Video Computing

It's not just for the Jetsons. Video is arriving as a real business tool. New systems from Apple and Silicon Graphics are leading the way.

STATE OF THE ART

DIGITAL DOCUMENTS MAKE YOUR DATA MORE USEFUL

PLUS

New Little Notebooks, CorelDraw 4.0, Debugging in Windows, Inside Intel's Pentium
**Compatibility & Upgradeability**

We understand compatibility and upgradeability are important to you. You can relax with Gateway. When Dataquest asked 833 PC users in Fortune 500 companies to rate personal computer companies, they ranked Gateway number one in the areas of compatibility, upgrade potential and price. And we give you a written guarantee that our 486 systems are upgradeable to Pentium technology.

**Reliability & Quality**

We understand you want reliability and quality, in both the products you buy and the company you buy them from. That's what you get with Gateway. In three reader surveys conducted by *PC Magazine*, Gateway systems received the highest ratings for reliability. Gateway 2000 is also one of the most financially stable companies in the industry, assuring you that you're buying from a reliable firm that can withstand the rigors of the PC Racing Series.

**Service**

We understand you want the best in service, from your first phone call through the years you own your computer. Judging from the recent “best service” award we received from readers of *BYTE*, you can count on Gateway to live up to your expectations.
In the fast-moving, hard-driving PC industry, the race for leadership is more competitive than a heat at your local stock car speedway. All classes of PC manufacturers are on the direct market track together, trading paint and slamming each other into the wall at every turn. All the while, the unassuming cow-spotted Gateway car consistently outmaneuvers and overpowers the competition.

Repeatedly, Gateway 2000™ leads the field by providing you with the best value in the PC industry. When Gateway takes the checkered flag in this race, you’re the winner!

What’s The Winning Formula?
The driving strategy behind Gateway’s success is simple: understand what customers want and give it to them!

Price
We understand you want the best possible price — and that’s easy for Gateway.

Our competitors would like to have you think they’re now offering a value that meets or beats Gateway. But apples to apples, they’re still hundreds, sometimes thousands of dollars more, while our systems consistently outperform theirs.

You’re a smart shopper. Do the comparisons yourself and you’ll confirm what Dataquest found in a 1993 customer satisfaction survey: Gateway ranked number one for best pricing. When you add the other buying criteria that’s important to you, we offer an unbeatable value.

Performance
We understand you want the best computer performance your money can buy. That’s what you get with Gateway. We hold the track record in the biggest bang-for-the-buck division.

Our price-performance ratio is even better this month thanks to improved video on our highest performance systems. We replaced the award-winning ATI™ Graphics Ultra Pro with ATI’s latest-generation video card, the Graphics Ultra XLR. The new XLR is up to twice as fast as the Ultra Pro, and it’s the best all-around video performer in DOS and Windows™.
The Heat Is On...
| Model  | Processor | RAM | Cache | Disk Drive | Hard Drive | Processor | Cache | Disk Drive | Hard Drive | Processor | Cache | Disk Drive | Hard Drive | Processor | Cache | Disk Drive | Hard Drive | Processor | Cache | Disk Drive | Hard Drive | Processor | Cache | Disk Drive | Hard Drive | Processor | Cache | Disk Drive | Hard Drive |
|--------|-----------|-----|-------|------------|------------|-----------|-------|------------|------------|-----------|-------|------------|------------|-----------|-------|------------|------------|-----------|-------|------------|------------|-----------|-------|------------|------------|-----------|-------|------------|------------|-----------|-------|------------|------------|
| 4DX-25 | 25MHz 486SX Intel® Processor | 4MB RAM | 3.5" Diskette Drive | 170MB 13ms IDE Hard Drive | Intel Pentium™ Technology Ready | Windows Accelerated Video w/512K DRAM | "14" Color CrystalScan® 1024NI | Mini Desktop Case with Password Protection | 124-Key AnyKey® Keyboard & MS Mouse | MS-DOS® 6, Diagnostics & Windows™ | MS Works for Windows® 2.0 | $1295 |
| 4DX-33V | 33MHz 486DX Intel Processor | 8MB RAM, 128K Cache | 5.25" & 3.5" Diskette Drives | 340MB 13ms IDE Hard Drive | Local Bus I DE Interface | Intel Pentium Technology Ready | Windows Accelerator w/1MB DRAM on VL-Bus™ | "14" Color CrystalScan 1024NI | Desktop Case (Tower Upgrade) with Password Protection | 16-Bit ISA Slots | 124-Key AnyKey® Keyboard & MS Mouse | MS-DOS 6, Diagnostics & Windows | MS Works for Windows 2.0 | $1995 |
| 4DX-50V | 50MHz 486DX2 Intel Processor | 8MB RAM, 128K Cache | 5.25" & 3.5" Diskette Drives | 340MB 13ms IDE Hard Drive | Local Bus IDE Interface | Intel Pentium Technology Ready | "15" Color CrystalScan 1572FS | Desktop Case (Tower Upgrade) with Password Protection | 7 16-Bit ISA Slots, 2 on VL-Bus | 124-Key AnyKey® Keyboard & MS Mouse | MS-DOS 6, Diagnostics & Windows | Choice of Application Software | $2295 |
| 4DX-66V | 66MHz 486DX2 Intel Processor | 16MB RAM, 256K Cache | 5.25" & 3.5" Diskette Drives | 500MB 11ms SCSI Hard Drive | 32-Bit EISA/SCSI Controller | Windows Accelerator w/1MB DRAM on VL-Bus | "15" Color CrystalScan 1572FS | Desktop Case (Tower Upgrade) with Password Protection | 7 16-Bit ISA Slots, 2 on VL-Bus | 124-Key AnyKey® Keyboard & MS Mouse | MS-DOS 6, Diagnostics & Windows | Choice of Application Software | $2995 |

**SOFTWARE**

If a system comes with "choice of application software," choose one of the following packages:
- Microsoft Works for Windows®
- Microsoft Excel for Windows®
- Microsoft Word for Windows®
- Microsoft Word and Bookshelf "92, CD-ROM Edition
- Microsoft PowerPoint for Windows®
- Microsoft Project for Windows®
- The MS Entrepreneur Pack
- Borland Paradox® and Quattro Pro® for Windows

All hard drive sizes are manufacturer’s specified capacities. MS-DOS® 6 can increase hard drive capacity through software compression.

---

**GATEWAY2000**

"You’ve got a friend in the business."®

800-846-2058

610 Gateway Drive • P.O.Box 2000 • North Sioux City, SD 57049-2000 • Phone 605-232-2000 • TDD 800-846-1778 • Fax 605-232-2023 • FaxBack 605-232-2561

Sales Hours: 7am-10pm Weekdays, 9am-4pm Saturdays (Central Time)

©1993 Gateway 2000, Inc. AnyKey, CrystalScan, black-and-white spot design, “G” logo and “You’ve got a friend in the business” slogan are registered trademarks, and Gateway 2000 and Telepath are trademarks of Gateway 2000, Inc. The Intel Inside Logo, Intel and Pentium are trademarks or registered trademarks of Intel Corporation. All other brands and product names are trademarks or registered trademarks of their respective companies. Prices and configurations are subject to change without notice. Prices do not include shipping.
You DON'T WALK AWAY FROM

PRESENTING INTERACTIVE UNIX 4.0

When the INTERACTIVE™ UNIX® System for personal computers was introduced in 1987, it quickly became a classic. Suddenly operations from video stores to Bridgestone/Firestone® production lines had a reliable, stable operating system ready for mission-critical applications. It's still among the most cost-effective multiuser operating systems available and a dream to install and administer. In fact Open Systems Today called it "...a masterpiece of good design". Today over 500,000 users enjoy its benefits. But time marches on, and even an industry-tested classic

FOR A LIMITED TIME*, ALL MULTIUSER INTERACTIVE UNIX 4.0 ORDERS WILL INCLUDE A FREE COPY OF FASTBACK PLUS™ (A

©1993 Sun Microsystems, Inc. SunSoft, the SunSoft and Sunburst logos are trademarks or registered trademarks of Sun Microsystems, Inc. INTERACTIVE is a trademark of INTERACTIVE Systems Corporation. UNIX is a registered
A GREAT IDEA. YOU EVOLVE.

deserves a superior upgrade. Hence, INTERACTIVE UNIX 4.0 — with new power features that improve system functionality and peripheral support, making it perform better than ever. It still runs over 2,000 applications including RealWorld Accounting Software®, Informix® and WordPerfect®. And now it runs more SCO applications because it's iBCS2 compliant. What's more, INTERACTIVE UNIX 4.0 is backed by SunSoft, the leading supplier of 32-bit UNIX operating systems. Fact is, INTERACTIVE UNIX 4.0 is even better at doing what the industry classic has always done so well: improving the performance of your computing system at a lower cost per seat. Nothing revolutionary. Simply evolutionary.  

$399 VALUE. IT'S THE INDUSTRY'S FASTEST UNIX BACKUP SOFTWARE. FOR MORE INFORMATION, CALL 1-800-227-9227.  

trademark of UNIX System Laboratories, Inc. All other trademarks and registered trademarks are the property of their respective holders. Open Systems Today quote April 13, 1992. *Must purchase by December 31, 1992.  

Circle 169 on Inquiry Card.
Cover Story

PERSONAL DIGITAL ASSISTANTS

Behind the Wheel of the First Newton and Zoomer PDAs
By Andy Reinhardt
Page 22

Test drives of prerelease Apple, Sharp, and Casio Zoomer PDAs reveal rough edges and a lot of promise.

DATA ANALYSIS

Spreadsheet or Database?
The Best of Both
By Andy Reinhardt
Page 29

A new breed turns the traditional spreadsheet metaphor on its head.

DESKTOP PUBLISHING

Windows No Mac at DTP
By Tom Thompson and Ben Smith
Page 35

In desktop publishing, Windows has come a long way, but DTP experts say it still has a long way to go.

CONTACT MANAGEMENT

Scanners Turn Business Cards into Database Records
By Randy Cronk
Page 44

Is your desk cluttered with business cards that you still haven't entered into your database? Technology comes to the rescue.

OPERATING SYSTEMS

IBM Announces "Better" DOS Than MS-DOS
By Randy Cronk
Page 46

IBM releases a new version of PC-DOS.

PROCESSORS

AMD Declares Independence
By Randy Cronk
Page 46

AMD unveils the first of a new line of processors.

PACIFIC RIM

Report from Taiwan
Page 48

Taiwan is reengineering itself to be a designer of computer products.

NEW PRODUCTS

What's New
Page 236

A workstation line with zippy graphics, a notebook with an active-matrix display, portable multimedia, a RAID-5 array, CAD tools, and more.

VIDEO COMMUNICATIONS

Video Conquers the Desktop
By Andy Reinhardt
Page 64

Integrated video capability has arrived for desktop systems—and with it, intriguing new possibilities.

Document Conferencing Keeps Data Close-By
Page 66

Video Compression Standards Vie for Acceptance
Page 72

Pandora and the Active Office
Page 76

Apple, SGI Blaze Video Trail
By Tom Thompson and Ben Smith
Page 81

With integrated video and sound features, new systems from Apple and Silicon Graphics herald a new era of desktop computers.

Features

COMPUTING IN INDIA

India's Software Edge
By Jon UdeUll
Page 55

India has contributed programming talent to the microcomputer world. Now it wants to contribute products.

State of the Art

ELECTRONIC PUBLISHING

Publish It Electronically
By Cary Lu
Page 94

Electronic publishing lets you build enterprise-wide knowledge bases.

Magazines Without Paper
Page 108

Unlocking Data's Content
By Randy D. Cronk
Page 111

Tagging languages and compound document architectures code your documents for cross-platform access.

This month's cover image—showing George Jetson and his boss taking advantage of digital video communications—was created exclusively for BYTE by artists at Hanna-Barbera.
C++ Does Windows
The Littlest Notebooks
AGiant Leap to
subnotebook machines, including Co mp USA ·s
OPERATING SYSTEMS
addresses the complexities of Windows.
operating system forward, beyond the reach of
current desktop operating systems. Bulletproof
compilers, from Microsoft, Borland, Symantec,
and conferencing system goes multiplatfom1. I LS
Gemiany, presents the Video Machine, a
a real contender in the E-mail market.
APPLICATIONS
are among the improvements.
WORKGROUP SOFTWARE
A FirstClass Experience
BY RAYMOND GA C6TE SoflArc's First Class mail
and conferencing system goes mult platform. Its
elegant client interface, strong conferencing features,
and multitasking communications engine make it a
real contender in the E-mail market.
MULTIMEDIA
Video Machine: True Desktop Video
BY BOB LINDSTROM Fast Electronic of Munich,
Germany, presents the Video Machine, a
software/hardware combination that links with
VCRs and video monitors to turn a PC into a
Windows-based desktop video editing system.
PROGRAMMING TOOLS
C++ Does Windows
BY RICK GREHAHN The BYTE Lab tests five C/C++
compilers, from Microsoft, Borland, Symantec,
MetaWare, and Watcom, to determine how well each
dresses the complexities of Windows.
PORTABLE COMPUTING
The Littlest Notebooks
BY STEVE APIKI BYTE tests three next-generation
notebook machines, including CompUSA's
4SL/25 Subnote, HP's OmniBook 300, and the
Zenith Data Systems Z-Lite 320L.
OPERATING SYSTEMS
A Giant Leap to OS/2 2.1
BY BARRY NANCE OS/2 2.1 brings IBM's 32-bit
operating system forward, beyond the reach of
current desktop operating systems. Bulletproof
multitasking and support for Windows 3.1
applications are among the improvements.
WORKGROUP SOFTWARE
A FirstClass Experience
BY RAYMOND GA COTE SoflArc's First Class mail
and conferencing system goes mult platform. Its
elegant client interface, strong conferencing features,
and multitasking communications engine make it a
real contender in the E-mail market.
MULTIMEDIA
Video Machine: True Desktop Video
BY BOB LINDSTROM Fast Electronic of Munich,
Germany, presents the Video Machine, a
software/hardware combination that links with
VCRs and video monitors to turn a PC into a
Windows-based desktop video editing system.
HANDS-ON TESTING
Lab Report:
32 High-Speed Hard Drives
We stress-tested 32 hard drives to find the best
performers in capacities from 250 MB to 2 GB.
The Best Drives in Capacities from 250 to
350 MB—178
How We Tested—182
The Best Drives in Capacities from 400 to 600 MB—184
The Best Drives in Capacities from 1 to 2 GB—188
Honorable Mentions—190
PROCESSORS
Under the Hood:
Pentium: More RISC
Than CISC
BY DICK POUNTAIN Why the
Pentium's architecture doesn't
measure up to its RISC
competitors.
PROGRAMMING
Some Assembly Required:
Debugger Support in
Windows 3.1
BY MATT PIETREK How to exploit
debugging support in Windows 3.1.
OPERATING SYSTEMS
Beyond DOS: Virtual Device
Drivers for DOS
BY BILL HAWKINS AND
ED PUCKETT Virtual device drivers aren't just for Windows
applications.
Opinions
Pournelle:
IBM's Preemptive Strike
BY JERRY POURNELLE OS/2 2.1
is technically excellent. What's
needed is widespread device-driver
support.
Books & CD-ROMs:
Cyber Worlds
BY HUGH KENNER AND OTHERS
William Gibson's Virtual Light;
the hip guide to NetWare; learning
about computers on CD-ROM;
nanotechnology; and other titles.
Commentary:
Installer Hell
BY MICHAEL Crichton Software
installation programs work in
strange and mysterious ways, says
the author of Jurassic Park.
Editorial
BY DENNIS ALLEN
Letters
BY BOB LINDSTROM
Readers react to BYTE's
new look.
RECOR S G I D E
Inquiry Reply Cards
BUYER'S GUIDE
Mail Order
Hardware/Software Showcase
BYTE's Mart
PROGRAM LISTINGS
From BIX: Join "listings/ frombyte93" and
select the appropriate subarea
(i.e., "aug93").
From the UNIX ftp://ftp.unix.net, log
in as "anonymous," and enter your user
ID as your password. Type
"cd/published BYTE" and type "DIR.
"Files appear in subdirectories arranged
by month.
From the BYTE BBS at 1200-9600 bps:
Dial (603) 924-9820 and follow the
instructions at the prompt.
BYTE (ISSN 0360-5280) is published monthly with adver-
torial issues in April and October by McGraw-Hill
Inc., U.S. subscription rate $20.95 per year. In Canada
and Mexico, $34.95 per year. European surface mail sub-
scriptions $60, airmail $80. Non-European subscrip-
tions, $60 surface mail or $85 airmail. All foreign sub-
scriptions are payable in U.S. funds that can be drawn
on a U.S. bank. Single copies $2.50 in the U.S., $4.50
in Canada, Executive, Editorial, Circulation, and
Advertising Offices: One Phoenix Mill Lane, Peterbor-
ough, NH 03690. Second-class postage paid at Peterbor-
ough, NH, and additional mailing offices. Postage paid at
Winnipeg, Manitoba, Canada Post International Publications
Mail Agreement No. 244642. Register-
ted for GST as McGraw-Hill, Inc., GST #123075673.
Printed in the United States of America. Postmaster:
Send address changes and fulfillment questions to
BYTE Subscriptions, P.O. Box 552, Hightstown, NJ
08520.

The Jetsons are a Registered Trademark of Hanna-Barbera Productions, Inc. All Rights Reserved.

September 1993 BYTE 5
Spreadsheet or Database? The Best of Both

What's happening in data-analysis tools, including Windows-based spreadsheets.

Windows No Mac at DTP
Some people are using Windows as a platform for desktop publishing, but as a publishing environment, Windows has a long way to go.

IBM Announces “Better” DOS Than MS-DOS
PC-DOS 6.1 comes with a disk doubling, a backup utility, and speed improvements.

C++ Does Windows
A review of five compilers for Windows...

A FirstClass Experience
SoftArc's mail-and-conferencing system connects Windows and Mac users.

Video Machine: True Desktop Video
Fast Electronic's hardware/software package turns a Windows PC into a video-editing system.

LANtastic 5.0 vs. Invisible LAN
Better Windows integration is just one of the improvements made to both of these peer-networking packages.

CorelDraw 4.0: The Word Is More
A look at all the new things added to this ever-evolving graphics package.

Some Assembly Required: Debugger Support in Windows
Good debugging help at the operating-system level is essential for writing good code. The author of Windows Internals looks at how Windows stacks up.

Beyond DOS: Virtual Device Drivers for DOS
Developers can build virtual-device-driver support into their DOS applications and tap into the power of the Windows API.

OS/2
A Giant Leap to OS/2 2.1...
Barry Nance finds the newest OS/2 "a definite step up from Windows-on-DOS." It's faster than before, supports more printers and CD-ROM drives, and has multimedia hooks.

Pouvelle: IBM's Preemptive Strike
Our columnist checks out OS/2 at Comdex, talks to IBMers about device drivers, and praises the operating system but bemoans its PR.

Macintosh
Video Conquers the Desktop
With desktop systems like the new audiovisual Macs, video can be treated as just another data type. This will open up more effective channels of communication among individuals and workgroups.

Apple, SGI Blaze Video Trail
Apple's new Quadra 840AV and Centris 660AV take a pioneering step in the merging of computers and audio/video technology. Tom Thompson reports the firsthand details.

A FirstClass Experience
SoftArc's FirstClass, a Mac-centered e-mail and conferencing system, reaches out to include Windows users.

Lab Report: 32 High-Speed Hard Drives
Buying a new hard disk? This month's Lab Report will help you pick the right one. Our custom benchmarks rate hard drive speeds...in capacity categories ranging from 250 MB to 2 GB.

Unix
Pandora and the Active Office
Unix workstations are part of a distributed multimedia system being developed at Olivetti Research, in Cambridge, England. Digital video and audio services will be able to follow users from room to room and then route video calls and messages to the nearest workstation.

