 $59.95

Crayola Art Studio

★★★★ WIN 6-12 $59.95

The collaboration between a leading manufacturer of graphics software—Micrografx—and the premier children's-art-supply company—Binney & Smith, maker of Crayola crayons—has produced two of the best art-for-kids programs on the market. Crayola Amazing Art Adventure and Crayola Art Studio are two versions of the same product, each tailored to a specific age group. This is an important distinction because these products provide age-specific structured activities.

Comprising ten different games based on childhood favorites such as Connect-the-Dots, Amazing Art Adventure is geared at younger painters. Art Studio offers a variety of project templates that let users create things like notepaper, certificates, and badges, and it also offers many of the Art Adventure games, which have been revamped to appeal to more sophisticated older artists. So while tiny tots play the Monster Mix-Up game, older kids can use that mix-and-match technique to design clothing or vehicles. After playing the games, kids can color the pictures.



Crayola Art Studio's watercolor tools produce cool transparent paints.

These packages share the same easy-to-use yet powerful painting tools. The watercolor and marker tools paint transparently, so children can mix new colors right on the page, and the fill tool produces smooth gradients. And where other children's art programs let users paint with simple pictures, these products offer brushes that look just like dinosaurs or gemstones.

Like Microsoft Fine Artist, the Crayola products offer both still and animated stickers that remain separate from the underlying scene. But Micrografx's implementation of this feature yields more consistent results. For example, if you start painting on top of a sticker, you can paint only the sticker; if you start painting on the background, you can paint only the background. There are a few small shortcomings: You can't assign sounds to objects, for example, and you can't create your own stickers.

These are but minor omissions in what are otherwise excellent products. The best part is the interface, which incorporates the metaphor of a child's room, so even the youngest computer artist will feel right at home.



After you've played a game in Crayola Amazing Art Adventure, you can color the picture.

Microsoft Fine Artist

Microsoft Corp.; 800-426-9400, 206-882-8080

Circle 477 on reader service card

★★★ WIN 8-18 $49.95

Microsoft Fine Artist transports your children to Imaginopolis, an exciting new place where creativity is

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king. Once there, they will meet three cartoon characters: a gnomelike creature named McZee and two cool kids named Maggie and Max, who act as guides. All of Microsoft Fine Artist's support is provided through these on-line characters. In the beginning, it's great to learn about things such as negative space by painting along with Maggie. But the constant pop-ups containing questions and instructions require users to read lots of text, and they can sometimes feel intrusive.



The stickers in a Microsoft Fine Artist painting can be moved, flipped, and resized.

Microsoft Fine Artist uses the metaphor of a building to organize activities, and whether you travel via a goofy elevator, a fire pole, or surprise animations, getting to each of the floors is half the fun.

A full complement of fun brushes, such as railroad tracks and spider webs, can entertain children for hours. When a user pastes a sticker into a picture, Microsoft Fine Artist maintains it as a separate object that can continue to be manipulated. And special animated stickers come to life when clicked with the magic wand, so birds can flap their wings and snakes can slither across the screen. With sound effects such as dinosaur roars, boinks, and animal squawks—which can be assigned to individual objects—and the ability to sequence paintings and transition effects into a screen show, Microsoft Fine Artist may be the perfect gift for budding multimedia producers.

On the downside, portions of the program are downright illogical. For example, you can inadvertently paint over a sticker even when you are not in the special sticker-editing window. A more serious shortcoming is that advanced functions—such as making objects shrink toward a vanishing point—require too many steps and tool changes for the average eight- or nine-year-old.

PROBLEM SOLVER

Secretive artists can safeguard their pictures using Microsoft Fine Artist. To hide a picture so no one else can see it, simply start its name with an exclamation point. This will keep it from appearing in the gallery.

Kid Pix 2

Broderbund Software Inc.; 415-382-4400

Circle 475 on reader service card

★★★ WIN 3.1+ $39.95

Kid Pix, once the defining product in the children's art category, is beginning to show its age. Though it pioneered many of the concepts used by the other products in this article, those products have refined and improved upon these ideas. For example, where Kid Pix offers stamps that are part of the background, newer programs maintain these stamps as separate objects. And where the other packages offer support for up to 256 colors, Kid Pix supports only 16-color VGA mode, which means that transparency effects are limited, and gradient fills are out of the question.