Apple, SGI Blaze Video Trail
Silicon Graphics' new Indy workstation features advanced capabilities for creating and displaying information, including full-motion video and a built-in digital color camera. But SGI has also revamped the user interface, adding voice commands and refining the Motif-based workspace. It now looks like a combination of Hewlett-Packard's VUE, Solbourne's virtual desktop, Next's NextStep, and the Mac.

Networks
Books & CD-ROMs
How to Keep Your Novell Network Alive is a gonzo guide to Novell networking.

Video Conquers the Desktop
With the integration of digital video and desktop computers, video files could be coming soon to a network near you.

Pandora and the Active Office
An experimental system being developed by Olivetti Research distributes video and audio across a high-speed ATM network. The current setup links more than 40 workstations spread over four separate sites, a half-mile apart. Users have videophone, video mail, and conferencing services. "Pandora's Box" combines the functions of network interface, stream manager, and video mixer.

Publish It Electronically
Network-based database documents can help you find the right information when you need it. Products such as network librarians can keep it all under control.

A FirstClass Experience
SoftArc's FirstClass is an E-mail and conferencing system that works equally well over LAN and dial-up connections. The new version of this Mac-centered product works with Windows clients.

LANtastic 5.0 vs. Invisible LAN
Artisoft and Invisible Software have improved their peer-to-peer network packages with major revisions. Both are now faster, and they simplify the linking of DOS and Windows workstations. They also offer an alternative to Windows for Workgroups. But one is built for comfort, the other for speed.

Client/Server
India's Software Edge
As a nation of small systems and no mainframe era, India has an edge when it comes to client/server computing.

Publish It Electronically
Publishing data digitally can enable people in an enterprise to quickly find the information they need.

Audio
C++
CD-ROM
Compressors
Compilers
Compound Document
Architecture
Compression
Conferencing
Debugging
Desktop video
Documents
Electronic publishing
Electronic reference documents
E-mail
Encoding documents
Hard drives
Illustration software
Imaging Systems
India
Installers
Networks
Notebooks
OS/2
Paperless magazines
PCMCIA
Pentium
Personal digital assistants
Processors
Programming
RISC
Search engines
SGML
Spreadsheets
Taiwan
Virtual device drivers
Virtual reality
Windows
The Pinnacle Tahoe™ Portable 3.5" Optical Drive

Introducing the world's smallest portable 3.5" optical drive with a rechargeable battery pack option that provides hours of portable computing. The Pinnacle Tahoe-130 offers the ultimate in removability and transportability. It provides portable storage for notebook computing and is the perfect choice for your desktop computer.

The Tahoe™'s 128 MB optical drive weighs only 1.8 pounds and can fit in the palm of your hand. It's small size is so flexible it can easily fit into any briefcase.

Lake Tahoe, Nevada

128 MB REWRITABLE OPTICAL DRIVE

The Tahoe™ is the perfect solution for users on the go, providing fast data transferring between your notebook and desktop computers. Simply connect the Tahoe™ to any parallel port interface and you are ready to go.

The Pinnacle Tahoe-130 has an ultra fast seek-time and data throughput that rivals hard disk performance.

To order a Tahoe™ to go call: 800.553.7070

Trademark: Tahoe and Tahoe-130 of Pinnacle Micro Inc. All other trademarks and registered marks are their respective owners.
In relentless detail, we studied hands of all dimensions. We consulted professors of kinesiology, engineers, ergonomists and computer users. We used digital fiber optics to analyze the human hand. We followed it in motion.

The result is a new Microsoft Mouse that is, well, anatomically correct. Uncommonly comfortable.

The palm is perfectly supported. Left or right handed, the grip is comfortable. Fingertips fall naturally into place. A click feels just right.

This mouse even looks good. Intriguingly asymmetrical. Yet it somehow reminds you of the gentle curves of a human form.

Did we mention that it also has some innovative new software features? They allow you to customize the mouse, so it works the way you like to work.

Try the new Microsoft Mouse. If you're not comfortable, we'll refund your money. Guaranteed. Details are on the box, which you can quickly get your hands on at a computer store near you.
The Promise of High-Tech

Exploitive promises only serve to confuse the ill-informed and artificially inflate market demand

Our generation always knew that video computing would happen, and we knew it long before personal computers even existed. We grew up believing in it like we believed in many other high-tech possibilities. The potential of technology seemed endless and so simple that our imaginations were easily ignited by "The Jetsons," *2001: A Space Odyssey*, a myriad of science fiction novels, and countless B-grade sci-fi movies.

The question has never been *if* the technology would be possible, but *when* it would become available. And therein lies the implicit promise that the general media so willfully and continually exploited, raising expectations of technology beyond what could actually be achieved.

So it was with a little tongue in cheek that we chose an image from "The Jetsons" for our cover art. No, I’m not suggesting that George Jetson’s view of video computing is even close to today’s video reality. However, the fine folks at Hanna-Barbera created a wonderful original illustration for BYTE that reminds me of how the general public perceives video computing. It also reminds me of the nearly three decades of raised expectations and undelivered promises that have confused computer illiterates. Is it any wonder that when it comes to video computing so many people are jaded?

Some folks will say that video computing is a solution looking for a problem. You and I, of course, know better. We know that while the enabling technology has finally arrived in the form of integrated, video-ready systems such as the Silicon Graphics Indy and the Apple AV Macs, the application of that technology must still be developed. That means a lot of hard work from folks like you, who choose to implement desktop video, and from folks in the computer industry, who should listen to your needs. I’m confident that work will be fruitful, and that it will take the next few years to be accomplished.

Meanwhile, it’s time that we hold in check some of the high-tech promises being exploited by the general press and industry leaders who stand to gain from that exploitation. Take, for example, John Sculley’s promises for Apple’s PDA (Personal Digital Assistant), the Newton. Over a year ago, Mr. Sculley—back when he was running the show at Apple—started his crusade about how the Newton, which is yet to become available, would do nearly everything that a secretary could do. Now *that* sounds like an idea right out of "The Jetsons." If you think for one minute that a hand-held computer is going to be anything nearly as effective as a real live assistant, then you’re probably not a regular BYTE reader—BYTE readers know better.

The fact is that, since Mr. Sculley’s first remarks about the Newton over a year ago, Apple has been doing some serious backpedaling about what the Newton might do. That’s not to say that the Newton won’t be a useful device; it may be, and we’ll be the first to let you know one way or the other. To say the least, the Newton is very clever and interesting.

The point is just that I’m sick and tired of all the exploitive promises about high-tech that only serve to confuse the ill-informed while artificially inflating market demand. These promises also send other manufacturers on a wild-goose chase, and users down a primrose path loaded with more thorns than petals.

Sure, PDA technologies hold a great deal of potential, and there’s nothing wrong with dreaming a little. To paraphrase Henry David Thoreau, we *should* build castles in the clouds. But we must also construct solid foundations to support them. For PDAs, though, the foundation, or enabling technologies—namely greater horsepower and miniaturization—are yet to come.

For the time being, these little hand-held computers will be cute and perhaps useful. But calling a tiny computer an “assistant” is stretching things a bit too much. Regrettably, though, these devices have already been christened, and BYTE will join the rest of the world in using the term Personal Digital Assistant. We do so under protest, however, because a tiny computer is no more an assistant than my lawnmower (or is that PMA—Personal Mower Assistant?) is. Hell’s bells, my dog assists me better than the Newton ever will, and I don’t call her a PDA (Personal Dog Assistant). At least my dog understands voice commands and can fetch things.

Please, let’s spend less time perpetuating technology myths and more time creating and implementing enabling technologies that can do something useful.
"The new speed demon"

—PC Magazine, May 11, 1993

The fastest dBASE ever
Whether you’re browsing data, executing queries, creating reports, or running applications, new dBASE IV® version 2.0 gets your job done faster. Everything is 100% compatible with earlier versions of dBASE III PLUS® and dBASE IV, only now it works up to ten times faster. Some tasks are hundreds of times faster—even on networks! It’s no wonder that PC Magazine calls new dBASE IV v2.0 “the new speed demon.”

there, it’s easy to create or use any data table, query, form, report, label, or application. dBASE IV is built for end users and developers alike. In fact, a recent usability study* proves that for everyday tasks, users get their work done 25% faster with dBASE IV v2.0 than with FoxPro v2.5.

New! dBASE Compiler
The new dBASE Compiler for DOS* is the only compiler 100% compatible with the industry standard dBASE language. Compile and run your existing dBASE III,® dBASE III PLUS, and dBASE IV applications without modification. And generate high-performance, fully functional .EXEs with no royalties or runtime modules.

Catch up with the new speed demons. Get new dBASE IV v2.0 and the dBASE Compiler today!

Borland
Power made easy

*Susability Science Corporation, dBASE IV v2.0 vs. FoxPro v2.5, June 1993. dBASE Compiler for DOS sold separately. Copyright © 1993 Borland International, Inc. All rights reserved. All Borland product names are trademarks of Borland International, Inc. Offer good in the United States and Canada only. Prices in U.S. dollars. Dealer prices may vary. BL 5750.1

Circle 67 on Inquiry Card (RESELLERS: 68).
We can understand why other companies don't include a 3 year warranty.

(If We Sold Their Compus

In the computer business, the standard warranty is one year. As in twelve computer and you get a free 3-year warranty! Buy one of their computers.
months. 365 days. 8,760 hours. Buy any Compaq and you could find yourself counting the minutes.
How to Contact the Editors

We welcome your questions, comments, complaints, kudos, and submissions.


ELECTRONIC MAIL ON BIX, send to "editors." All BYTE editors and columnists also have individual mailbox numbers on BIX for easy access.

MOHICAN 25138 BYTE Magazine. Other editors also have individual MCI addresses in their own name.

OTHERS: Many editors also reach out through usenet, AppleLink, CompuServe, and numerous other services.

U.S. fax: Editor (603) 924-2550. Advertising: (603) 924-7507. Marketing: (603) 924-3633.

SUBMISSIONS: Authors: We welcome article proposals and submissions. Unacceptable manuscripts will be returned if accepted by sufficient return postage. Please call us before submitting any unsolicited product samples.

EDITORIAL REPRINTS: For permission to reprint customized reprints of BYTE articles, contact Susan Montonk, reprints manager, at (603) 924-2686. (Minimum quantity: 500).

BYTE Subscriptions Service

Inside U.S.: (800) 553-BYTE; outside U.S.: +1 603 426 7676. For a new subscription, (800) 257-9402 U.S. only, or write to BYTE Subscriptions Dept., P.O. Box 2055, Hightstown, NJ 08520. Subscriptions are $29.95 for one year, $34.95 for two years, and $74.95 for three years in the U.S. and its possessions. In Canada and Mexico, $34.95 for one year, $64.95 for two years, $76.95 for three years. In Europe, £42 ($US60) for fast surface delivery, £55 ($US80) for air delivery. Non-U.S. residents outside Canada, Mexico, and the U.S. must add $75 per year for air delivery. $55 (US$80) for surface mail, or $US85 for air mail. Single copy price is $3.50 in the U.S. and its possessions, $4.50 in Canada. Foreign subscriptions and sales should be remitted in U.S. funds drawn on a U.S. bank. Please allow six to eight weeks for delivery of first issue.

COPYRIGHT PROTECTION: Where necessary, permission is granted by the copyright owner for those registered with the Copyright Clearance Center (CCC), 27 Congress St., Salem, MA 01970, to photocopy any article herein for personal or internal reference use only for the flat fee of $1.00 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 27 Congress St., Salem, MA 01970.

CCC, 27 Congress St., Salem, MA 01970. Special ISSN 0390-5260. $1.50. Copyright done for other than personal or internal reference use requires written permission from the copyright owner. Grants general permission for the copier to use up to 100 percent of any article herein. For articles in this issue, please contact the copyright owner directly. Use of computer programs and other computer-related articles is subject to copyright holder's permission.

Member Audit Bureau of Circulation
**ON ONE HAND, PROJECT MANAGEMENT CAN BE A REAL HEADACHE.**

You work hard enough planning your projects; why not let Microsoft Project 3.0 for Windows help you make it easier?

With clear graphs, you’ll be able to see and communicate your project even better—from the tiny details to the big picture.

Changes? No problem. For every revision you make, Microsoft Project helps you see how it will affect the entire job.

Assigning a new job? Just click the People button. Want to know who’s doing what, when? Microsoft Project can help you keep track of everyone.

And if you need to get off to a fast start, use Planning Wizards to guide you step by step. Soon, you’ll have great-looking, easy-to-read reports that make all your plans perfectly clear.

You can even exchange files between Microsoft Project on your PC and your Mac. Either way, why not plan on the leading project management software? Microsoft Project 3.0—it takes the pain out of planning.

---

**ON THE OTHER HAND, WHY SHOULD IT BE?**
If this is how your computer does Windows, we got a PC for you.
Don't wait. Put one of our Image Series 486 PCs on your desk immediately. You'll get Windows performance that really screams.

And we're not the only ones who feel that way. In a recent review of the Image Series, PC World wrote, "Say goodbye to waiting in Windows."

**Making it fast.**

Our ingenious Image Video technology combines second-generation local bus video with a powerful graphics accelerator, so even the most complex, most demanding graphics applications run full blast. And with our True Color support for over 16.8 million colors and photo-realistic images, those applications will have the impact of a speeding freight train. The bottom line: Your productivity takes a fast turn skyward.

Our new Image PCs are built for easy, 238-pin ZIF-socket upgrades to the next generation of Pentium-based Intel OverDrive processors. We've also given them an on-board SCSI II interface, for quick connections to a wide range of peripherals.

**But wait: it gets even better.**

In addition, NEC's OptiBus technology can make those peripherals perform up to 30% faster than ordinary systems. While our ImageSync feature delivers flawless, flicker-free images with no adjusting when used with one of our award-winning MultiSync FG monitors.

The NEC Image Series. Just part of a whole family of great personal computers, from our affordable PowerMate PCs, to our expandable Express servers. So (why wait?), call 1-800-NEC-INFO or NEC FastFacts at 1-800-366-0476, request document 46243.

Because is the way you want to go.
A Better BYTE

The June issue of BYTE is the best one yet. Dennis Allen’s editorial, an excellent article on OS/2 2.1 (“IBM Unleashes a New OS/2”), and a few objective criticisms of Windows (“Windows, Windows Everywhere?”) indicate to me that BYTE does not intend to yield to the marketing pressures affecting other publications.

Robert Simpson
Library, PA

Thank you for the new design of BYTE. I can’t tell you how many times I have searched through a stack of magazines looking for an article that I remembered reading somewhere. It’s truly amazing how a simple idea such as a better table of contents can reap great benefits.

J. R. Beecham
Lantana, FL

Windows Everywhere

In “Windows, Windows Everywhere?” (June BYTE), Jon Udell is correct to remind us of “software developers who were badly burned by Microsoft’s handling of OS/2.” Indeed, that should have been the theme of his entire article on the “Windows everywhere” strategy.

BYTE owes its readers more responsible reporting of computer technology. Udell raises important questions about the viability of “Windows everywhere,” but the analysis of Windows NT and the “Windows everywhere” strategy is incredibly vacuous. After two years of hype, we are finally told that Windows NT will require too many resources and have too little downward compatibility for desktop systems.

Furthermore, NT’s sparse graphics support limits its value as a graphics workstation, and its inability to support multiple terminals means it can’t handle multiple users. The lack of global directory services gives pause to the question: How useful is NT as a network operating system? In view of these facts, the obvious question is: “Who needs NT?”

Remarkably, the credibility of this “Windows everywhere” strategy was never seriously questioned. Microsoft scarcely has a track record on multitasking systems. Yet we are supposed to believe that version 1.0 of one of the most complex systems Microsoft has ever designed will be a good candidate for a mission-critical server.

Udell recommends Win32s and suggests that Windows 4/DOS 7 is “lurking offstage.” But he does not say when this may be available. The latest rumors seem to be late 1994. Given Microsoft’s practice of missing shipping dates by more than a year, perhaps that means 1995. It might be more accurate to say Chicago isn’t even on its way to the theater.

Richard E. Hodges
Los Angeles, CA

The opinions expressed are mine, but they are supported by interviews with dozens of software developers, systems builders, and other industry experts. Most informed observers agree that the Windows API in its various forms is a force to be reckoned with, as is NT as the top tier of a layered operating-system strategy. Where there are holes in that strategy—advanced graphics, directory services, multiuser capability, and suitability for small and/or mobile devices—I called attention to them and discussed alternatives.

My assessment of NT is, indeed, strongly influenced by my own experience with the product. It has been, throughout its long beta-test cycle, as solid a system as I’ve ever seen. That robustness, coupled with strong support, smooth application portability from 16-bit Windows, and the ability to leverage RISC and multiprocessing technologies, I find impressive.

Given the importance of the Windows 3.x software base—something that Windows OS/2, WABI (Windows Application Binary Interface), and other initiatives clearly acknowledge—Microsoft’s plan to carry Windows forward to the next generation of PCs is certainly a reasonable one. IBM, Sun, and some other companies have their own plans, which you’ll read about here. But to have focused the whole piece on the IBM/Microsoft rift, as you suggest, would have been a peculiar way to do the “responsible reporting” you say the article lacked.—Jon Udell

OS/2 in Review

Kudos to BYTE for its fair review of OS/2 2.1 in the June issue (see “IBM Unleashes a New OS/2”). Although only two pages were devoted to OS/2, it was a remarkable divergence from the media’s tendency to bash OS/2 in favor of the sacred cow, Windows NT. I hope that BYTE will not simply become another Microsoft lackey, so many other publications have done.

Tim Tyler
Rockledge, FL

Thanks for printing Barry Nance’s “IBM Unleashes a New OS/2.” I’ve been critical of BYTE for its apparent Windows-centric orientation, but this article and your Contents by Platform index are very reassuring.

John Faughnan
Escanaba, MI

Stop the Whining

I wish you would cut down on the number of “what about us” letters from OS/2 users. It seems that a great deal of space is being devoted to distrib-uties complaining about how OS/2 is greatly superior to Windows, yet receives almost no coverage.

This is reminiscent of the old DOS versus Mac wars. Mac users complained that the superior Mac OS wasn’t given a fair shot because of the immense sales and marketing muscle of IBM. Now OS/2 users are making the same complaints about Microsoft.

Let’s have more letters about real user issues.

Aaron F. McPherson
Allston, MA

Fix

Our July review of Lotus Notes release 3 (“One Thumb Up, One Thumb Down”) contained incorrect pricing information. The Starter Pack ($995) and User license ($495) prices are correct, but the prices for other user levels are erroneous. Contact Lotus for quantity prices.

We want to hear from you. Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458; send BIX mail c/o “editors,” or send Internet Mail to letters@byteb.byte.com. Letters may be edited.
THINGS THAT SCREAM.

From 0 to 66 MHz in no time flat.
Introducing Austin Computer's new 486 color and B&W notebook family. Featuring 32-bit local bus video, serious Windows users will appreciate the speed — screaming along at 66 MHz. And PCMCIA type II & III slots.

The largest hard drive available anywhere.
This lightning-fast machine is sure to keep you busy, so you'll want plenty of storage capacity. That's why we've equipped our notebooks with your choice of hard drive options from 130 MB to 340 MB — the largest on the market.

Choose your own processor.
There's a color or B&W notebook model that's right for you. Many configurations — Intel® SX-25, DX-33 and DX2-66 CPUs. All with lots of features and plenty of power. Windows 3.1 and DOS 6.0 come preinstalled on all our notebooks.

Color models start at $2,999.
A hot price for active TFT color. And our B&W models start at $1,799. That's hundreds less than our competitors, which is sure to leave them crying. Call and ask for your Austin Computer 486 notebook. Miss out on this and you'll want to scream.

INTRODUCTORY SALE PRICES

<table>
<thead>
<tr>
<th>Austin Notebooks</th>
<th>$1,799</th>
<th>$2,999</th>
<th>$2,999</th>
<th>$4,499</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intel 486 CPUs 25-66 MHz</td>
<td>486SX-25 Mono</td>
<td>486DX2-66 Mono</td>
<td>486SX-25 Color</td>
<td>486DX2-66 Color</td>
</tr>
<tr>
<td>8.5&quot; x 11&quot; x 1.75&quot;</td>
<td>4 MB RAM standard</td>
<td>8 MB RAM standard</td>
<td>4 MB RAM standard</td>
<td>8 MB RAM standard</td>
</tr>
<tr>
<td>6.38 lbs (including battery)</td>
<td>130 MB Hard Drive</td>
<td>340 MB Hard Drive</td>
<td>130 MB Hard Drive</td>
<td>340 MB Hard Drive</td>
</tr>
</tbody>
</table>

800-331-1701

© 1993 Austin Computer Systems. All rights reserved. Other product names or trademarks shown herein are for illustrative purposes only and may be the property of other companies. Prices and specifications are subject to change without notice. Austin Computer Systems cannot be responsible for errors in typography or photography. Intel and the Intel inside logo are trademarks of Intel Corp. Microsoft is a registered trademark and Windows and the Windows logo are trademarks of Microsoft Corp.
Introducing Indeo™ technology and the Smart Video Recorder from Intel.

When it comes to putting video technology on your PC, Intel knows exactly which buttons to push.

Intel's new Indeo™ technology is the first video compression technology that lets you capture and compress video in one single step. (Now that's easy.) And the Smart Video Recorder is the first video capture board that takes advantage of Indeo technology. Which means adding the impact of motion video to your business presentations is faster and simpler than you ever imagined.

Recording with the Smart Video Recorder is as simple as pushing a button. And it's fast. It only takes one minute to capture and compress a one-minute video clip. (Other products take up to 15 minutes.) One-step recording also cuts the Smart Video Recorder's disk space requirements—other systems can require

©1993 Intel Corporation. The Indeo logo is a trademark of Intel Corporation. *Third party trademarks are the property of their respective holders.
technology
concept to your PC.

up to five times the disk space.
A key component of Indeo technology, scalable performance adjusts playback quality based on your system's processing power. And you don't need special hardware for playback. Scalable performance gives you the best playback possible from the computer you have now, and whatever computer you may use in the future.

You can get started right away, too, because Microsoft Video for Windows* and Asymetrix Compel* and MediaBlitz* software programs are included in the Intel Smart Video Recorder box.

To learn more about Indeo technology and the Smart Video Recorder, call 1-800-538-3373, ext. 1150. Or to receive information immediately, call Intel's automated FaxBACK® service at 1-800-525-3019 and ask for document 9871. Because with Intel, PC video is all fast forward.
PERSONAL DIGITAL ASSISTANTS

Behind the Wheel of the First Zoomer and Newton PDAs

The first Newton and Zoomer machines still have rough edges but show tremendous promise

DAVE ANDREWS

After months of anticipation, the first pen-based PDAs (Personal Digital Assistants) are finally nearing commercial release. In recent months, that statement has carried about as much weight as "the check is in the mail." However, Zoomer and Newton PDAs are now scheduled for release in October or earlier. In evaluating prerelease versions of both systems, I found that they resemble each other in size and weight. But the underlying software, processor, and handwriting-recognition engines are quite different.

Zooming In On the Zoomer

The Zoomer label indicates software compatibility: Applications will run on both Casio and Tandy systems, as well as other Zoomer PDAs that will be announced later this year. AST Research's recent purchase of portions of Tandy manufacturing facilities and its Grid division will not affect the Zoomer rollout, according to Tony Magoulas, spokesman for Tandy. The Zoomer will remain a Tandy/Casio joint venture, he said. Tandy says it will sell its Z-550 for $699. Casio will sell its XL7000 in different retail channels than Tandy, but the two systems are essentially the same.

The Z-550 runs for a claimed 100 hours on three AA alkaline batteries. You work with the Zoomer by flipping its cover up and over the back of the unit, which exposes the unit's 320- by 256-pixel, 3.2-by 4-inch monochrome LCD. The entire system measures 1 by 4.2 by 6.8 inches. Total system RAM is 1 MB, 640 KB of which is used by the operating system. Santa Clara-based SunDisk will offer a range of flash-memory PCMCIA cards (2 to 20 MB).

The Zoomer's GEOS is the latest in a family of graphical operating systems from GeoWorks. GEOS is both multi-threaded and multitasking, yet its kernel requires just 60 KB. Library routines that are loaded as needed by applications total 180 KB.

The Zoomer will come with over 20 built-in applications. At the bottom of its screen, you will find several fixed icons, including the Launcher, Address Book, Date Book, Note Book, Pocket Quicken from Intuit, a world clock, calculator, menu, keyboard, and help. By tapping any icon with the plastic stylus pen, you execute the program. Tapping the Launcher icon (i.e., a rocket icon) gives you a menu of additional applications to choose, including a dictionary, a language translator, America Online, U.S. and world information, games, and others.

In its task switching and response to commands, the Zoomer's performance is fast. However, several BYTE editors who tried a beta system deemed the handwriting-recognition performance poky, requiring you to wait several seconds as the Zoomer attempts to convert your handwriting into text.

When you want to write notes and memos that will be recognized and converted into text, the PalmPrint handwriting-recognition engine (also developed by Palm Computing) works best when you print in block letters. You can write
The First Newton

Although Apple had not officially released details on the Newton and its Newton Intelligence operating system at press time, Sharp Electronics, which is manufacturing Newtons in partnership with Apple, let BYTE test its first Newton PDA, called the Expert Pad, which was running a beta version of Newton Intelligence. (The October BYTE will have in-depth coverage of Apple's Newton.)

Physically, the Expert Pad resembles the Zoomer—it has a reflective monochrome LCD and a flip-top cover—but it's quite different under the hood. Sharp officials said that the Expert Pad has a battery life of about 24 hours, which is much less than the Zoomer's claimed 100-hour battery life. Also, the Newton takes a different approach to recognizing your handwriting.

One of the benefits of Newton Intelligence is that every entry you make during the day is stored in Newton's object database. Thus, if you make an entry several days ago referring to "Bob," you can use the Find feature to search through all the applications for every occurrence of the word Bob. The system presents you with an indexed list of every hit that occurs.

A key part of the Newton will be its ability to take actions that you normally do manually and do them for you. The Intelligent Assistant accomplishes this. For example, if you write a reminder like "fax this document to Bob" and tap the proper icon, the Intelligent Assistant pops up a dialog box asking if you mean the Bob at 555-5555. If you indicate yes, it places the document in the in/out communications box.

Like the Zoomer, Sharp's Newton will come bundled with several applications. The first one you see when you turn on the Expert Pad is the Newton NotePad, within which you can enter text. Handwriting recognition is that if you write a word that it cannot match to the dictionary, its best guess at what you were writing may prove to be wildly inaccurate. You have to train it on the spot by correcting the software using the on-screen keyboard. Luckily, the Newton's system software tracks these corrections transparently, without requiring any input on your part.

The Expert Pad recognizes words by comparing what you write to words in a dictionary. Handwriting-recognition performance is snappy. However, the downside to the Newton's handwriting recognition is that if you write a word that it cannot match to the dictionary, its best guess at what you were writing may prove to be wildly inaccurate. You have to train it on the spot by correcting the software using the on-screen keyboard. Luckily, the Newton's system software tracks these corrections transparently, without requiring any input on your part. Sharp officials claim that the Expert Pad's handwriting recognition accuracy improves with continued use.

Sharp says the final version of the Newton will let you set up a guest preferences profile. Thus, if someone else uses your Newton, it won't confuse...

Palm Computing designed its applications to let you create documents that mix and match text and ink data types. The benefit: You don't always have to rely on the text recognizer to correctly interpret your handwriting.

In many cases, the accuracy of the Newton's handwriting recognition engine will not matter: entries like this reminder and associated map won't be converted to text.

In Zoomer programs mix text and ink seamlessly.

Palm Computing's applications let you create documents that mix and match text and ink data types. The benefit: You don't always have to rely on the text recognizer to correctly interpret your handwriting.

**Handwriting Recognition at a Glance**

**Newton**
- Defaults to dictionary-based word comparison: its best guess can be wildly inaccurate
- It learns how you write
- Has handwriting training module
- Guest preference recommended for secondary user

**Zoomer**
- Recognizes on a character-by-character basic: words can be partially correct
- You learn how it recognizes
- No training module
- Anyone can pick it up and use it
Wake up and smell
The new HP DeskJet 1200C.
$1,699*

Welcome to the dawning of a new era in office printing. Hewlett-Packard presents the HP DeskJet 1200C. The world's first affordable, networkable, plain-paper, 300-dpi black and color printer.

The HP DeskJet 1200C printer has everything your users could want: HP's next generation of inkjet technology, for sharp 600x300-dpi black and stunning 300-dpi color on plain paper. LaserJet PCL 5 compatibility, so it runs any existing LaserJet printer file or font. And network upgradability, giving everyone equal access to high-quality color.

Besides offering compatibility and great print quality, the DeskJet 1200C is fast. Six pages per minute for black & white. And only one to two minutes per page for color graphics. It comes with 45 scalable fonts, same as the new HP LaserJet 4, and lets you easily add PostScript®.

The future of office printing is here. To see for yourself, call 1-800-552-8500, Ext. 7398 for the name of the HP dealer nearest you.*

DeskJet Printers
Make it happen.

HEWLETT PACKARD
that person’s handwriting style with yours.

The Connectivity Issue
In their initial releases, neither the Zoomer nor the Newton will include a built-in modem. Instead, the companies are working with third-party vendors to develop external data/fax serial modems. America Online (Vienna, VA) will offer Zoomer users access to E-mail, a gateway to Internet, ASCII text fax and U.S. Mail gateways, access to wire services, and other services like stock quotes and travel brokers. Motorola (Boyynton Beach, FL) says it will make its Embarc wireless data service compatible with the Zoomer PDA, so that Zoomer users can receive wireless E-mail and access electronic news summaries.

No third-party vendor has announced a general communications program for the Newton. Connecting it to desktop PCs will be done through the serial port or the infrared transceiver. Joe Ratner, product manager for personal information processors at Tandy, said the company is evaluating PCMCIA modems for compatibility with the Newton. Newton PDAs will support infrared data exchange. Mac and Windows versions of the Newton Connection Kit will let you transfer, synchronize, back up, and update information via the Newton’s serial port with a desktop computer.

Remember the Original PC
Based on my initial trials of both PDA machines, it appears that the Newton offers faster handwriting recognition than the Zoomer. I wasn’t able to verify either company’s battery-life claims. My emotions in testing both PDAs ran from awe to exasperation, especially when they did not correctly recognize my handwriting.

These are the first devices in a totally new category of computing. As with the first Mac and IBM PC, the first PDAs will not likely be as capable as their successors. But I think many people will find them useful. The situation can only get better, as handwriting recognition improves and applications, peripherals, and content are released to the market.

Dave Andrews  

INTEROPERABILITY

A Unified Ink Standard

D igital ink, the most useful data type for mobile applications, is ironically one of the least portable data types for sharing information between machines, operating systems, and applications. Effectively sharing ink requires more than a common bit map; unfortunately, a shareable ink data format that captures stroke order and other key attributes of ink hasn’t emerged.

Six heavyweights in the mobile- and pen-computing arena—Slate, Apple, General Magic, Go Corp., Lotus, and Microsoft—are currently developing what they hope will be a long-term solution to the problem of shareable ink. Jot 1.0, the result of collaboration between these six players and a few others, is a specification for a standard, comprehensive ink format that each company has pledged to support.

Jot is a platform-independent format definition for captured ink. It includes properties like timing, pressure, stylus angle, and bounding coordinates, plus more esoteric attributes like color and type of nib. Software using Jot can choose the only properties it requires and ignore nonessential information. Jot is designed to be complete and extensible as other required qualities of ink are uncovered.

Captured ink stored in Jot format maintains all the attributes of “fresh” ink. As a result, it can be scaled, fed to recognizers that require information about how the ink was created, and processed by systems that don’t include a stylus. Jot-format ink can be stored in shared databases, processed off-line, or incorporated into keyboard-oriented applications. Because storing the information required by Jot can consume a lot of space, Jot includes an optional provision for compression and stroke information reduction. Slate’s Dan Bricklin said Jot would likely be an interchange format only, and most ink-based applications would continue to use smaller custom data formats internally.

Slate plans to incorporate Jot into PenApps; General Magic will include Jot in Telescript; Microsoft offered a long-term goal of rendering ink on every Windows desktop, and it will provide an OLE object with Windows for Pen Computing that will support Jot; and Go announced the integration of Jot into the next release of PenPoint, scheduled for late this year.

Lotus and Apple will also support Jot-format ink, but Apple’s Rick Spitz noted that Jot will not be built into the initial release of the Newton. Brian Dougherty, chairman and CEO of GeoWorks, said that his company is currently evaluating the Jot 1.0 specification and will likely support it in the next release of Geos. “The only reason we wouldn’t support it would be if we saw some performance problem with it,” Dougherty said.

Jot offers a great deal of promise, not hindered by its solid support among ink-software vendors. But its timing may be the real key. Microsoft’s Pradeep Singh praised the definition of the format “at the outset of the data type.” Jot has its best chance for universal acceptance now, before the mobile/pen industry is well off the ground.

Steve Apiki
Professional C and C++ Development Tools

C/C++32 delivers the key technologies for professional developers: comprehensive C++ support including templates and exception handling; advanced superscalar optimization; and 32-bit multi-platform support. C/C++32 includes both C and C++ compilers, so you can incrementally adopt the benefits of C++.

Unleash 32-bit Power!

C/C++32 delivers 32-bit performance. The 32-bit flat memory model simplifies memory management and lets applications address beyond the 640K limit. Powerful 32-bit instruction processing delivers a significant speed advantage: typically a minimum 2x processing speedup.

A C++ compiler designed to deliver on the promise of object-oriented programming

The C++ compiler provides comprehensive support for the AT&T version 3.0 language including templates, plus exception handling. These features are key to realizing the benefits of object-oriented programming: code reusability, increased reliability and reduced maintenance.

Hot New Superscalar Code Optimizer

The hot, new C/C++32 code generator advances the performance envelope. New superscalar optimization strategy uses "riscification" and instruction scheduling to deliver improved performance on 486 and Pentium processors. The compiler can create a single, high-performance executable which runs on 386, 486 and Pentium processors.

Industry Standard. Industry's Choice

WATCOM's working relationships with industry leaders such as Autodesk, GO, IBM, Intel, Lotus, Microsoft and Novell ensure that we continue to understand and meet the needs of the software industry and professional developers.

Multi-Platform, Cross Development Support

C/C++32 supports a wide range of 32-bit Intel x86 host and target platforms allowing professional developers to leverage the multi-platform, cross-development capabilities of today's operating environments including OS/2 2.x and Windows NT.

Also Available: WATCOM C* for DOS

C* for DOS is a professional, low cost 32-bit C compiler and tools package enabling development, debugging, performance profiling and royalty-free distribution of 32-bit applications for extended DOS. Suggested retail price: $199*.

WATCOM C/C++32 has a suggested retail price of $599*.

For additional information or to order direct call 1-800-265-4555. Call our FAX Back system at 1-519-747-2693 from your fax machine for immediate product information.

WATCOM 1-800-265-4555

The Leader in 32-bit Development Tools

415 Phillip Street, Waterloo, Ontario, Canada, N2L 3X2 Telephone: (519) 886-3700, Fax: (519) 747-4871

*Price in US dollars. Does not include freight and taxes where applicable. Authorized dealers may sell for less.

WATCOM C and the Lightning Device are trademarks of WATCOM International Corp. DOS4GW and DSS/16M are trademarks of Rational Systems Inc. Other trademarks are the properties of their respective owners.

Copyright 1993 WATCOM International Corp.

Circle 158 on Inquiry Card.
GREAT AS PC & MAC SCREEN SAVERS
ALL UTILITIES INCLUDED

COREL PROFESSIONAL PHOTOS
CD-ROM

Works with any ISO 9660 CD-ROM drive (XA support not needed)

Royalty Free

Kodak Photo CD Format

PC & Mac Compatible

Ideal for Desktop Publishing

Each collection features 100 razor-sharp Kodak Photo CD format photographs on a single disk. The stand alone Corel utilities included let you turn any of these stunning CD-ROM photo images – or your personal photos on CD – into Screen Savers, Wall­paper and slideshows (with optional background music tracks).

Save time and money on stock photography!
Corel Professional Photos are royalty free for all applications and ready for color separation. There are no additional fees. That makes them ideal for use in any visual communication such as ads, brochures, presentations and multimedia. And you can use CorelDRAW to retouch or add special effects to any Corel Professional Photo.

Already more than 50 titles:


The world's leading photo CD collections from the makers of CorelDRAW, the world's best selling graphics software!

CALL NOW! EXT. 100
1-800-772-6735

ATTENTION PROFESSIONAL PHOTOGRAPHERS!

If you are a professional photographer interested in having Corel publish your photographs, please call the number below for more information.

CALL: (613) 728-8200 ext. 5080

Suggested List Price
$49.95 U.S. Funds

100 SUPERB IMAGES IN EACH COLLECTION!

*Not all utilities are available for Macintosh
Spreadsheet or Database?
The Best of Both

Watch the demonstrations, and multidimensional data-analysis products like Lotus Improv and CA-Compete seem to have lifted their promotional style from the old Ginsu knife commercials—take your spreadsheet data and "slice, dice, rotate, twist, turn, and pivot it." At the very least, this software has the best verbs. Although the ads for these data-analysis software to a Rubik's Cube. Think of a single side of the cube and its nine squares arranged in three rows and three columns. This is the typical spreadsheet. And while that spreadsheet may have 3-D capability, true data-analysis software lets you take any row or column of that cube face and rotate it in either direction, for a possible total (differing by product) of 12 or more alternate views.

Answers to questions about why sales were down in the third quarter, after all, will not be found in a row-and-column display of sales by region. You may also need to view additional dimensions (e.g., quarterly sales by product type, sales by sales representative, year-by-year third-quarter sales per region, forecasted versus actual sales, and even product allocation by region). With a data-analysis product, you can point and click your way to viewing—in tabular or graphical form—the necessary data and forecast the effects of your decisions.

The missing link in all this is the grunt work required to establish direct and timely feeds from your database, Oracle, DB2, Sybase, or other databases to the data model you have created. Each program differs in the file formats it imports and exports. Beyond that, it's up to someone to categorize the data that will be coming in and, in doing so, determine and configure the relationships among data fields. The latter process gives you the chance to think about how a data model can best be structured to be of the most use.

The English-language item names that are used in programs like Improv are beneficial in that they are not tied to cell references like A7. Instead, they're tied to understandable concepts (e.g., Total Cost) that make for easier reference and

Corporate Vision boasts a high degree of linking among table, text, and chart data.

data-analysis programs may smack of superficiality, the challenge of this type of software in business today is a daunting one: to help strategists glean the most meaning from the immense storehouses of data their organizations have collected. In doing so, these products have created a product category all their own—one that, under their spreadsheet and graphing front ends, more closely resembles databases than the traditional spreadsheets from which this category has evolved.

Rubik's Cube Viewing
Michael Komspan of Computer Associates compares the concept of multidimensional

CA-Compete, like Lotus Improv, offers English-language-like formulas.

SPREADSHEET WARS TO HEAT UP IN FALL

With Lotus 1-2-3 for Windows release 4's improved database access, Scenario Manager, new @functions, and other features, Lotus Development finally delivered a worthy competitor to Borland and Microsoft Windows spreadsheets. This fall, Lotus's chief competitors are expected to strike back with new feature-laden versions of their Windows spreadsheets.

Are all these new features necessary? "That's a tough question," said Nicholas Delonas, a consultant and coeditor of the Spreadsheet Consultant (Allston, MA) newsletter. "I have yet to find an accounting department that enthusiastically moved from DOS to Windows. Most people, all they want to do is add up numbers." However, Delonas said that on another level, the trend in MIS appears to be a standardization on Windows and a move toward suites of products that work well together and share a common macro language. Microsoft says Visual Basic, Applications edition will let its Windows and Mac applications control each other. Meanwhile, Lotus plans to include its LotusScript macro facility in upcoming releases of its Mac, Windows, DOS, and Unix applications.