But even though Kid Pix 2 is basically a repackaging of Kid Pix and Kid Pix Companion, it still has a lot of life in it. Unique features include the ability to switch from English to Spanish, which is a great learning tool when used in conjunction with such features as the talking alphabet, hidden pictures that can be revealed only with the mystery eraser, and an idea generator that produces a silly sentence for children to illustrate. Users can even expand Kid Pix's horizons with the more than 400 stamps, 32 ready-to-paint scenes, and 40 hidden pictures that come in The Kid Pix Fun Pack, a $19.95 add-on.

Using Kid Pix 2's simple interface, which puts all of the tools on-screen at once, even the smallest painter will be making art in no time. Older children may outgrow the painting tools, but the ability to record sounds and the new support of AVI movies (which users can paste into paintings or create from a Kid Pix Slide Show) will keep even preteens interested in this classic program.

—Luisa Simone

Journey to the Source

CD-ROM PICK HIT

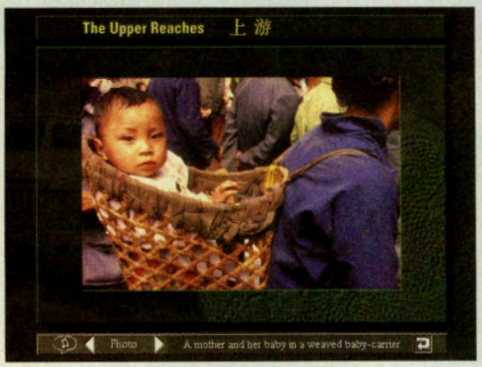
Journey to the Source: An Expedition Along the Yangtze River allows you to follow along with acclaimed explorer How Man Wong as he searches for the source of the renowned river. With this interactive coffee-table book, you can explore China through photos, video clips, and maps, as well as through the text of the explorer's book. You can listen as the explorer narrates the tale or explore a particular region. Like the best paper-based coffee-table books, Journey to the Source is entertaining, educational, and beautiful.

—Gayle C. Ehrenman

Grid Media Ltd.; 011-852-591-0730 (Hong Kong).

Circle 474 on reader service card

★★★★ WIN $59.95





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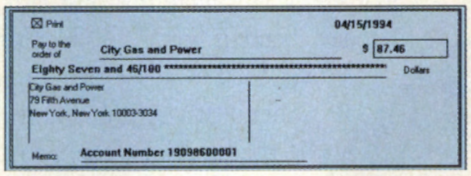

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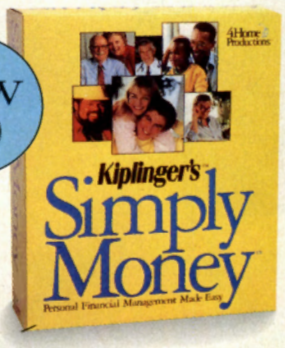

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2015

CIRCLE 920 ON READER SERVICE CARD

Multimedia

Show-and-Tell Goes High Tech

Magic Theatre

Knowledge Adventure; 800-542-4240, 818-542-4200.

Circle 476 on reader service card

★★★ WIN 6-12 $59.95

When telling a story with words and simple pictures ceases to amuse your young raconteurs, it's time to introduce them to Magic Theatre, a creativity program that lets kids create their own animated movies.



The Studio is the heart of the program; here kids choose scenery, paint in props, and add moving objects, animated characters, and background music. To complete the storytelling process, kids can add their own narration using the included microphone. Magic Theatre records each of these actions (ignoring any undos) and then plays them back in real time as a movie scene. Movies may consist of single or multiple scenes.

Spoken help and large icons make it easy for even little filmmakers to get the hang of the program. Adding the many provided elements to a movie is as simple as pointing

QUICK CLIPS

Recommended
? It's Your Call
Not Recommended

Fabio Screensaver and Wallpaper for Windows

A veritable pectoral pictorial starring guess which romance-novel hunk. As the static images flip by, all but the most smitten will wonder why. . . . *$29.95; GTInteractive Software; 212-951-3000.*

Heart: 20 Years of Rock & Roll

More than you ever wanted to know about the lives, loves, and labors of the Wilson sisters, told through diary excerpts, music, and video clips. Imagine your family scrapbook on a memory hog of a CD-ROM and you get the picture. *$49.95; The New CD Music Show; 408-626-1571.*