- D. A.

QUATTRO PRO 5.0 FOR WINDOWS (DUE THIS FALL)

- Data Modeling Desktop adds Lotus Improv-like data viewing
- Consolidator lets you merge and combine data across multiple sheets
- Scenario Manager with versioning control lets you store scenarios for repeated comparisons
- More than 360 additional mathematical and other @functions
- Data queries to SQL databases like Sybase and Oracle
- Shared spreadsheet notebooks over LAN and E-mail connections

EXCEL 5.0 FOR WINDOWS (DUE BY END OF 1993)

- Lotus Improv-like pivoting views of data
- 3-D worksheets
- Built-in version of Access database query Interface for ODBC (Open Database Connectivity) applications
- Support for OLE 2.0
- Enhanced Scenario Manager
- Tighter integration with Word for Windows and Project through Visual Basic, Applications edition

SEPTEMBER 1993 BYTE 29
The notebook industry's first 4mm, full-travel keyboard with the look and feel of a desktop system.

Built-in Windows plus 50MHz 486DX2 processor (with coprocessor) for blazing performance.
New brilliant Active Matrix display – 640 x 480 VGA with high-speed video system for lightning fast graphics.

**New TI TravelMate 4000E WinDX2™/50 Active Matrix Color**

If you've been waiting for an active matrix color notebook with true desktop power, your wait is over. Thanks to the new TravelMate 4000E WinDX2/50 Active Matrix Color notebook from Texas Instruments.

With 256 brilliant, simultaneous colors and a 50MHz 486DX2 processor, this powerhouse doesn't just whisper color, it screams it.

And yet the TravelMate 4000E weighs a mere 6.2 pounds, including battery. This convenient size and weight gives you more performance* than the leading 486 notebooks.

Thanks to the built-in Windows 3.1 and useful TI utilities, you can power up to Windows in just 15 seconds. And the TravelMate 4000E is Windows NT-compatible. With 4MB of main memory, expandable to 20MB, you're ready for today's and tomorrow's software.

Using the mouse on the TravelMate 4000E is a snap. The Microsoft BallPoint™ mouse with QuickPort™ connection snaps on and off and needs no cable, giving you more flexibility and better ergonomics than a built-in mouse. With the industry's first 4mm, full-travel keyboard, the TravelMate 4000E gives you the feel of a desktop.

If you work on the go, you'll also go for the rugged 200MB hard disk drive, the high-speed video bus and 1MB of video RAM, as well as the full range of connectivity options – snap-on modules for Ethernet® LANs, SCSI-compatible devices and an internal 14,400 bps V.32 bis modem with 9,600 bps send/receive fax capability.

<table>
<thead>
<tr>
<th>TI TravelMate 486DX2 Notebooks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Processor Speed</strong></td>
</tr>
<tr>
<td>50MHz DX2</td>
</tr>
<tr>
<td>40MHz Enhanced</td>
</tr>
</tbody>
</table>

Texas Instruments offers over 10 models of 486 notebooks for you to choose from.

For more information about the world's widest range of 486 notebooks, as well as the location of the dealer nearest you, don't wait another nanosecond. Call 1-800-527-3500.
modification. In other words, you can refer to Total Cost from anywhere in the model or often from other models. The English-language naming convention for spreadsheet items also helps to make sense of a model's structure when you first view it.

Formulas, global and cell-specific, also become easier to write, use, and modify. For the above Total Cost in a sample CA-Compete model, the governing formula is “=Total Cost of

bunch, Corporate Vision from IntelligenCeWare, goes a step further by making each data point itself an icon on which you can click for more detail. For example, you might want to get a monthly breakdown of a charted year's profits figure on a bar or pie chart. It applies the same concept to hypertext links you can make to textual data in a bulleted list. Click on the phrase “printer sales” in a bulleted chart, and the program can pop up a bar chart of sales by region.

Deceptive Learning Curve
Because multidimensional data-analysis software looks like a spreadsheet—in fact, CA-Compete includes most of CA-SuperCalc’s code to give that program a dual nature—it can initially look easy to maneuver data views and arrive at what you need to make a solid decision. In fact, these products can pose a formidable and deceptive learning curve. It’s not for lack of effort on the part of vendors, though. The problem is a result of the very concept of multidimensional analysis and the fact that spreadsheet users, before trying one of these products, have typically not had to think this way.

Strategic decisions, however, can still be made far more quickly using products like Improv or Corporate Vision than they have been in the past. To solve the problem of why expenses are up, for instance, a manager may have previously had the MIS department write a 4GL (fourth-generation language), SQL, or other type of query to produce a report that subsequently requires a rephrasing of the question or further information to get anything useful in solving the problem. This spiraling toward answers could take weeks. With data-analysis software properly set up and maintained, it takes only seconds.

—Ed Perratore

A SAMPLING OF DATA-ANALYSIS SOLUTIONS

Because multidimensional data-analysis software inherently defies classification—a challenge for its marketers, to say the least—products that fall loosely into the category vary widely in their capabilities, pricing, and target markets.

CA-Compete 5.0 (Computer Associates, Islandia, NY), $495: Expected to ship in the third quarter, this complete revamp of the Windows-based product that CA bought from ManageWare matches Lotus Improv on several fronts. Improvements include speed enhancements, an unlimited number of named views stored with each model, and the integration of CA-Cfle, CA-Realizer’s extended BASIC macro language, which lets users make C or DLL calls.

Corporate Vision 1.0 (IntelligenceWare, Los Angeles, CA), $690: Expected to be announced in late August, this product accesses data from Paradox, dBase, Oracle, Sybase, DB2, and SQL Server to combine spreadsheets with EISes (executive information systems) for a Windows-based system with linking among table, text, and chart data.

Diver for Windows, Diver for Macintosh 2.0 (Dimensional Insight, Burlington, MA), $750 per station: GUIs to the company’s client/server CrossTarget product, both versions of Diver permit dive-downs (with multiple data models) into cross-tabular data sets as large as 32,000 rows by 32,000 columns. CrossTarget compresses, indexes, and stores data from dissimilar sources (via comma-delimited format) into a proprietary structure that serves for easy access and reporting of otherwise raw data.

ESSBase 2.2 (Arbor Software, Santa Clara, CA), $27,000 for a server plus a five-user license: This client/server package extends the capabilities of Lotus 1-2-3 and Excel to allow analysis of a claimed unlimited number of dimensions. Designed initially for Windows clients connected to O/S2 servers over major network operating systems, it includes an API for third-party customers using Visual Basic, C, and C++ to build custom applications (e.g., an EIS).

Improv for Windows 2.1 (Lotus Development, Cambridge, MA), $495: The latest version of this popular product includes network installation, WK4 file support, integration with Lotus Notes, and a scaled-down version of Q+E Software’s Q+E Extend for Improv 1.0. Five Q+E drivers let you build models using data from dBase and compatible formats,trieve, Paradox, Excel .XLS, and text files.

Muse 1.1 (Occam Research, Watertown, MA), $695: This Mac-based search-and-analysis product includes five environments—spreadsheet, database, scriptwriting, dictionary, and charting windows—for analyzing multidimensional data. The scriptwriting window accepts English-language queries; the dictionary interprets them. (A Windows version is expected this fall.)

SpreadBase 1.1 (Objective Software, Redwood City, CA), $695: Mac-based but with a Windows version in the works, this client/server product uses English-language cell references and offers three main view types: table (resembling a relational database table), graph, and matrix—a table in which each cell represents a database record. You can expand or collapse models.

TM/1 Perspectives 1.0 (Sinper, Warren, NJ), $495 for Professional Version, $795 for Corporate Version: Derived from TM/1, a data-analysis product dating back to the mid-1980s, this Windows-based tool is a client/server add-on to Excel or Lotus 1-2-3 (both ship together) that lets you analyze 2-D slices of data derived from comma-delimited files or data entered directly into the program. Not intending to compete against Lotus Improv, Sinper calls it a “database for spreadsheet users” rather than a modeling product. —E.P.
About to purchase a new computer? Absolutely has to be the latest, leading technology? Anticipating Pentium, perhaps? Asking around for the best price? Allow us to introduce ourselves...
is for Attention, please! All you people who want the latest technology at Amazingly Affordable prices! Introducing AMBRA: a new and fast-on-its-feet computer company.

means we’re Making our Move! With high-performance Made-to-order AMBRA Machines. All are tested for industry-standard compatibility, and come with a 30-day Money-back guarantee.

is about Built-in extras—like added cache and VESA local Bus. It’s for Blazing-fast IBM Blue Lightning™ processors. And the Big advantage of 64-Bit Pentium. Across the Board, we’re talking Best value here.

is for Responsive to your needs, and Ready to deliver to your door.

It’s for Rapid onsite service! Plus Round-the-clock technical support. The kind you can Really Rely upon.

stands for “Just Ask us.” AMBRA has intelligent Answers to All your questions and computing needs. Call 1-800-25-AMBRA. Act now!
INTRODUCING

AMBRA

AN IBM COMPANY
We're raising industry standards by giving you more.

Combining industry-wide resources with independent responsiveness, AMBRA provides you with immediate access to the latest technology.

If it's industry-standard, we've got it for you now. If it's coming soon, we're positioned to get it — from advanced video to the latest microprocessors.

We're committed to giving you more for your money. Like extra cache at no added cost. Accelerated local bus without accelerated prices. Pentium™ upgradeability without a premium.

Along with extra features, we believe in giving you extra flexibility. Each and every AMBRA model is custom-built to your exact specs. With no penalty in terms of time or expense.

We offer hundreds of brand-name hardware, software and peripheral options — everything from Hayes® modems to Lexmark® printers. To make sure that every possibility is open to you.

All AMBRA computers carry a 30-day, money-back guarantee. They're backed by quick onsite service and round-the-clock support — the kind of service and support that never lets you down.

IBM's 486 Blue Lightning processor builds on the best features of Intel microprocessors, including performance, instruction set and upgradeability. IBM optimized the instruction set, added a 16KB internal cache, lowered power consumption and improved power management. The result: Blue Lightning doubles internal clocking to 66 MHz, while maintaining full 486 compatibility. AMBRA harnesses the power of Blue Lightning to deliver 66 MHz system performance at 33 MHz prices.

Built to your order, exactly. AMBRA will custom-configure any and every computer for you — and it won't cost you an extra day or an extra dime! You have your choice of chassis, processors and a full range of memory sizes. Hard and floppy disks, tape drives, CD-ROM drives, multimedia kits, and more. Plus high-quality, low-radiation AMBRA monitors, network cards, you name it. You get it all preinstalled, from a single source.

Preloaded software.
We automatically preload AMBRA computers with MS-DOS® 6.0 and Windows™ 3.1. Purchase any of our large collection of software, and we'll preload it for you at no additional installation charge.

True-blue service and support.
We've contracted with IBM to back each AMBRA with a one-year onsite warranty. So you can count on 10,000 technicians at 190 locations nationwide to deliver service within two days of your call, Monday through Saturday. Plus, you get toll-free support from IBM technical representatives 24 hours a day, 7 days a week.

Convenient payment options.
Our lines are open every weekday 8 am to 9 pm, and Saturday 10 am to 6 pm (ET). We accept American Express®, Visa® and MasterCard®. Purchase orders may be used by qualifying businesses.

Fast, to-your-door delivery.
We ship within three days of confirmation of your order. If, for any reason, we can't meet that deadline, we'll tell you up front — and give you a firm delivery date.
66 MHz performance at 33 MHz prices.

With Blue Lightning AMBRA models, you reap the benefits of 66 MHz system performance — at 33 MHz prices.

<table>
<thead>
<tr>
<th>AMBRA</th>
<th>GATEWAY</th>
<th>DELL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>486 Blue</td>
<td>480DX-33V</td>
</tr>
<tr>
<td>Internal clock</td>
<td>66 MHz</td>
<td>33 MHz</td>
</tr>
<tr>
<td>External clock</td>
<td>33 MHz</td>
<td>33 MHz</td>
</tr>
<tr>
<td>System case</td>
<td>Desktop</td>
<td>Desktop</td>
</tr>
<tr>
<td>RAM</td>
<td>8MB</td>
<td>8MB</td>
</tr>
<tr>
<td>Cache</td>
<td>256KB</td>
<td>—</td>
</tr>
<tr>
<td>Floppy</td>
<td>One</td>
<td>One</td>
</tr>
<tr>
<td>Hard disk</td>
<td>340MB</td>
<td>340MB</td>
</tr>
<tr>
<td>Onboard SCSI</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Local bus</td>
<td>VESA</td>
<td>VESA</td>
</tr>
<tr>
<td>Video</td>
<td>Win accel</td>
<td>Win accel</td>
</tr>
<tr>
<td>Color monitor</td>
<td>16&quot; SVGA</td>
<td>15&quot; SVGA</td>
</tr>
<tr>
<td>Pentium-ready</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>DOS 6.0, Windows 3.1, mouse</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Network-ready</td>
<td>Ethernet</td>
<td>—</td>
</tr>
<tr>
<td>Tech support</td>
<td>24 hours</td>
<td>24 hours</td>
</tr>
<tr>
<td>Warranty/Service</td>
<td>1 year</td>
<td>1 year</td>
</tr>
<tr>
<td>Price</td>
<td>$2,079</td>
<td>$2,025</td>
</tr>
</tbody>
</table>

Intel® Pentium, within your reach.

AMBRA is one of the few who can offer you Pentium today — and we offer it at a price you can afford.

<table>
<thead>
<tr>
<th>AMBRA</th>
<th>DELL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
<td>Intel Pentium</td>
</tr>
<tr>
<td>Bus type</td>
<td>EISA</td>
</tr>
<tr>
<td>System case</td>
<td>Desktop</td>
</tr>
<tr>
<td>RAM</td>
<td>8MB</td>
</tr>
<tr>
<td>Cache</td>
<td>256KB</td>
</tr>
<tr>
<td>Floppy</td>
<td>One</td>
</tr>
<tr>
<td>Hard disk</td>
<td>540MB SCSI</td>
</tr>
<tr>
<td>Onboard SCSI</td>
<td>Dual 32-bit</td>
</tr>
<tr>
<td>Local bus</td>
<td>64-bit VESA</td>
</tr>
<tr>
<td>Video</td>
<td>ATI Ultra Pro w/2MB DRAM</td>
</tr>
<tr>
<td>Color monitor</td>
<td>15&quot; SVGA</td>
</tr>
<tr>
<td>Pentium-ready</td>
<td>—</td>
</tr>
<tr>
<td>DOS 6.0, Windows 3.1, mouse</td>
<td>—</td>
</tr>
<tr>
<td>Tech support</td>
<td>24 hours</td>
</tr>
<tr>
<td>Warranty/Service</td>
<td>1 year</td>
</tr>
<tr>
<td>Price</td>
<td>$4,259</td>
</tr>
</tbody>
</table>

Solid products, hot prices. Competitive prices shouldn’t mean mediocre machines. Example: AMBRA’s low-cost Model S425SX. It puts you in touch with tomorrow’s innovations. That’s because it’s Pentium-ready — and supports memory upgrades to 36MB. It features the upgradeable 486SX 25 MHz processor, cache to spare, a fast local bus, and Windows accelerator with 1MB video memory.

Extra compact design. Extra color.

At 6.4 pounds, our 486SX 25 MHz SL-enhanced notebook packs a lot of performance. You get 4 MB of expandable memory; a 120MB hard disk; STN dual-scan, passive-matrix screen for vibrant color and easy mouse tracking; plus integrated fax/modem and built-in trackball. All for $2,449.
AMBRACustom-building lets you cover all the bases.

HERE ARE JUST A FEW MODELS WE'LL MOLD TO MEET YOUR NEEDS:

**Model S450SL**
- 486SLC2, 50 MHz
- 4MB RAM, max 16MB
- 64KB processor cache
- 33MHz floppy
- 125MB (14ms) hard disk
- Windows accelerator with 1MB video memory
- 14" VGA color monitor
- Slimline case
- 3 16-bit ISA slots
- MS-DOS 6.0, Windows, mouse

**Model S425SX**
- 486SX, 25 MHz
- Intel Pentium-ready
- 4MB RAM, max 36MB
- 128KB processor cache
- 33MHz floppy
- 170MB (17ms) hard disk
- 2 VESA local bus slots
- Windows accelerator with 1MB video memory
- 14" SVGA LR color monitor
- Slimline case
- 3 16-bit ISA slots
- MS-DOS 6.0, Windows, mouse

**Model S433DX**
- 486DX, 33 MHz
- Intel Pentium-ready
- 4MB RAM, max 36MB
- 128KB processor cache
- 33MHz floppy
- 240MB (15ms) hard disk
- 2 VESA local bus slots
- Windows accelerator with 1MB video memory
- 14" SVGA LR color monitor
- Slimline case
- 3 16-bit ISA slots
- MS-DOS 6.0, Windows, mouse

**NC425 SL Notebook**
- 486SX, 25 MHz, SL-enhanced
- Dual-scan STN color screen (640 x 480 x 256)
- Fax-modem 2400/9600 baud
- 4MB RAM, max 12MB
- 120MB hard disk
- 33MHz floppy
- 9.5" screen
- Integrated trackball
- 8.6" x 11.4" x 2.0", 6.4 lbs
- MS-DOS 6.0, Windows, MS Works for Windows

**Model D466BL/CD**
- An AMBRA Best Buy!
- 486 Blue Lightning 66 MHz
- Intel Pentium-ready
- 8MB RAM, max 64MB
- 256KB processor cache
- 33MHz floppy
- 240MB (15ms) hard disk
- Onboard SCSI
- 2 VESA local bus slots
- Windows accelerator with 1MB video memory
- 15" Flat Square LR color monitor, NI
- Network-ready (Ethernet 10BaseT)
- Desktop case
- 5 16-bit ISA slots
- MS-DOS 6.0, Windows, mouse

**Model D466BL**
- 486 Blue Lightning 66 MHz
- Intel Pentium-ready
- 8MB RAM, max 64MB
- 256KB processor cache
- 33MHz floppy
- 340MB hard disk
- Onboard SCSI
- 2 VESA local bus slots
- Windows accelerator with 1MB video memory
- 15" Flat Square LR color monitor, NI
- Network-ready (Ethernet 10BaseT)
- Desktop case
- 5 16-bit ISA slots
- MS-DOS 6.0, Windows, mouse

**Model D466DX**
- 486DX2, 66 MHz
- Intel Pentium-ready
- 8MB RAM, max 64MB
- 256KB processor cache
- 33MHz floppy
- 440MB IDE hard disk
- 2 VESA local bus slots
- Windows accelerator with 1MB video memory
- CD-ROM drive
- 15" Flat Square LR color monitor, NI
- Network-ready (Ethernet 10BaseT)
- Desktop case
- 7 available ISA slots
- MS-DOS 6.0, Windows, mouse

**Model D466E/VL**
- 486DX2, 66 MHz
- 64-bit Intel Pentium upgradeable
- 8MB RAM, max 64MB
- 256KB processor cache
- 33MHz floppy
- 440MB IDE hard disk
- 2 VESA local bus slots
- Windows accelerator with 1MB video memory
- CD-ROM drive
- 15" Flat Square LR color monitor, NI
- Network-ready (Ethernet 10BaseT)
- Desktop case
- 7 available ISA slots
- MS-DOS 6.0, Windows, mouse

**Model DP60E/VL**
- A Pentium Powerhouse!
- Intel Pentium processor, 60 MHz
- 64-bit processor complex
- VESA local bus with 1 available slot
- 8MB RAM, max 64MB
- 256KB processor cache
- 33MHz floppy
- 540MB SCSI hard disk
- Onboard dual 32-bit Fast SCSI
- ATI Ultra Pro Mach 32, 2MB DRAM
- 15" Flat Square LR color monitor, NI
- Desktop case
- 7 available 32-bit ISA slots
- MS-DOS 6.0, Windows, mouse

$1,199
$1,339
$1,689
$2,449

$1,979
$2,599
$2,699
$4,259

SPECIAL OFFER: GET THE BIGGER PICTURE!