? Stereolusions

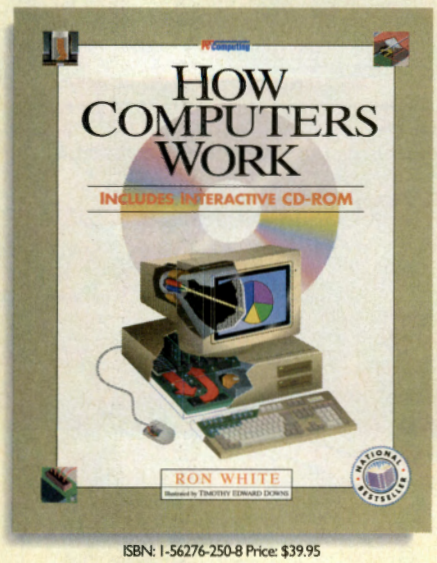
Now you see it, now you don't. Take artwork you've created in a paint package, then render it into one of those vision-shattering hidden images. And let me know if you can find the hidden picture. *$39.00; I/O Software Inc.; 800-800-7970, 909-483-5700.*

Woodstock 25th Anniversary CD-ROM

Like wow, man, it's three days of peace, love, and music on one disk. It's better this time around since you won't have to sleep in the mud just to hear "Suite: Judy Blue Eyes." *$39.95; Time Warner Interactive Group; 800-482-3766.*

Click Click.

PC/Computing How Computers Work CD-ROM/Book extravaganza from Ziff-Davis Press.



ISBN: 1-56276-250-8 Price: $39.95

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WHIZ



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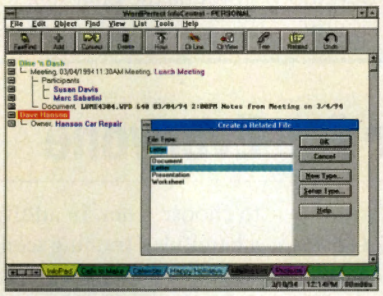

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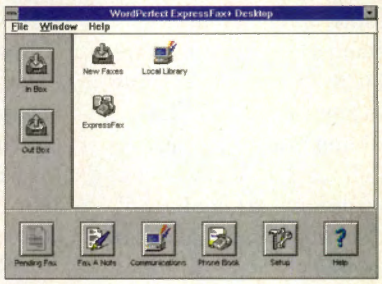

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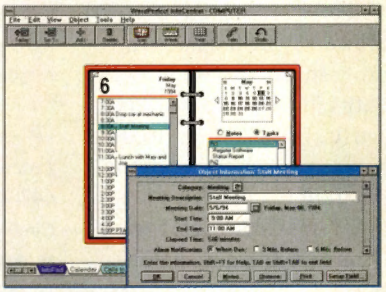

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SPOTLIGHT ON ART

Learning to Paint with Dabbler

Fractal Design Dabbler isn't about instant art. There are no clip-art pictures, no wacky drawing tools, and no animated stamps here. Simply stated: Dabbler is about learning to paint. Like its older sibling Fractal Design Painter, Dabbler mimics traditional art media. So drawing with the pencil tool on one of the 20 different paper grains produces nubby, textured lines. Likewise, markers blend into the underlying colors, and crayons display waxy buildup. The program includes 12 different painting tools ranging from Impressionist oil paint to chalk or spray paint.

Tools are stored in drawers, which makes the program easy to use for both children and novice artists. But Dabbler doesn't have any of the limitations inherent to children's art programs. It isn't restricted to one unchanging palette, for example, and it won't work with anything less than a 256-color adapter.

Dabbler knows that in order to make pretty pictures you have to know how to draw. Toward that end, the manual includes discussions on color theory, as well as a series of abridged drawing lessons by well-known art instructor Walter Foster. There are also prerecorded drawing sessions that can be played back stroke by stroke. You can record and play back your own sessions as well.

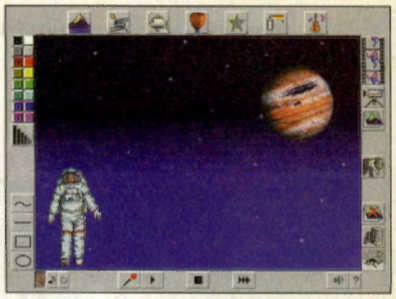
While you might buy Dabbler for your kids, you should also consider buying it for yourself. With practice, you'll be able to recapture your lost creative urges.

—Luisa Simone

Fractal Design Corp.; 800-647-7443, 408-688-5300.
Circle 473 on reader service card
★★★★ WIN $99



Fractal Design Dabbler's drawers open to reveal paper textures and brush options.



Creating multimedia presentations is a snap with Magic Theatre.

and clicking. Adding a piece of art created outside the program, however, is a more tedious process. It will probably require parental intervention to rename drawing files to match the program's naming conventions and then move those files to Magic Theatre's Libraries.

Despite this flaw, Magic Theatre is a wonderful tool for helping kids develop their storytelling and creativity skills. Show-and-tell will never be the same again.

—Gayle C. Ehrenman

Simulations

A Chopper for Everyone

Comanche CD

NovaLogic Inc.; 818-774-0600.
Circle 471 on reader service card
★★★★ CD $74.95

The RAH-66 Comanche attack helicopter was designed for speed and maneuverability at low altitudes, so you'd expect a simulation of it to provide lots of hot action over detailed terrain. Comanche CD delivers on all counts. This disk includes the entire Comanche trilogy, as well as ten bonus missions. The graphics are far more detailed than in other flight simulators, so you can clearly see boulders, rubble, and reflections as you fly through canyons and over water. The best part is that you can fly without spending much time studying the manual. The only controls you need are the collective (altitude) and the cyclic (direction).

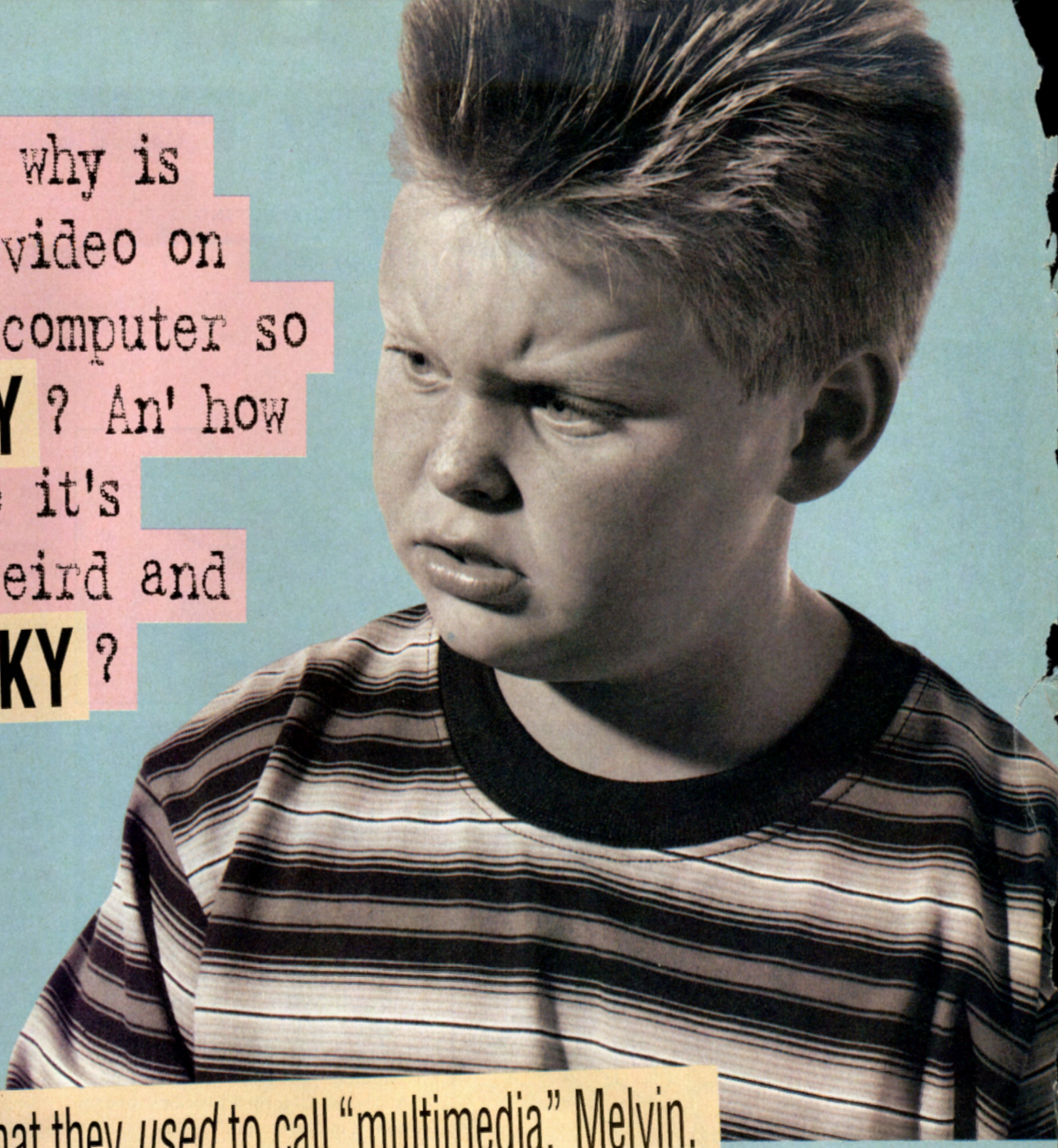
Missions are the focus of Comanche, and there are 100 to choose from. In addition to a handful of training scenarios, there are a number of realistic operations from which to choose, with Maximum Overkill being the ultimate multibattle, theater-wide campaign. Each operation has a different objective and different complications to overcome; at times you may be low on fuel or shy on ammunition. Welcome to the military!