* Purchase any 66 MHz or Pentium model, and AMBRA upgrades your view — from the standard 14-inch SVGA to a 15-inch Flat Square color monitor. At no extra cost to you! Limited-time offer. Call for details.

©1993 AMBRA Computer Corporation.
IBM is a registered trademark and Blue Lightning is a trademark of International Business Machines Corporation.
All other product names are trademarks or registered trademarks of their respective suppliers.
Offerings, prices and products are subject to change without prior notice. Prices do not include shipping.

In Canada, call 1-800-363-0066

In Canada, call 1-800-252-6272, Ext. 265

1 Warranty and 30-day guarantee information available through AMBRA. Please call 1-800-252-6272 for details regarding AMBRA's money-back guarantee and limited warranty. Copies of the terms of AMBRA's money-back guarantee are available upon request. One-year onsite service at no additional charge during warranty.
2 Return shipping and insurance charges are the responsibility of the customer.
3 All other product names are trademarks or registered trademarks of their respective suppliers.
4 Offerings, prices and products are subject to change without prior notice. Prices do not include shipping.

Circle 91 on Inquiry Card.
Although Windows desktop publishing applications out-sold such Mac programs by $8.4 million in the first quarter, the high-end world of professional, four-color desktop publishing has traditionally been a stronghold of the Mac. But with the release of Adobe Systems' high-end Photoshop for Windows image-editing program bolstering Windows stalwarts like Adobe Illustrator, QuarkXPress, and Aldus PageMaker, the PC is now a viable platform for high-end desktop publishing. Programs like FrameMaker, Interleaf, and Island Write, Draw & Paint offer viable desktop publishing on the Unix platform. But Craig Yappert, product manager of new products and technologies at Frame Technology, says users of the Unix versions of FrameMaker occupy a different space of desktop publishing than users of PageMaker or QuarkXPress, by typically creating technical documents that are hundreds or thousands of pages long.

Three companies—Adobe, Dell Computer, and SuperMac Technology—have combined marketing resources and products to promote Windows-based PCs as an effective platform for high-end desktop publishing and prepress work. As part of this initiative, the companies have delivered two 486-based Power Publishing Alliance PCs that offer plug-and-play desktop publishing.

Officials of the Alliance member companies said that taking on Apple is not their main intention. Their target market consists of PC users who have been waiting to do color desktop publishing on the PC rather than on the Mac. Several desktop publishing experts agreed that these Power Publishing systems and their applications could satisfy the pent-up demand for color prepress on the PC. "Windows users who are in it [desktop publishing] haven't been in color desktop publishing," said Pauline Ores, director of editorial services at New World Information Trading in New York City. "It's a new market."

Nevertheless, the Power Publishing systems will inevitably be compared to what's available on the Mac, and in the opinion of several prepress experts, Windows as a high-end desktop publishing platform is not nearly as mature as the Mac. "The [Windows] PC world, in terms of desktop publishing, has a way to go," said Ira Fuchs, president of Digital Pre-Press, a New York-based company that runs three daily 8-hour shifts servicing magazines by generating four-color prepress output on both Windows and the Mac.

According to Fuchs, one problem his company often encounters in Windows—and not on the Mac—is an inconsistent implementation of PostScript drivers among Windows applications. He said that this is a major reason that whenever his company gets a request for a job under Windows, "We approach it with trepidation."

Victor Beitner, owner of Victor Beitner Systems, a service bureau in Toronto, said that corporations are now doing high-end publishing on PCs but agreed that the PostScript issue is slowing acceptance. "Once it's as easy to print from Windows as from the Mac, you'll see service bureaus accept Windows desktop publishing more readily," he said.

—Anne Fischer Lent

### OUT-OF-THE-BOX WINDOWS DTP SYSTEMS

<table>
<thead>
<tr>
<th>PC</th>
<th>1992 Desktop Publishing Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$469,000</td>
</tr>
<tr>
<td></td>
<td>$129 Million</td>
</tr>
<tr>
<td>Mac</td>
<td>$242,000</td>
</tr>
<tr>
<td></td>
<td>$95 Million</td>
</tr>
</tbody>
</table>

Source: International Data Corp.

I took a look at the Superstation 466/ME, which had both QuarkXPress and PageMaker loaded. I was amazed that those two behemoths could coexist without any speed degradation. If the Superstation I tested was any indication of the quality of the Power Publishing systems, you get a host of desktop publishing power for a relatively low cost. The peripherals I'd add right off the bat include a CD-ROM drive and a network card, both of which are optional add-ons.

—A. F. L.
If managing your server eats up all

Introducing the new HP NetServer LM and LE.

More than just two new servers, we're introducing a profound improvement in the way you monitor and manage them.

Continuous Assistance.
We've put server management right where it belongs. At your fingertips. The HP NetServer Assistant software lets you easily monitor and manage your network servers from a single console—either locally or remotely. So your server stays up and running. Not you.

What's more, you can quickly diagnose and solve problems with its intuitive interface and troubleshooting tools. And the HP Support Assistant, a CD-ROM-based library, is included to provide lots of valuable technical information.

Maximum Uptime.
These new HP NetServers lead the pack in reliability. RAID-based disk arrays on the LM provide advanced fault tolerance. And, thanks to our hot-swap capabilities, you can now replace an internal drive without bringing the server—or your network—down. The array will also automatically rebuild data on a failed drive. And for maximum protection, the LM even supports Error Correcting Code memory. In fact, the more critical your data, the more critical these servers become.

Investment Protection.
With technology changing faster than the weather, you'll be happy to know that HP's NetServers are designed to keep pace. And keep your investment protected. Both the LE and LM fit smoothly into multivendor environments. The LE is the ideal entry-level server. Upgradable to the future Intel OverDrive Pentium technology-based processor, it provides affordability, exceptional serviceability and future scalability.

Built to meet the full demands of the Pentium processor, the LM will also support dual symmetric multiprocessing. Its Power Cabinet allows room for expansion with nine front-accessible mass storage shelves, eight expansion slots and maximum memory capacity of 384 MB.

HP Service and Network Expertise.
All this is backed by HP's complete range of support services. And by HP's 20+ years of network
your time, you need an assistant.

systems experience. You can choose support from HP directly, or from your local authorized HP dealer. HP NetServers come standard with a three-year, on-site limited warranty. And a host of 24-hour at-your-service support programs, such as our fax information retrieval service, automated phone support and electronic bulletin board service, ensure easy manageability around the clock.

If all this sounds good, call 1-800-964-1566. We'll be happy to provide you with fast assistance. And, chances are, without the HP NetServer LM or LE, that's exactly what you need.

HP NetServer LM

- 60-MHz Intel Pentium™ processor, 33-MHz Intel 486 DX and 66-MHz Intel 486 DX2 processors
- Support for dual Pentium symmetric multiprocessing
- High fault tolerance with internal RAID disk array option (RAID 0, 1, 5, 6)
- 16-MB standard RAM, 384-MB maximum memory, ECC memory support
- 128-KB and 256-KB external cache
- 9 mass storage shelves, 3.5" floppy disk drive standard, maximum 8-GB internal storage
- 8 EISA-2 with Enhanced Master Burst bus-master I/O slots
- Integrated Fast SCSI-2, IDE and video controllers
- HP NetServer Assistant software included
- 3-year on-site, next-business-day limited warranty
- Tested and certified on major network operating systems

HP NetServer LE

- 33-MHz Intel 486 SX, 33-MHz Intel 486 DX and 66-MHz Intel 486 DX2 processors
- Upgradable to Intel OverDrive Pentium technology-based processor when available
- 4-MB and 8-MB standard RAM, 128-MB maximum memory
- 256-KB external cache
- 4 mass storage shelves, 3.5" floppy disk drive standard, maximum 3-GB internal storage
- 5 EISA bus-master I/O slots
- Integrated Fast SCSI-2, IDE and video controllers
- HP NetServer Assistant software available as an option
- 3-year on-site, next-business-day limited warranty
- Tested and certified on major network operating systems

HP NetServer Assistant

Easy-to-use centralized management based on HP OpenView's leading network management environment allowing multiple servers in multiple sites to be managed from a single graphical map.

Problem identification and resolution tools including diagnostics, configuration information (whether the network operating system is up or down), disk capacity planning and technical information via a CD-ROM-based library.

Remote management capabilities allow administrators to use the same tools whether at their local console or a remote PC.

Open architecture facilitates adding specialized third-party or HP management utilities.


HP NetServer LE
LOW-COST LASER PRINTING

OL400e Offers Laser Output at Unlaserlike Price

Okidata's OL400e printer, expected to have a street price of $499, may remove the last obstacle for true laser quality to permeate the budget-minded small business. Okidata is marketing the 300-dot-per-inch OL400e, an upgrade to the OL400, at potential Hewlett-Packard LaserJet 4L users who would trade in a few features for a rock-bottom price.

The big sacrifice is scalable fonts: The OL400e's HP IIP+ emulation permits bit-mapped fonts only. Forty-four fonts (four typefaces) come standard, plus two USPS PostNet bar code faces. Okidata built four cards for tax-preparation forms, bar codes, typewriter-style fonts, and symbols.

Despite its low price, buying the 17-pound OL400e is not a total exercise in feature denial. It lets you add 4 MB onto the standard 512 KB of RAM. A Mips 3000 RISC processor and a high-speed, parallel interface help keep things moving for the 4-page-per-minute engine. Okidata's 6,000 copies-per-month duty cycle rating indicates the printer is best for light to moderate traffic. Okidata uses a solid-state LED print head in the OL400e. The printer comes with serial and parallel interfaces, and the printer can autosense between the two.

Unlike the LaserJet 4L, which forgoes the usual front-panel control in favor of a set of software utilities, Okidata's OL400e comes with a 16-character LCD control panel. The printer includes drivers for Windows 3.0 and 3.1, Microsoft Works, Microsoft Word 5, WordPerfect 5.0 and 5.1, and other programs.

Projects involving virtual reality include creating a model of a mine and a 3-D walkthrough in nuclear and diesel submarines.

Industry Uses Virtual Reality

LONDON—Twelve firms have formed an initiative with one of Europe's leading virtual-reality research centers to apply computer-based simulation and advanced visualization in complex industrial design and 3-D modeling projects. Under the VRS (Virtual Reality and Simulation) initiative, major industrial firms such as Rolls-Royce, Nirex, Vickers Shipbuilding and Engineering, ICI Chemicals and Polymers, and British Nuclear Fuels will pool their engineering talents with the Salford-based Advanced Robotics Research (ARR) center at several levels.

Movies like The Lawnmower Man have glamorized the more advanced aspects of virtual reality, where subjects don special helmets and gloves to enter exotic and futuristic worlds. However, the companies participating in the VRS initiative will use virtual reality in nuts-and-bolts projects ranging from environmental impact studies to 3-D walkthrough models of nuclear and diesel submarines. The first three projects should achieve tangible results within the next 18 months, says Bob Stone, who is ARR's technical manager.

The three projects are a 300-acre mine model for Nirex, an engine simulation for Rolls-Royce, and a submarine compartment program for Vickers. ARR is providing consultancy to help Nirex benchmark and convert data about the mine, based at Sellafield, into virtual-reality models. ARR will use Nirex AutoCAD files to create a surface model of the mine and then develop further models for sections underground. The hardware for the Nirex project has yet to be chosen, although the two likely candidates are Silicon Graphics platforms and the high-end 3-D graphics Freedom workstation sold by Sun Microsystems and Evans & Sutherland.

ARR will also be helping Rolls-Royce develop a model of its Trent 800 aero engine's fan casing and other features. The ARR contract with Vickers will eventually result in models to test new submarine designs.

—Dom Pancuccio

—Ed Perratore

OkiData, (609) 235-2600; fax (609) 778-4184.


You won’t believe your ears.

PC audio never sounded so good—genuine CD-quality audio with fully 12% more dynamic response and 15% better signal-to-noise ratio than any competing 16-bit sound board. Plus software data compression that delivers 16-bit fidelity while maximizing disk storage capacity.

But there’s more. Included in the Sound Blaster 16 package is the biggest advancement in PC control since the invention of the mouse: our exclusive VoiceAssist™ software. It’s a sophisticated speech recognition interface that uses a 32,000-command library to control Windows applications hands-free!

The only sound card that grows with you.

Unlike other 16-bit cards, Sound Blaster 16 comes with built-in interfaces for CD-ROM, MPU-401 MIDI and joystick control. And the unique modular, scalable architecture lets you add more advanced features and technologies as you need them.

Like our Advanced Signal Processing chip that delivers 4:1 real-time hardware data compression while reducing CPU time up to 65%. Or professional-quality sampled wave synthesis with our plug-in Wave Blaster™ daughter board.

And—unlike other cards—the Sound Blaster 16 is 100% compatible with every game and application ever written for the Sound Blaster...which is to say virtually every game and application available for sound.

Nobody packs in more value than the industry leader.

And as if that weren’t enough, we’ve completed the package with more than $1000 worth of leading software—not too shabby considering the entire package retails for just $249.®

So let’s face it. When it comes to audio quality, features, and bottom-line value, we’ve got it all right here. With the Sound Blaster 16—the new 16-bit PC audio standard.

For more information about Creative Labs products and the name of your nearest Sound Blaster Dealer, call 1-800-998-5227.
**ON-LINE GRAPhICS**

**Fractal Compression Goes On-Line**

Perhaps the biggest obstacle to the electronic information highway is the problem of sending graphics images across telephone lines. Millions of people are already sending and receiving text-based E-mail and messages downloaded from on-line services. But graphics are another story. Because graphics images are often several megabytes in size, they take a long time to transmit across telephone lines, and they require a lot of disk space once they get there.

A small start-up company called Imagen (604) 266-2240, based in Vancouver, has an answer for DOS and Windows users. Imagen’s Fracterm, which is based on fractal-compression technology developed by Iterated Systems (Norcross, GA), compresses images that will later be transmitted from BBSes. Using Fracterm (starts at $350), BBSes can offer electronic information delivery consisting of full-color images along with text to their subscribers.

Fractal-compression algorithms are based on a mathematical description of the image and are resolution-independent: A compressed fractal image requires the same number of bytes whether it is displayed on a 640- by 480-pixel VGA screen or on a 1024- by 768-pixel high-resolution monitor. According to Imagen’s CEO, Dwight Jones, the resolution independence of fractal compression offers a major advantage over the JPEG compression scheme, which is dependent on the resolution, thus requiring larger files for higher-resolution images. (For more information, see “Compressing with Fractals,” BYTE’s Essential Guide to Windows, Spring.)

Fracterm is offered as a host system for BBS operators with an unlimited license to distribute the user software to its subscribers. Any image compressed at the BBS end can be downloaded by users with this software. To the user, it appears that the image is being transmitted in real time, but in fact, the compressed image is first transmitted and then decompressed by the user software. In testing Imagen’s system, full-color images I downloaded took less than a minute to decompress.

Fracterm seems to be an elegant solution for image compression, but it is not likely to become widely adopted by major on-line services such as CompuServe. Jones admits that on-line services have given his product a lukewarm reception because they’re more committed to JPEG. CompuServe even has its own compression system called GIF. Debra Young, CompuServe PR representative, says, “We look into all kinds [of technologies], but right now we’re focused on JPEG and GIF.”

Jones says that Fracterm will support JPEG in a release called Fracterm Pro, to be released later this year. Some other drawbacks of Fracterm are that it doesn’t support the Mac and works with a limited number of video adapters. But if you’re running a BBS and want to provide graphics images, Fracterm is worth looking into.

—Nicholas Baran

**ELECTRONIC PUBLISHING**

**Electronic Newspaper Offers Color Pictures**

It’s a vision as old as the PC itself: electronic delivery of newspapers and magazines directly into your computer. On-line services and CD-ROMs let you retrieve the text of articles that appear in dozens of sources—but all you get is text. Photos, charts, and other graphics never make it off the printed page.

A new service from start-up WalkSoft (Rochester, NY) takes electronic publishing a step further, delivering once a week via modem or disk a formatted “newspaper” that includes color pictures and animations. WalkSoft’s News In Motion costs $250 for 52 issues—including telephone charges to download the data files, if you use a 9600-bps or faster modem.

Each week, News In Motion includes roughly four animations, 10 photos, and 50 to 60 articles culled from such diverse sources as the Economist, the Financial Times, and the International Herald Tribune; translated material from Le Monde, Der Spiegel, Asahi Shimbun, and others; news photos from Agence France-Press and Reuters; and op/ed pieces and the crossword puzzle from the New York Times.

When you subscribe to News In Motion, WalkSoft provides software that includes everything you need to download, read, and search articles. It includes the Newsstand user interface, communications software, a run-time version of Apple’s QuickTime for Windows, and PKUnzip and JPEG utilities for decompressing text and images. One remarkable aspect of News In Motion is that to download the newspaper, which takes less than 10 minutes, you dial a toll-free 800 number. Each issue is 700 KB compressed or 1.4 MB uncompressed, which means it fits on a single disk.

The key technology breakthrough in News In Motion is that the layout templates are predefined and reside at the user’s PC, rather than being transmitted with each issue. Thus, only the text and photos need to be sent, and the layout occurs on-the-fly using codes embedded in the text.

—Andy Reinhardt
"Raima Database Server's performance is roughly equivalent to hitting the afterburner." – John Michelsen, Millennium Software

John Michelsen knew what he wanted in a database. After doing his homework, John chose Raima Database Server as the client-server DBMS for his exciting new Dominion™ Accounting Series.

Raima Database Server is the client-server database of choice for applications with demanding performance requirements. It has everything you look for in a client-server DBMS: ANSI-standard SQL, support for Microsoft ODBC and SAG client APIs, declarative referential integrity, and extension modules that allow you to execute user functions on the server via Raima's embedded remote procedure call mechanism.

And ultimately, performance. Raima Database Server delivers consistently high throughput and fast response times. We support all the major server platforms, including NetWare 386, OS/2, UNIX, and Windows NT. And Raima Database Server gives you all this with prices that blast the competition—for example, our unlimited user NLM is $8995.

Hit the afterburner with your client-server application. See what our customers in design automation, workflow computing, document and image management, geographic information systems, process control, and vertical-market solutions already know. For a commercial product or an in-house project, Raima Database Server is the answer.

Call today for a free white paper on Raima Database Server

Seattle • Los Angeles • Chicago • New York • Australia • Belgium • Brazil • Costa Rica • Estonia • Finland • France • Germany • Italy • Japan • Mexico • The Netherlands • Norway • Russia • Sweden • Switzerland • Taiwan • Turkey • United Kingdom

© 1998 Ebling Corporation. Raima Database Server is a trademark and Raima is a registered trademark of Raima Corporation. Other names and software names are trademarks or registered trademarks of their respective holders. Raima Corporation: 1600 NW Slawson St. Suite 200, Issaquah, WA 98027 USA. Millennium Software, Inc., 6233 Centeregate, San Antonio, TX 78217
Even a free memory manager may not be a bargain—especially if it can't give you all the memory you need.

Introducing QEMM 7
The Memory Manager Worth Paying For

The newest version of the Quarterdeck Expanded Memory Manager (QEMM) version 7, once again is extremely innovative in using the critical area between 640K and 1024K. It finds space for more TSRs and drivers in this area than anyone thought possible. It optimizes this area, taking into account the many drivers that need more memory at start-up than when running; instantly calculating millions of possible memory configurations to find still more memory for your programs to use. And it treats the rest of memory as a giant pool to instantly fulfill the needs of all of your programs—whether they use extended or expanded memory. Whether your PC has 1 megabyte or 16, you can benefit from new QEMM 7.

Instant Riches
What does more memory mean in a practical sense? It means that your DOS and MS Windows programs run faster, smoother and more reliably. It means you can continue to add valuable utilities, drivers, TSRs and new capabilities to your PC. Whether it's workhorse drivers like LAN utilities and fax drivers; productivity-enhancers like disk caches and disk compressors; or fun and exciting capabilities like sound boards, CD ROM drivers, graphics tablets, etc. The better your memory is managed, the more versatility and flexibility your PC has. QEMM 7 lets you have it all without fear of 'out of memory' messages or crashes.
DOS 6 Giveth; DOS 6 Taketh Away

The best feature of new DOS 6 is the stable of utilities it includes. Trouble is, they all eat up memory. DoubleSpace file compression needs 43K, Vsafe anti-virus needs 7-45K, Smartdrv disk cache needs 28K and even Undelete takes 104-1K as a resident program. Using Microsoft's free memory utility, MemMaker, you could easily end up with a net loss of available 'conventional' memory in DOS 6.

New QEMM 7 takes the best of the new DOS 6 features into account, finding ways to give you more free memory for your program while taking full advantage of DOS 6. One new QEMM 7 feature, DOS-Up, moves the DOS 6 kernel, its data and resources to memory above 640K (this feature also works with DOS 3.5, freeing 77K). Another new QEMM 7 feature, Stealth DoubleSpace, frees 40K of the memory addresses used by DoubleSpace and makes them available for other drivers and TSRs. Both features ensure that the all-important memory below 640K is free for your programs. And QEMM 7's seemingly small feature of supporting multiple configurations gives you the flexibility and ease of setup that you expect. (MemMaker doesn't work well with this important DOS 6 feature.) That's why it makes more sense than ever to put your money on the best memory manager.

Page Frame: the Key to Your Future

There's been a lot of talk about our patent-pending Stealth technology. Jealous talk, mostly. Because nobody else can touch its performance. Our Stealth ROM feature, pioneered in QEMM 6, frees 48-115K of ROM addresses for use by TSRs and drivers. Our Stealth DoubleSpace feature, described above, frees another 40K. And as you might imagine, there's more to come.

The key to Stealth is its use of a 64K reserved area above 640K called the page frame. Because being used by Stealth, the page frame is used by Lotus 1-2-3 2.x for larger spreadsheets and WordPerfect 5.x for larger documents, DESQview for multitasking, Novell Netware, IBM LAN Server and DECnet for reducing the network driver memory footprint, plus games like Wing Commander, Car and Driver, Ultima Underworld II, Wolfenstein and others for fast action. You sacrifice all this when you turn off the page frame (which other memory managers do to maximize available memory above 640K). It's this use of the page frame by Stealth that lets you set up your PC with a mouse, CD ROM, sound board, a network such as Novell Netware, reserve 8-24K of extra memory for optimal MS Windows performance, use all of DOS 6's memory-hungry utilities and still have more than 63K available for your programs. (Compared to DOS 6's 527K available in the same configuration, after using MemMaker).

Easier to use for Novices,
More Power for Experts; More Memory for All

Our seventh-generation thoroughbred QEMM has improved ease-of-use, with Express Install and Help features. And for power users, Advanced Install and editable parameters and troubleshooting hints.

And QEMM 7 comes with Mani fest, the award-winning memory analyzer—enhanced for more flexibility with Pentium testing, laptop battery reporting, network analysis and editable configuration files.

The new and ever more exciting capabilities coming to your PC will all compete for memory with your favorite applications, TSRs and drivers. And that makes QEMM 7 the front runner in your efforts to get the best performance out of your PC today—and tomorrow.
**News & Views**

**CONTACT MANAGEMENT**

**Scanners Turn Business Cards into Database Records**

If your desk is piled with stacks of business cards and you dread the prospect of laboriously entering all those names into a database, technology has come to the rescue. A pair of new products will let you scan business cards, convert their images to text, and pump the names, titles, addresses, and phone numbers into appropriate database fields.

The first of these nifty gadgets is the Scan-in-Dex from Microtek (Hsinchu, Taiwan, and Torrance, CA), which consists of a small scanner (6.4 by 5.8 by 2 inches) designed specifically for reading business cards and a Windows software package that performs OCR, extracts the data, and puts it into a proprietary database. Scan-in-Dex is being sold as an integrated one-button solution that is easy enough for any user.

A more recent arrival is the CypherScan family from CypherTech (Sunnyvale, CA), consisting of two software-only products. The first is for users with a flatbed or hand scanner ($245 and $145, respectively): CypherScan shows a business card image and completed database fields.

CypherScan's S395 Scan-in-Dex weighs less than 2 pounds.

The other product costs $395 and includes the same diminutive card scanner as the Scan-in-Dex. The flatbed version includes a cardholder template that lets you read in up to eight cards in a single swipe. The software runs in Windows.

Both companies use AI to parse out the name-and-address information and assign it to the proper fields. Microtek's OCR software (licensed from Ocrorn) routes the converted text to a rules engine that searches for keywords and character patterns. Thus, if a line of text includes the words Street or Avenue, the software assumes this is the address. Five digits in a row—or five plus four—are likely to be the ZIP code. Job titles are identified through a lookup table of likely candidates (e.g., president).

CypherTech's technology, built on the Calera OCR engine, is more sophisticated, using a combination of positioning, relative font sizes, word lookups, and other rules to determine where text should go. Thus, it might be able to successfully identify an odd job title because it is located on the line between the name and the address. However, both companies' products can be fooled by unusual business-card designs. To facilitate fixes, both put text that can't be placed into a "comments" box.

Both packages include a simple database that stores card data, but CypherScan offers more flexibility: Records can be stored natively in dBase or Paradox formats or exported directly into Lotus Organizer or Contact Software’s Act. Scan-in-Dex exports only ASCII. CypherScan also recognizes E-mail addresses, and reads Canadian postal codes. Both companies plan Mac versions, but neither company has announced expected Mac shipping dates.

**WORD PROCESSING**

**Next Word for Windows to Work Better with Other Applications**

A preview of the next version of Word for Windows indicates Microsoft has improved the word processor's ability to share documents with other Windows programs in a number of areas. Word 6.0 for Windows (the current version number is 2.0, but the company wants to synchronize the Windows version with the DOS version number) will offer an enhanced interface, drag-and-drop text editing among applications, and inplace editing through its support of OLE 2.0. Version 6.0 will not ship initially with Microsoft's Visual Basic, Applications edition (VBA), but other VBA-enabled programs like the next releases of Excel and Project will be able to control the word processor.

VBA, which Microsoft says will eventually appear in all its major office productivity programs, will provide a way for developers to write agent programs that perform tasks across the company's Mac and Windows programs.

Microsoft says it is also improving Word for Windows' ability to convert WordPerfect files into Word files. The program will likely ship by year end.

**BUSINESS-CARD SCANNING ON THE ROAD**

Pacific Crest Technologies ((714) 261-6444) will release this fall a business-card scanner that will compete in the same category as CypherTech's and Microtek's products, yet in a much smaller size. The company's business-card scanner will be about the size of a portable cassette player and will connect to your desktop or notebook PC through the parallel port. It will weigh less than a pound without the AC power adapter.

Rich Sondheimer, president of the company, said the business-card scanner's small size and parallel-port connectivity make it an ideal solution for portable computers. "We're targeting it for professionals and salespeople who don't want to have to open their computer or laptop to install a new product," he said.

The hardware/software unit will include Windows-based software that automatically identifies names, titles, company addresses, and other information and put it in the proper fields in the included stand-alone database. The program will offer the ability to import and export data from Paradox, dBase, Lotus 1-2-3, Packrat, Act, Organizer, Ascend, and Franklin. It will also have a universal import/export function that lets you create your own import or export format for any Windows or DOS-based address database. Pricing on the system isn't finalized.

-D. A.
Most of the time all mice are nice and fine for pointing around. But when it comes to inputting graphics or logos into any application or any CAD package, they are hopeless. They just can’t — and so you can’t. No way.

Problem? Yes and no. It depends — you may shrug your shoulders and say “Well, I’ll never do CAD and I just never want to input any sketches, logos, or photos into my computer anyway.” Or — you feel that isn’t good enough after all the money you have invested and all the nice things you know you could do today with your own graphics once they were in the computer.

**Problem Solved.**

Here comes the mouse that lets you input all your graphics as well. How?: That’s what they all want to know, but we’re not telling. Its a new invention. It’s a universal combination of a true mouse and an independent manual drawing board that becomes a precision full-featured digitizer tablet once you just place the mouse onto the board. It’s all in one or all separate as required. Simply unplug your poor old mouse, plug in our mouse and have the real all purpose input device to your PC always at hand. At a price poor mice can afford too.
**OPERATING SYSTEMS**

**IBM Announces “Better” DOS Than MS-DOS**

Compatibility used to be the name of the game. In past releases of their respective versions of DOS, IBM and Microsoft consistently released products that were almost identical to each other. Those days of product uniformity have apparently ended with IBM’s announcement of PC-DOS 6.1, which was expected to ship at the end of July.

The new game is MBD (More, Better, Different) marketing, and IBM has come out swinging. IBM says PC-DOS 6.1 is smaller and faster than MS-DOS 6.0. The company demonstrated speed improvements in video updates, batch processing, and the execution of ANSI commands. UMB (upper memory block) support was improved to decrease DOS’s memory requirements by using extra video memory as UMBs and adding UMB support for 286-based systems.

The major area of product differentiation is the included utility programs. IBM responded to Microsoft’s DoubleSpace disk compression by announcing that Addstor’s SuperStor disk doubler will be bundled this fall. Early purchasers of PC-DOS 6.1 will receive a coupon they can use to upgrade at no cost when the SuperStor version is released. This new version will provide full support for the Microsoft Real-Time Compression Interface.

Central Point Software’s Backup program supports archival storage on floppy disk, minitape, or SCSI tape. This program is augmented by RAMBoost, a memory optimizer, Undelete, and Scheduler, a program that can run Backup unattended at periodic intervals.

The included AntiVirus program is a product of IBM’s own Thomas Watson Research Center. It’s claimed to detect and correct over 1400 viruses. Fuzzy-logic technology is used to find mutating strains of known viruses.

**PROCESSORS**

**AMD Declares Independence**

Late this summer, Advanced Micro Devices (Sunnyvale, CA) will start shipping a new series of 80x86-compatible processors that it says are not based on Intel microcode. AMD’s strategy is not only to free itself from costly legal entanglements with Intel but also to attract new customers by offering chips that fill perceived gaps in Intel’s product line. For instance, among the first three new processors is a 40-MHz 486SX. Intel’s fastest 486SX runs at only 33 MHz.

AMD also introduced a pair of 33-MHz 486SX chips: One is a 5-V part for desktop systems, and the other is a 3.3-V part with SMM (System Management Mode) for mobile computers. First shipments were slated for August and September.

All the chips are based on clean-room microcode developed by engineers who did not copy Intel’s 80x86 microcode, according to AMD. Until now, AMD’s 80x86-compatible chips used Intel microcode obtained through licensing agreements dating back to the 1970s—the source of a long-running court battle between AMD and Intel.

The new processors have fully static cores and are manufactured in Sunnyvale using a 0.7-micron, triple-layer CMOS process technology. They will cost $185 each in 1000-unit quantities. That’s comparable to Intel’s prices for similar parts, indicating AMD is not interested in starting the kind of price war that eroded the price of 386-compatible chips in 1991 and 1992.

“We’re capacity-constrained with our 486 production right now,” said Dirk Heinen, a program manager at AMD. “There’s no point in driving the price down, when we’ve already got more orders than we can handle and we’re still trying to ramp up production.”

Heinen said AMD will probably ship only a few hundred thousand of the new processors this year—a minuscule fraction of the total 486 market, that is estimated at 25 to 30 million chips this year.

—Matt Trask

---

**SPA Software Sales Report**

In the first three months of this year, sales of Windows-based applications surpassed sales of DOS-based applications in North America, for the first time, according to the Software Publishers Association, a trade association of the PC software industry. The SPA reports that the Windows sales growth was fueled by the 112 percent increase in the sales of Windows databases over the previous quarter, a sales growth driven primarily by the success of Borland’s Paradox for Windows and Microsoft’s Access. The popularity of Windows databases no doubt contributed to Lotus Development’s acquisition of Approach: Software’s Approach database for Windows.

In all four of the major business-oriented categories (i.e., word processing, spreadsheets, databases, and presentation graphics), Windows programs outsold DOS applications. DOS continued to hold the lead in home education, finance, and utilities. In the area of entertainment, DOS whopped Windows by generating $60.1 million in sales, compared to $3.1 million for Windows.

Trends in Europe were similar to North America’s in the first quarter of this year, according to SPA Europe. Revenues generated by Windows products accounted for 70 percent ($338.1 million) of the 41 software firms participating in the SPA’s data program.

—D.A.
Van Wolverton gently teaches beginners the basics and offers more experienced computer users a solid grounding in computer fundamentals. Includes coverage of MS-DOS back to version 3.3 and a complete command reference. Suggested retail price $24.95.

Easy-to-use strategies, tricks, and shortcuts from the #1-rated MS-DOS authority. Boost performance, safeguard your data, and create the ultimate MS-DOS-based system! More than 20 powerful batch files and utilities. Suggested retail price $29.95.

The first easy-to-understand look under the hood at MS-DOS 6. A powerful tool for support professionals who provide assistance to coworkers and business associates. It's the ultimate nonprogrammer power user's guide! Suggested retail price $29.95.

Easy-to-use strategies, tricks, and shortcuts from the #1-rated MS-DOS authority. Boost performance, safeguard your data, and create the ultimate MS-DOS-based system! More than 20 powerful batch files and utilities. Suggested retail price $29.95.

Too busy to attend classroom training? Train yourself with this timesaving, self-paced book-and-disk package. There's no downtime because you learn right at your own desk! Suggested Retail Price $29.95.

Microsoft and MS-DOS are registered trademarks of Microsoft Corporation.
From Manufacturing to Design

Taiwan, long known for making products for American and European computer vendors, is now having to reengineer itself. As labor rates rise here, vendors in Europe and North America who must compete in markets defined by low profit margins are moving their manufacturing to countries like Thailand, Malaysia, and even mainland China, where the average labor rates are about one-fourth Taiwan's.

The AcerFormula 64-bit Windows PC from Acer (based in Taipei) was the winner of the Best System award. Its PICA (performance-enhanced I/O and CPU architecture) exhibited outstanding design in a competitive product category.

The winner of the Best of Input award was Dextrareader, from Taipei-based Dextra Technologies. Dextrareader is a 600-dpi gray-scale sheet-fed scanner, supporting the TWAIN standard. It lets users scan up to 12 pages at a time.

The Best of International award is a category for products from companies based outside of Taiwan. This award went to the Lexicomp LC-8600 Palmtop PC, designed by Abstract Research & Development (Orinda, CA). This system included a 16-bit F8680 PC/Chip, 1 MB of RAM, three AA alkaline or rechargeable nickel-cadmium batteries, a 640- by 200-pixel-resolution screen, an optional 2 MB of internal RAM, and an internal 9600-/2400-bps fax modem.

You can expect to see more PC innovations from Taiwan as more companies take the giant step from product manufacturing to product design.

Janet Wang is the editor in chief of 0 & 1 BYTE, a Chinese-language affiliate of BYTE. You can reach her on BIX c/o "editors."
PCI Local Bus
A New Era in Speed
PCI: LAYING THE TRACKS FOR TODAY’S TECHNOLOGY.

This third Technology Briefing will tell you about a new local bus technology—PCI. Jointly developed by Intel and other industry leaders, it’s designed for current and next-generation PCs. PCI picks up where today’s bus architectures leave off, providing greater system performance via a wider data path and increased expandability.

HOW TO BREAK THE BOTTLENECK.
The I/O bus most people use today, ISA, was specified for the original 286 computer. Its 16-bit data path and 8 MHz clock speed provided satisfactory performance for moving CGA graphic images of 150-thousand bytes and DOS applications limited to several hundred-thousand kilobytes. But with current generation Super VGA images requiring 750 KBytes and Windows applications weighing in at several megabytes, traditional I/O buses are unable to transfer the information quickly enough. The solution? A local bus system capable of moving 32 bits of data at 33 MHz.

LOCAL BUS IN A NUTSHELL.
Simply put, a local bus takes peripherals off the I/O bus and connects them, together with the CPU and the memory subsystem, to a wider, faster pathway for data. The result is faster data transfer between the CPU and the peripherals. That’s especially important for servers and graphic-intensive software like Windows and OS/2.*

PCI: WHERE LOCAL BUS IS GOING.
PCI is the best local bus implementation.
• Highest performing bus today (refer to back page).
• Pathway to new capabilities like plug and play.
• Offers the best expandability for high performance peripheral devices.

ROOM TO GROW.
Most PCI systems will support three to five performance-critical peripherals. These peripherals will be either integrated directly onto the motherboard or can be added via PCI expansion cards, such as multimedia, graphics, disk drives and LAN cards. Of course, you can still use existing ISA, EISA or Microchannel add-in cards because PCI is designed to supplement, not replace, the traditional I/O bus.

INDUSTRY-WIDE SUPPORT.
It was in 1991 that Intel’s Architecture Lab, along with leading computer vendors, began work on a design specification for PCI. The PCI specification has now been adopted by 168 companies including OEMs like Compaq, Dell, DEC, Gateway 2000, IBM, NCR and NEC; and add-in card vendors like Adaptec, ATI Technologies, Diamond Computers, STB, Tseng Labs and Matrox. As a result of this alliance, PCI chipsets, systems, and add-in cards for graphics, multimedia and LANs are now being introduced.
BURST MODE DATA TRANSFER.

PCI boasts a 32-bit data path and a 33 MHz clock speed. This yields a maximum data transfer rate of 132 megabytes per second, a marked improvement over the 5 MB/sec. for a standard ISA bus.

CPU Bus

33 MHz x 32-Bit = 132 MB/sec

PCI BUFFERED EXPANSION ARCHITECTURE.

PCI's architecture features a buffer design between the CPU and peripherals that amplifies the signal, allowing multiple high-speed peripherals to be attached to the same PCI local bus. Buffering also isolates the peripherals from the CPU, reducing noise and increasing reliability. And because PCI interfaces with ISA, EISA and Microchannel buses, you can continue to use existing add-in cards.

A JUMPERLESS FUTURE.

Through PCI, Intel is working to make autoconfiguration a practical reality. At the heart of PCI's design, built-in configuration registers and software will automatically keep track of every interrupt being used in the system. When a new PCI peripheral is added, the PCI chipset will simply select an unused interrupt. No more changing jumpers. No more keeping track of IRQs.
The Torque Benchmark illustrates PCI's bus throughput for graphics operations. It measures the rate at which bytes are transferred from main memory to screen.

This benchmark was run on identically configured i486™ DX2-66 CPU-based systems. Only the bus architecture, and therefore the graphics card, was changed. All SVGA graphics cards used versions of ATI's Mach32® graphics accelerator family.

PCI: A BUS WITH A FUTURE.

The Intel Architecture Lab was instrumental in establishing the industry's PCI Special Interest Group (SIG). The PCI SIG was responsible for defining and establishing the PCI specification as a standard. In fact, it has already defined a new specification to support 64-bit extensions and 3.3 volt systems.

Is there a PCI local bus in your future?

Yes, especially if you're interested in maximum performance and functionality from today's demanding peripherals like full-motion video and graphics. And there certainly is if your outlook is long-term, since Intel and its partners designed PCI to also be the architecture for the next generation of technology. Users of i486 processor-based and Intel Pentium™ processor-based systems will be the real beneficiaries of PCI's greater bandwidths and clock speeds. So when buying your next system be sure to specify PCI local bus.

©1993 Intel Corporation.

All products mentioned are trademarks of their respective companies.

WANT TO LEARN MORE? CALL 1-800-955-5599.

To find out more about PCI local bus technology, call us and we'll gladly send you a PCI technical overview with benchmarks, a list of PCI systems and add-in boards, and information on the PCI SIG. Just ask for literature package #69. Reprints of the Pentium processor and OverDrive™ Processor Technology Briefings are also available through our toll-free number.
Like the worlds he presents, William Gibson’s way with words can take some getting used to, if only because word and world are aspects of one another. He writes from within the dystopia he’s presenting, and the language he puts on the page is different from today’s American for the same reason today’s American is different from 1770’s American (“When in the course of human events...”). Bill Clinton’s way with idiom would have broken Thomas Jefferson’s heart, but then so would have Bill Buckley’s.