Comanche CD offers 100 missions, ranging from training flights to multibattle campaigns.

Great graphics, sound, and animation come at a price. For best performance, you'll need at least a 486-based PC and lots of memory. Even if you never shoot down an enemy gunship, the graphics alone are worth the ride.

—Don Trivette



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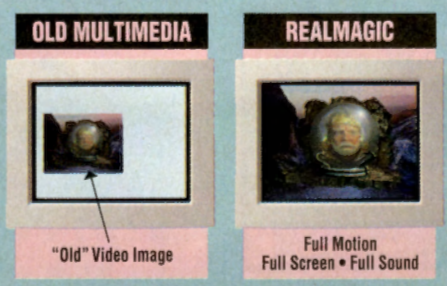

For the store near you or more information on RealMagic, call

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CIRCLE 399 ON READER SERVICE CARD

Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott



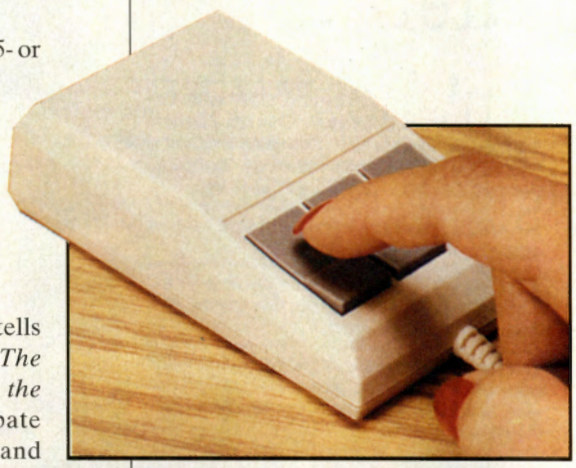
The best way to cheat at Solitaire: Just pretend the card you get is the card you need. (Aristo-Soft brochure.)

Amazing Facts

"Not all storage devices are 3.5- or 5.25-inch squares. A third type of storage medium—the CD-ROM—is spherical."
—*PC Novice*

Hope You Like the Book, Moron

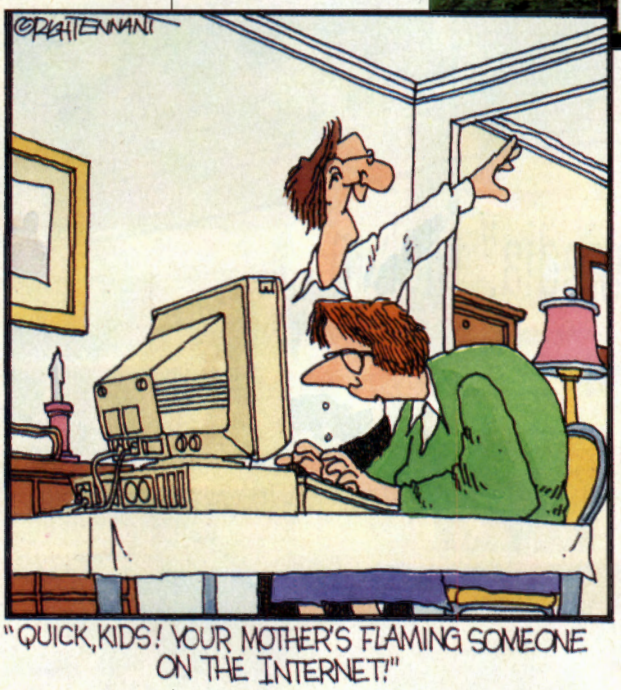
Faithful reader Chris Smith tells us he bought a book called *The Complete Idiot's Guide to the Internet*. Excited by a $3 rebate offer, he filled out the form and sent it in. Two weeks later, he received a check thoughtfully labeled "Complete Idiot's Rebate."



Well, let's hope she knows which end of a knife to hold. (Jones Computer Supplies catalog.)



ARF on the road: Rhinebeck, New York.



Even Dear Abby Would Have Trouble with This One

"**Q.** What are the three keys you hit on an IBM machine to put the booties on your computer?"—R.B., South Toms River
"**A.** The actual term is to boot your computer. It means start it."
—*Asbury Park Press*



Yeeeeouch!!! A radical approach to data protection. (Sofdesign International ad.)

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