We feel at home, it may be, in our grandparents’ nightmares. And very likely we should all be unhappy in any future to which we could be suddenly transported. What has always made real futures habitable is their way of coming about in tiny increments, and what makes fictive ones like Gibson’s unsettling is the Blade Runner effect: our total immersion as early as page 1.

So novel is the language, it’s not always quite clear what he’s saying. Look back three paragraphs. What about that “hepatic corona”? Hepatic in a visual context means liver-colored, which the OED specifies as dark brownish-red. But “a tint of jaundice”? Jaundice—true, a liver disorder—does tint the skin, though not dark brownish-red but yellowish. So what does Gibson mean us to see? I’d call that a naive 1990’s question. He means us to receive the sickly impact of a word-string, hepatic-jaundice-brownish-fecal-sewage. Not a nice place, Mexico City, 2005.

Yes, as near as 2005. The writer who coined the word cyberspace, and a decade ago took every science fiction award in sight with the dystopia of the decade, Neuromancer, now ventures a future just 10 years away, when, in his words, “All the technology we read about today like virtual reality and telepresence has come to pass, but otherwise it’s business as usual.”

And if you think I’m not telling you what the book’s “about,” you’re right. Reviewers of Neuromancer ran up against the difficulty of saying what “happens” in a mental space where such once-firm counters as “character” have fallen victim to virtuality. There are “characters” in Neuromancer whom you could neither see nor shoot, existing as they do solely as binary trees of interactive cognitive attributes. Hence, no way to paraphrase that book’s last 20 pages.

But Virtual Light? It turns on the theft of a pair of virtual-reality glasses that an ex-cop named Berry Rydell is supposed to retrieve. (“Ex-” is a trademark of the Gibson cosmos, where people get demoted, disgraced.) But something not quite human has an interest in what those glasses show....

Don’t worry. Just absorb the prose texture. It’ll carry you through a reality every bit as absorbing as Blade Runner’s.

Hugh Kenner is Franklin and Callaway Professor of English at the University of Georgia. He writes for publications ranging from the New York Times to Art & Antiques. You can contact him on BIX as “hkenner.”

---

Computer Fundamentals

How Computers Work

Warner New Media, 3500 Olive Ave., Burbank, CA 91505, (800) 593-6334 or (818) 955-9999, $79.99

How Computers Work is an interactive CD-ROM for the Mac that explains in layperson’s terms the fundamentals of computer hardware. While this title won’t help the experienced computer user, it’s a great way to introduce new users to computer technology basics.

Based on Time-Life’s Understanding Computers and How Things Work series of books, it uses rich graphics, animation, and QuickTime movies to illustrate the fundamentals of computer hardware and software. This complex topic is broken down into categories such as input, output, memory and storage, processing, programming, applications, and a timeline.

In one topic, a QuickTime movie shows a diagram of a color monitor with red, green, and blue electron-gun beams sweeping across the monitor’s face. It clearly demonstrates how the beam strikes the surface, thereby energizing the screen phosphors, which glow to form the image. Icons supply access to a notepad, a bookmark function, a glossary/index, and a navigation aid that helps steer you through the reams of information.

Both male and female voices provide a sonorous voice-over for these sections. The time line provides a comprehensive history of the computer’s evolution, yet there are curious omissions. For example, the Macintosh appears several times, but the only processor mentioned is the Intel 80x86 series, which isn’t found in that computer.

The average BYTE reader probably won’t find much new in this material. But if you’re training new users, or you have a child starting an introductory computer course, How Computers Work might be a great help.

—Tom Thompson
PROTECT YOUR SOFTWARE

NO BUTTON, NO ACCESS.

Dallas Semiconductor is re-shaping the world of software protection and distribution control with a new family of microchips called Buttons. We put the lid on software piracy by packaging microchips in button-shaped, stainless steel cans. The chips contain missing but critical information to make the software run.

We offer a variety of Authorization Buttons and features so you can select the level of protection and price point that are right for you.

<table>
<thead>
<tr>
<th>Button Type</th>
<th>Unique Serial #</th>
<th>Read/Write Protection</th>
<th>Expiration Timer</th>
<th>Decay Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS1420 ID Button</td>
<td>X</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>DS1427 Time Button</td>
<td>x 4k bits</td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>DS1425 Multi Button</td>
<td>x 2k bits</td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

Snap In, Snap Out
Authorization Buttons interface to the installed base of 100+ million PC’s via the DS1410 Button Holder. They simply snap in and out. The DS1410 accepts two Buttons concurrently.

Toward a Dongleless World
New computers that accept Buttons directly, including palm and notebook, are being designed at OEM’s today. Our Dongle Trade-In Program will help in your transition to this world. With an approved application, we’ll pay you $7.00 for each dongle that you trade in for an Authorization Button and Holder. This offer is good until August 31, 1993. The one-piece price for the DS1420 is $4.35; volume discounts apply.

We’re Serious About Security
At Dallas Semiconductor, we design and manufacture our own microchips. And we’re the only ones in the software protection business who do. Sixty intricate process steps and a 64-bit unique registration number lasered into each chip prevent duplication.

To learn how to button down your software, give us a call.

DALLAS SEMICONDUCTOR
4401 South Beltwood Parkway, Dallas, Texas 75244-3292
Telephone: 214-450-8170 FAX: 214-450-3715

Books & CD-ROMs

NETWARE FOR THE FUN OF IT


The opening Hunter S. Thompson quote announces that this gonzo guide to Novell networking won’t take the dry, plodding approach typical of the genre. Humorously messy cartoons by Steve Marcus confirm that this is a hip computer book with an attitude. It’s also informative. Chapters on subjects such as cabling, internetworking, tape backup, storage sub-systems, communications, printing, and workstation/server hardware deliver a healthy mixture of technical reference, product description, troubleshooting procedures, and general advice all focused on what you need to know to run Novell LANs.

The advice rings true: Divide and conquer, do with few and simple tools, be religious about backups, and respect users. The technical, product, and troubleshooting materials from a vast reservoir. Nadler and Guarnieri are working consultants, no theoreticians. You won’t find answers to every conceivable question about source routing, X.25 gateways, or DAT (digital audiotape) backup products—that wouldn’t be possible—but you will find a number of highly specific nuggets on these and many other subjects. If one of those tips solves a problem of yours, the book will have paid for itself. If not, you will still have been entertained, enlightened, and reassured. “Remember,” the authors point out, “that none of this stuff really works.”

—Jon Udell

RELATIONAL DIFFERENCES

UNDERSTANDING RELATIONAL DATABASES by Fabian Pascal
John Wiley & Sons, ISBN 0471-585-386, $29.95

You don’t have to get far into Fabian Pascal’s Understanding Relational Databases before you’re struck by the uneasy feeling that (a) you thought you understood what it meant for a DBMS to be a relational DBMS, but you were wrong, and (b) many people writing and selling DBMS packages (as well as computer publications reviewing the software) were equally ill-informed.

Not only is the book a tutorial, it also points a harsh finger at an industry that, in its rush to build database software, has forgotten (or possibly ignored) many of the fundamental requirements of the relational technology. The yield is a crop of file management packages with “sort of relational” outer husks passing themselves off as true RDBMSes.

The author’s sharp elbow in our ribs reminds us that there’s no such thing as “sort of relational.” Worse, many DBMS products have—with the help of nonlogic from their designers—changed from “sort of relational” to simply relational. The ultimate losers
Computing Know How Books for advancing your business skills

PC Intern
A literal encyclopedia of DOS knowledge. This book is a completely revised edition of our bestselling PC System Programming book which has been read by over 225,000 programmers worldwide. Whether you want to program in Assembly Language, C, Pascal or BASIC, you'll find dozens of practical working examples for each of these languages. $59.95 with companion disk.

AutoCAD 12 Programming
Teaches you how to integrate custom functions and commands into your AutoCAD system. Learn about batch file programming, for user defined startup; creating script files, for specific drawing sequence; and programming custom commands with AutoLISP or ADS. Sample menus and programming examples on the companion disk help you learn quickly and easily. $44.95 with companion disk.

EXCEL for Science & Technology
Focuses on the power of Excel to apply what you learn by using Excel to create software products available. It's an indispensable professional work tool. $34.95 with companion disk.

Upgrading & Maintaining Your PC
Turn your PC into a high performance screaming! Whether you're adding memory or a hard drive, a CD-ROM or a sound board or upgrading an XT to a 386 or 486, this book shows you how. Includes companion diskette of utilities and System Stext diagnostic software that helps you analyze your systems performance. $34.95 with companion disk.

NEW !

The 486 Book
See why the 486 is the processor of choice; how it works and how you can set up your system for maximum performance — even with DOS 6. Contains info on new Overdrives, DX2s and even the Pentium. Includes System Sleuth Professional and PC Info software on companion diskette. $34.95 with companion disk.

Multimedia Mania
Learn the basics from adding CD-ROMs and sound boards to making a MPC system. Includes CD-ROM with over 400 megabytes of sounds, graphics, animations, samples and applications. Valuable coupons from major software publishers worth over $500.00 inside. Register your book and get a free jewel case. $49.95 with companion CD-ROM.

The SoundBlaster Book
This bestselling book is the guide to Sound Blaster cards, commercial, public domain and shareware software products available. $34.95 with companion disk.

Abacus
Dept. B9, 5370 52nd Street SE, Grand Rapids, MI 49512
Phone: (616) 698-0320 • Fax: (616) 698-0325

Order Toll Free 1-800-451-4319

In Canada at: Coles, W.H. Smith Books, Classif, SoundBlaster Book

Circle 61 on Inquiry Card (RESELLERS: 62).

Please rush me the following books:

PC Intern ........................................... $59.95 ea.
AutoCAD 12 Programming .................. $44.95 ea.
DOS 6.0 Complete SE .......................... $39.95 ea.
EXCEL for Sci. & Tech. .......................... $59.95 ea.
Upgrading & Maintaining Your PC .......... $34.95 ea.
MULTIMEDIA MANIA ............................ $49.95 ea.
SoundBlaster Book .............................. $54.95 ea.

Subtotal: .............................................

Please add sales tax as required. In US & Canada add 5.60 Charge:

Fax: (616) 698-0325

Foreign orders add $15.00 per item:

Total amount (US Funds): $

Name: ..............................................
Company: ........................................
Address: .........................................
City: ............................................. State: Zip:

Check / M.O. 

Method of Payment: 

Payment: 

Card#: .............................. Expiry:

For fast delivery Order Toll Free 1-800-451-4319 x 29, or FAX (616) 698-0325

Or mail this coupon to: Abacus, 5370 52nd Street SE, Grand Rapids, MI 49512
are you and I, since a DBMS that’s not relational is unable to incorporate all the safeguards and optimizations that relational technology sought to install in the first place.

It is Pascal’s well-meaning intention to introduce the reader to enough relational theory so that he can proceed to eliminate much of the confusion that has arisen about it over the past two decades. We are reminded that an RDBMS is not just a mathematical plaything, but a concept that yields practical results. Thanks to the author’s gift of clear writing, even a moderately determined reader stands a good chance of realizing the title’s promise by the last page.

—Rick Grehan

**CASUAL TECHNOLOGY**

**ARTIFICIAL LIFE PLAYHOUSE** By Steven Prata The Waite Group Press, ISBN 1-878739-32-8, $23.95

**NANOTECHNOLOGY PLAYHOUSE** By Christopher Lampton The Waite Group Press, ISBN 1-878739-33-6, $23.95

When the rush of technology seems too much, it’s useful to sit back and simply take a casual, lighthearted look at the oncoming wave. Artificial Life Playhouse and Nanotechnology Playhouse take this approach. Both are informative, and they include demonstration programs on disk. Neither will tax your technical skills.

Artificial Life Playhouse provides a quick overview of various artificial-life topics, such as cellular automata and genetic algorithms, and then plunges you into a delightful collection of demonstration programs. My favorites are a pair of programs that simulate the evolution of antlike creatures as they feed and reproduce. One version controls a single ant colony; the other program provides competition between two colonies. It is incredibly easy to become attached to these little critters as you design a better bug.

Most of the provided software is in the public domain and available through a variety of on-line systems. You’ll appreciate having them all in one place, along with design hints and problem-solving exercises to provide a little challenge.

If you’ve spent any time reading in the field of nanotechnology, you know that most of it is highly technical—articles describing the bonding mechanism between atoms and proving you can make mechanical dolls that will fit on the head of a pin. Nanotechnology Playhouse is more of a light stroll through the nano landscape—from roving factories able to manufacture your heart’s desires to machines surfing through your bloodstream looking for hostile cells.

All this, of course, is fictional; some of it absurdly so. However, this material is a look into the eyes of some modern dreamers who claim we have yet to begin making really microminiaturized systems.

—Raymond GA Côté
The New Generation Monitors

ViewSonic’s New Generation is everything high performance monitors should be ... and more.

The ViewSonic 15, 17, 20 and 21 produce remarkably crisp, sharp screen images with enhanced vibrant colors. Some advanced innovations include ergonomically designed drop-down digital control panels, special screen coatings, the ViewMatch™ color control system, and resolutions up to 1600 x 1280 non-interlaced.

The biggest surprise of all is the price — much less than you’d expect to pay for such astounding quality.

Call ViewSonic at 800-888-8583 for information on our award-winning monitors.

Welcome to the New Generation.

<table>
<thead>
<tr>
<th>FEATURE SUMMARY</th>
<th>ViewSonic 15</th>
<th>ViewSonic 17</th>
<th>ViewSonic 20</th>
<th>ViewSonic 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen Size</td>
<td>15&quot;</td>
<td>17&quot;</td>
<td>20&quot;</td>
<td>21&quot;</td>
</tr>
<tr>
<td>Dot Pitch (mm)</td>
<td>0.28</td>
<td>0.28</td>
<td>0.28</td>
<td>0.25</td>
</tr>
<tr>
<td>Horizontal Frequency (KHz)</td>
<td>50-64</td>
<td>30-82</td>
<td>30-82</td>
<td>30-82</td>
</tr>
<tr>
<td>1600 x 1280 Non-Interlaced</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Maximum Refresh Rate (Hz) at 1280 x 1024 N1</td>
<td>60</td>
<td>76</td>
<td>76</td>
<td>76</td>
</tr>
<tr>
<td>Flat Square Screen</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>ViewMatch™ Color Control</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Low Radiation (MPR11)</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Suggested List</td>
<td>$635</td>
<td>$1,299</td>
<td>$2,099</td>
<td>$2,399</td>
</tr>
</tbody>
</table>

Call ViewSonic at 800-888-8583 for information on our award-winning monitors.

Welcome to the New Generation.

ViewSonic

20480 Business Pkwy Walnut, CA 91789
Tel. (909) 899-7976 Fax (909) 899-7938

ViewSonic is a screen image by SPATIS TECHNOLOGY INC., Boulder, CO. Created with ACKS™ Geometric Modeler and rendered with Visualization Kit.

*Color temperature select 9300K or 6500K only.

All products and brand names are registered trademarks of their registered companies.

Circle 156 on Inquiry Card (RESELLERS: 157).
Now, tape backup is easier than ever. Unpack Trakker and plug it into your computer's parallel printer port. That's it. No assembly, no installation, no problem.

Trakker goes anywhere. It's light and compact, the ideal solution for backing up notebooks and laptops. And Trakker can back up unattended, so you can go anywhere, too. Trakker is available in two models. At $348, Trakker 120 (120 MB capacity, using data compression) is the price leader. And Trakker 250 (250 MB capacity using data compression) is the fastest in its class at up to 8 MB/minute. Both give you QIC Industry Standard Recording Format, as well as Novell* and LANtastic* certification.

For a FREE 88-page catalog, please call 1-800-451-0897 ext. 227 today.
India's Software Edge

JON UDELL

Recently, I saw a demonstration of a new Motif-based programmer's tool called Sextant. It's a source code analyzer that converts C programs into labeled graphs that you navigate interactively. The demonstration was impressive. What made it unique for me was that it took place in the offices of Softek, a software company in New Delhi, India.

It's well known that Indian engineering talent pervades every level of the microcomputer industry. But what's happening in India? On a recent tour of the country, I visited several high-tech companies and discovered that India is evolving rapidly from an exporter of computer engineering talent into an exporter of computer products and services. Software exports, in particular, dominate the agenda. A 1992 World Bank study of eight nations rated India as the most attractive nation for U.S., European, and Japanese companies seeking offshore software-development partners.

The World Bank study was conducted by Infotech Consulting ( Parsippany, NJ). When the opportunity arose to visit India, I contacted Infotech's president, Jack Epstein, for advice on planning my trip. He referred me to Pradeep Gupta, an entrepreneur in New Delhi who publishes two of India's leading computer magazines, PC Quest and DataQuest. Gupta also runs market-research and conference businesses. He orchestrated a whirlwind week of visits to companies in New Delhi and Bombay and generously took time to acquaint me with the Indian high-tech scene.

A Nation of Small Systems

Even among Indians, there's a tendency to attribute India's emerging software prowess to the innate mathematical abilities of its people. "After all, we invented zero," says Dewang Mehta, an internationally known computer graphics expert. He is also executive director of the National Association of Software and Service Companies (NASSCOM) in New Delhi.

While this cultural stereotype may hold more than a grain of truth, it's not the whole story. As NASSCOM's 1992 report on the state of the Indian software industry notes, India has the world's second-largest English-speaking technical work force. Consequently, Indian programmers are in tune with the international language of computing, as well as the language spoken in the U.S., the world's largest market.

Furthermore, India's data-communications infrastructure is rapidly modernizing. And the Indian government has begun an aggressive program of cutting taxes and lifting import restrictions for export-oriented Indian software businesses while simultaneously clearing the way for foreign companies to set up operations in India.

Other countries share many of these advantages, but India holds an ace. It is a nation of small systems. For U.S. and European companies that are right-sizing mainframe- and minicomputer-based information systems, the switch to PC-based
client/server alternatives can be wrenching. Dumping the conceptual baggage of legacy systems isn’t a problem for India, however, because, in general, those systems simply don’t exist. “India’s mainframe era never happened,” says Gupta.

When Europe, Japan, and the U.S. were buying mainframes left and right, few Indian companies could afford their high prices, which were made even more costly by 150 percent import duties. Also, a government policy limiting foreign investors to a 40 percent equity stake in Indian manufacturing operations drove companies like IBM away, and the Indian mainframe industry never got off the ground.

But what did develop was an indigenous microcomputer industry. In the early 1980s, Indian companies began to import components and to assemble and sell PC clones that ran DOS. This trend quickened in 1984, when the late Rajiv Gandhi, prime minister and an avid computer enthusiast, lifted licensing restrictions that had prevented clone makers from selling at full capacity.

In the latter half of the 1980s, a computerization initiative in the banking industry shifted the focus to Unix. Front offices would run DOS applications, but behind the scenes, a new breed of Indian-made PCs—Motorola- and Intel-based machines running Unix—would handle the processing chores. Unfortunately, that effort stalled when the banks ran afoul of the unions; even today, many of the Bank of India’s 50,000 branches aren’t linked electronically.

Nevertheless, the die was cast, and India entered the 1990s in possession of a special advantage. Indian programmers are not only well educated and English-speaking, but out of necessity they’re keenly focused on client/server or multiuser solutions for PCs running DOS (with NetWare) or Unix—just the kinds of solutions that U.S. and European companies are rushing to embrace. India finds itself uniquely positioned to help foreign partners right-size legacy applications.

The small-systems mind-set also guides India’s fledgling supercomputer industry. Denied permission by the U.S. government to import a Cray supercomputer, the Indian government’s Center for the Development of Advanced Computers built its own—very different—sort of supercomputer. Called PARAM, it gangs Inmos T800 transputers in parallel and can also harness Intel 860 processors for vector work. Related developments include a transputer-based neural-network engine intended to run process-control applications. The designers of this system impressed me with their clear grasp of the way in which inexpensive transputers can yield superior performance, scalability, modularity, and fault tolerance.

**Software Products and Services**

Many of the companies I visited produce comparable offerings for LAN or Unix environments. In the realm of packaged software, Oberoi Software in New Delhi sells a high-end hotel management application using Sybase 4.2 that runs on Hewlett-Packard, DEC, and Sun workstations. A low-end version uses Btrieve for DOS LANs. Softek offers 1-2-3, dBase, and WordStar work-alikes for DOS and Unix.

Shrink-wrapped products, however, aren’t India’s strong suit at the moment. PCs remain scarce and expensive commodities. According to DataQuest, fewer than 500,000 PCs can be found in this nation of 875 million people. To a U.S. software engineer, a $3000 PC might represent a month’s wages. An equivalently prosperous Indian professional would have to work a full year to pay for the same system. To put this in perspective, the average per capita wage in India is about $320, and the government caps the monthly
IF THERE WERE ONLY ONE KIND OF COMPUTER SYSTEM, YOU'D ONLY NEED ONE KIND OF PROTECTION.

Too many companies go out into the hazardous world of business with the wrong UPS protection, or none at all. At MINUTEMAN, we know that different systems face different dangers.

That's why MINUTEMAN offers five different safeguards, the most comprehensive line in the industry.

Like the new MINUTEMAN LANMASTER power monitoring shutdown software. It combines all the features of similar competitive products and features the most sophisticated diagnostic techniques available.

Or the MINUTEMAN LINE-INTERACTIVE MODELS, the most economical protection of their kind on the market. Each comes with a MINUTEMAN Platinum Protection Plan covering up to $25,000 and a two-year warranty.

So call MINUTEMAN today. Our skilled professionals worldwide are ready to answer your questions and help you find the perfect UPS for your system.

MINUTEMAN. It's all the protection you need. Whatever you need.
salary of Indian corporate executives at around $1600 per month.


Painfully aware of the effect piracy has on the country's international reputation and the industry leaders have joined forces to combat it. The Department of Electronics (DoE), for example, has funded an anti-piracy campaign, and Lotus has a $69 amnesty program that enables users of illegal copies of 1-2-3 to come clean.

Reengineering Is a National Strength

The real action in Indian software isn't in products. It's in reengineering services. A typical project, for example, might involve re-creating an IBM AS/400-type application for a LAN or Unix environment. A few years ago, Indian programmers almost invariably would perform such work on location in the U.S. or Europe, a practice called "body shopping." This was convenient for clients, but it wasn't very beneficial to India because the tools and the knowledge spun off from reengineering projects tended to stay overseas.

More recently, the trend is to carry out such projects on Indian soil. Softek, for example, used a contract to build a law-office automation system for a Canadian firm as an opportunity to weld a number of its own products into a powerful, general-purpose client/server development toolkit. Softek engineers showed me how that toolkit supports single-source development of GUI software for DOS or Unix (in character mode) as well as Windows. They explained that client programs can connect to Softek's own RDBMS (relational DBMS) or to servers from Gupta, Ingres, Oracle, or Sybase. That's an impressive achievement matched by few companies anywhere in the world, and it's one that should greatly enhance Softek's appeal to foreign clients.

While reengineering often means rightsizing, that's not always the case. For example, the National Indian Institution for Training, a New Delhi-based computer-training institute rapidly expanding into the realm of software products and services, has rewritten a well-known U.S. commercial word processor. Rigorous development techniques are the watchword at NIIT. "We have a passion for methodology," says managing director Rajendra S. Pawar, whose company also distributes Excelerator, Intersolv's CASE tool.

Other projects under way at NIIT include an X Window System interface builder, Mac and DOS tutorials to accompany the Streeter series of math textbooks (for McGraw-Hill), a simple but effective multimedia authoring tool called Imaging, a word processor for special-needs users that exploits an NIIT-designed motion- and sound-sensitive input device, and an instructional video system.

Although services outweigh products for now, and the Indian trade press has complained that no indigenous software product has yet made a splash on the world scene, the situation could well change. Indian programmers are talented, and they're up-to-date with database, GUI, network, and object-oriented technologies. These skills, along with wages 10 or more times less than U.S. programmers, make Indian programming a force to be reckoned with. Software development is a failure-prone endeavor; many products never see the light of day. But, as Tata Unisys (Bombay) assistant vice president Vijay Srinagan points out, "The cost of experimentation in India is low." Of the many software experiments under way in India today, some will surely bear fruit.

A major obstacle blocking the path to commercial success is the lack of international marketing, but some help has been forthcoming. Under contract to the U.K.'s Developing Countries Trade Agency, the marketing firm Schofield Maguire (Cambridge, U.K.) is working to bring selected Indian software companies to the attention of European partners. "India does have a technological lead over other developing countries," says managing partner Alison Maguire. "But to really capitalize on its software expertise, it must project a better image."

Some companies have heard the message. For example, Ajay Madhok, a principal with AmSoft Systems (New Delhi), parlayed his firm's expertise with computer graphics and digital video into a high-profile assignment at the 1992 Olympics. On a recent U.S. tour, he visited the National Association of Broadcasters show in Las Vegas. Then he flew to Atlanta for Comdex. While there, he bid for a video production job at the 1996 Olympics.

Incentives for Exporters

According to NASSCOM, in 1987, more than 90 percent of the Indian software industry's $52 million in earnings came from "on-site services" (or body shopping). By 1991, on-site services accounted for a thinner 61 percent slice of a fatter $179 million pie. Reengineering services (and, to a lesser extent, packaged products) fueled this growth, with help from Indian and U.S. government policies.

On the U.S. side, visa restrictions have made it harder to import Indian software labor. India, meanwhile, has developed a range of incentives to stimulate the software and electronics industries. Government-sponsored technology parks in Noida (near New Delhi), Pune (near Bombay), Bangalore, Hyderabad, and several other locations support export-oriented software development. Companies that locate in these parks share common computing and telecommunications facilities (including leased-line access to satellite links), and they can import duty-free the equipment they need for software development.

The Indian government has established

**We want to create many Hong Kongs and Singapore in India.**

— N. Vittal, Secretary to the Government of India, Department of Electronics

**Feature**

**INDIAN/U.S. PARTNERSHIPS**

**A growing trend among Indian computer companies is to work with U.S. companies.**

<table>
<thead>
<tr>
<th>INDIAN COMPANY</th>
<th>U.S. PARTNER</th>
<th>PRODUCTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citicorp Overseas Software</td>
<td>Citicorp</td>
<td>Software services</td>
</tr>
<tr>
<td>HCL-HP</td>
<td>Hewlett-Packard</td>
<td>Workstations, PCs, software</td>
</tr>
<tr>
<td>Lotus</td>
<td>Lotus Development</td>
<td>Software services</td>
</tr>
<tr>
<td>Mastek</td>
<td>Novell</td>
<td>Software services, maintenance</td>
</tr>
<tr>
<td>Outward Computer Technologies</td>
<td>Dell Computer</td>
<td>Motherboards, PCs</td>
</tr>
<tr>
<td>Pertech Computers</td>
<td>Intergraph</td>
<td>CAD workstations, services</td>
</tr>
<tr>
<td>Tata Information Systems</td>
<td>IBM</td>
<td>PS/2, PS/VP, software services</td>
</tr>
<tr>
<td>Tata Unisys</td>
<td>Unisys</td>
<td>Workstations, software services</td>
</tr>
<tr>
<td>Wipro Infotech</td>
<td>Sun Microsystems</td>
<td>Workstations, software services</td>
</tr>
</tbody>
</table>

**Ingras**, **Oracle**, or Sybase. That's an incentive among Indian computer companies to work with U.S. companies.
Power Packed Upgrades.

**POWER SUPPLIES**

"The premier power-supply maker"
John Dvorak, PC Magazine, March 30, 1993

"The only company to go to for a power supply"
Jerry Pournelle, Byte, April 1993

**STANDARD UNITS**

These UL/CSA approved, fully tested power supplies are the best basic units available.

- STANDARD 205 SLIM .................................. $89
- STANDARD 220 DESK/TOWER ........... $89

**ULTRA-QUIET UNITS**

Unrattle your nerves with a Silencer power supply, recognized since 1986 as the industry's quietest. They're cooled by custom, high-efficiency fans that are virtually inaudible!

A must for home office or multimedia applications.

- SILENCER 205 SLIM .................................. $119
- SILENCER 220 DESK/TOWER ........... $129
- SILENCER 270 DESK/TOWER ........... $179

**HIGH-PERFORMANCE UNITS**

Upgrade your computer with one of our premium Turbo-Cool power supplies—the choice of PC professionals. You'll get 50% - 100% more power, built-in line conditioning, super-tight regulation, ultra-clean output, a high-capacity ThermaSense variable-speed fan (300W models), UL/CSA/TUV approvals, and a no-hassle 2-year warranty! Ideal for high-end workstations and network file servers.

- TURBO-COOL 300 SLIM/BABY ........ $169
- TURBO-COOL 300 DESK/TOWER ... $189
- TURBO-COOL 450 DESK/TOWER ... $349

**CASE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Desktop</th>
<th>Tower</th>
<th>Monster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposed Drive Bays</td>
<td>3</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>Total Drive Bays</td>
<td>5</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>Motherboard Capacity</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Power Supply Capacity</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Cooling Fan Capacity</td>
<td>2</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Filtered Air Inlet</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Lockable Front Door</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Professional Controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>All-Steel Construction</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Beige or Black Finish</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Meets FCC-B Specc</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Made in USA</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

- SOLID-STEEL DESKTOP CASE .......... $295
- SOLID-STEEL TOWER CASE ........... $395
- SOLID-STEEL MONSTER CASE .......... $895

**CPU COOLER**

It's a fact. 486 chips run hot, often exceeding 185°F! Now, you can cool your 486 to a safe 85°-95°F with our popular CPU-Cool. It prevents random system errors and other heat-related problems. Consists of a mini-fan embedded in a sculptured heat sink that easily mounts on the CPU. Powered by a spare drive connector. Effective, inexpensive insurance!

- cools CPU 70° - 100°F
- prevents system errors
- adds years to CPU life
- thinner, quieter, and better-built than cheap imported imitations
- safe, simple installation

- CPU-COOL .............................................. $29

**REDUNDANT POWER**

Eliminate the risk of network downtime or data loss due to power supply failure with the TwinPower 900 redundant power system. It delivers high-capacity, fault-tolerant power to your entire network server. Consists of two Turbo-Cool 450 power supplies in parallel, utilizing a special power-management interface module. A must for mission critical LANs.

- 900 watts peak power
- 100 X more reliable than a single-unit
- load-sharing design
- hot-swap capability
- allows dual UPSs
- monster-case compatible

- TWIN-POWER 900 ............................... $995

PC POWER & COOLING, INC.

5995 Avenida Encinas, Carlsbad, CA 92008 • (619) 931-5700 • (800) 722-6555 • Fax (619) 931-6988

Most orders shipped same day. We accept Visa, MC, COD, or PO on approved credit. Turbo-Cool, TwinPower and CPU-Cool are trademarks or registered trademarks of PC Power & Cooling, Inc. ©1993 PC Power & Cooling, Inc.

Circle 127 on Inquiry Card (RESELLERS: 128).
export processing zones in which foreign companies can set up subsidiaries that enjoy similar advantages and receive a five-year tax exemption. Outside these protected areas, companies can get comparable tax and licensing benefits by declaring themselves fully export-oriented.

Finally, the government is working to establish a number of hardware technology parks to complement the initiative in software. “We want to create many Hong Kongs and Singapores,” says N. Vittal, Secretary of the DoE and a tireless reformer of bureaucracy, alluding to the economic powerhouses of the Pacific Rim.

The Indian high-tech entrepreneurs I met all agreed that Vittal’s tenacious slashing of government red tape has blazed the trail they now follow. How serious is the problem of government red tape? When the government recently approved a joint-venture license application in four days, the action made headlines in both the general and trade press. Such matters more typically take months to grind their way through the Indian bureaucracy.

The evolution of India’s telecommunications infrastructure shows that progress has been dramatic, though uneven. In a country where only 5 percent of the homes have telephone service, high-tech companies increasingly rely on leased lines, packet-switched data networks, and satellite links. The DoE works with the Department of Telecommunication (DoT) to ensure that software export businesses get priority access to high-bandwidth services.

But the slow pace of progress at the DoT remains a major frustration. For example, faxing can be problematic in India, because the DoT expects you to apply for permission to transmit data. And despite widespread Unix literacy, only a few of the dozens of business cards I received during my tour carried Internet addresses. Why? DoT regulations have retarded what would have been the natural evolution of Unix networking in India. I did send mail home using ERNET, the educational resource network headquartered in the DoE building in New Delhi that links universities throughout the country. Unfortunately, ERNET isn’t available in India’s high-tech businesses.

Vittal recognizes the critical need to modernize India’s telecommunications. Given the scarcity of an existing telecommunications infrastructure, he boldly suggests that for many scattered population centers, the solution may be to completely pass over long-haul copper and vault directly into the satellite era. In the meantime, India remains in this area, as in so many others, a land of extreme contrasts.

While most people lack basic telephone service, workers in strategic high-tech industries now take global voice and data services for granted.

Our multiprocessing implementation of Unix System V has been used since 1988 by companies such as Pyramid and NCR.

—Arjun Mahotra, director HCL-HP, Noida, India

Powerful Partners

When Kamal K. Singh, chairman and managing director of Rolta India, picks up his phone, Rolta’s U.S. partner, Intergraph, is just three digits away. A 64-Kbps leased line carries voice and data traffic from Rolta’s offices, located in the Santa Cruz Electronics Export Processing Zone (SEEFPZ) near Bombay, to an earth station in the city’s center. Hence, such traffic travels via satellite and T1 lines in the U.S. to Intergraph’s offices in Huntsville, Alabama.

Rolta builds Intel- and RISC-based Intergraph workstations for sale in India; I saw employees doing everything from surface-mount to over-the-network software installation. At the same time, Rolta does facilities mapping for a U.S. telephone company through its subsidiary in Huntsville. Every night, scanned maps flow through the satellite link to Bombay. Operators running 386-based RoltaStations retrieve the maps from a Unix server, digitize them using Intergraph’s MicroStation CAD software, and relay the converted files back to Huntsville.

Many Indian companies have partnerships with U.S. firms. India’s top computer company, HCL, joined forces with Hewlett-Packard to form HCL-HP. HCL’s roots were in multiprocessor Unix. “Our fine-grained multiprocessing implementation of Unix System V has been used since 1988 by companies such as Pyramid and NCR,” says director Arjun Malhotra. HCL’s joint venture enables it to build and sell HP workstations and PCs in India. “People appreciate HP quality,” says marketing chief Ajai Chowdhry. But since Vectra PCs are premium products in the price-sensitive Indian market, HCL-HP also plans to leverage its newly acquired HP design and manufacturing technology to build indigenous PCs that deliver “good value for money,” according to Malhotra.

Pertech Computers, a system maker in New Delhi, recently struck a $50 million deal to supply Dell Computer with 240,000 motherboards. Currently, trade regulations generally prohibit the import of certain items, such as finished PCs. However, exporters can use up to 25 percent of the foreign exchange they earn to import and sell such items. Pertech director Bikram Dasgupta plans to use his “forex” money to buy Dell systems for resale in India and to buy surface-mount equipment so that the company can build work-alikes.

IBM returned to India last year, after leaving in 1978, to join forces with the Tatas, a family of Indian industrialists. The joint venture, Tata Information Systems, will manufacture PS/2 and PS/VP systems and develop software exports.

Citicorp Overseas Software, a Citicorp subsidiary, typifies a growing trend to locate software-development units in India. “Our charter is first and foremost to meet Citicorp’s internal requirements,” says CEO S. Viswanathan, “but we are a profit center and can market our services and products.” On a tour of its SEEFPZ facility in Bombay, I saw MVS, Unix, VMS, and Windows programmers at work on a variety of projects. In addition to reengineering work for Citicorp and other clients, the company markets banking products called Finware and MicroBanker.

ITC (Bangalore) supplements its Oracle, Ingres, and AS/400 consulting work by selling the full range of Lotus products. “Because we have the rights to manufacture Lotus software locally,” says vice president Shyamal Desai, “1-2-3 release 2.4 was available here within a week of its U.S. release.” Other distributors of foreign software include Onward Computer Technologies in Bombay (NetWare) and Bombay-based Mastek (Ingres).

India’s ambitious goal is to quadruple software exports from $225 million in 1992 to $1 billion in 1996. To achieve that, everything will have to fall into place. It would be a just reward. India gave much to the international microcomputer industry in the 1980s. In the 1990s, the industry just might return the favor.

Jon Udell is a BYTE senior technical editor. You can contact him on BIX as “judell” or on the Internet at judell@bysep.byte.com.
The World's FASTEST CD-ROM.

Yes it is the world's fastest... and no one else comes close!

Pioneer's DRM-604X, featuring its exclusive Quadraspin technology, has jumped past double speed drives to a new transfer rate of over 600 KB/sec. That's four times the speed of standard drives and twice the transfer rate of double speed drives.

**DATA TRANSFER RATE (KB/SEC)**

<table>
<thead>
<tr>
<th>Rate (KB/Sec)</th>
<th>0</th>
<th>100</th>
<th>200</th>
<th>300</th>
<th>400</th>
<th>500</th>
<th>800</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pioneer DRM-604X</td>
<td>🟢</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SONY CDU-3003</td>
<td></td>
<td>🟢</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOSHIBA XN-3401A</td>
<td></td>
<td></td>
<td>🟢</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHINON CDA-653</td>
<td></td>
<td></td>
<td></td>
<td>🟢</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEC 3B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>🟢</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEXEL DM-3324</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>🟢</td>
<td></td>
</tr>
</tbody>
</table>

In an independent Test*, Pioneer ranked number one in overall performance. The DRM-604X searched databases, retrieved files and read CD's faster than any other drive.

**Highest Capacity**

Not only is this drive fast, it's also the industry's only 6 disc mini-changer.

The DRM-604X holds 6 CD's and can change CD's in an amazing 5 seconds. If you need more than 6 CD's you can manually change magazines or daisy chain up to 7 mini-changers to automatically access up to 42 discs and more than 5 million pages of data.

**Best Flexibility**

The DRM-604X is compatible with most operating systems and hardware platforms and has the latest features including multisession technology. Multisession makes it 100% Kodak Photo CD compatible and ready for new applications in the future.

For a fast response, call Pioneer at 1-800-LASER ON.

Pioneer New Media Technologies, Inc.

*MacWorld, July 1993

Circle 133 on Inquiry Card.

The Art of Entertainment
This Should Give You Of Why We Created An

The image you see over there started out attached to the image you see over here. But as it made its way to the printer, the computer it was created on recognized a problem: 11 x 17 pages can't fit on 8½ x 11 paper.

And so, out came the electronic scissors.

Now, if you're like a lot of people, you know all about this routine.

And you know how it feels to walk into a meeting with a presentation that contains hours of blood, sweat and tears, and a big fat strip of tape going right down the middle of it.

Enough said.

COMPAQ PAGEMARQ Network Laser printers were built to help put an end to all of that. They can print 11 x 17 pages in a single pass.

They come with up to three paper trays, which lets you switch between paper sizes without leaving your desk, so you don't have to pull one paper tray out and replace it with another, only to have your neighbor

CONNECTIVITY OPTIONS

COMPAQ PAGEMARQ Printers can be directly connected into the following environments:

NetWare, EtherTalk, LocalTalk, LAN Manager, LAN Server, Windows NT, and TCP/IP (including Sun, HP, SCO, IBM, DEC and Ipod compatible hosts).
I A PRETTY GOOD IDEA in 11 x 17 LASER PRINTER.

repeat the process two minutes later. They hold up to 1,500 sheets of paper. And for people whose design ambitions extend beyond Helvetica...

Font Modules, or you can add an internal 60-MB Hard Drive.

All of which print with razor-sharp clarity thanks to the 800 x 400 dpi high-resolution mode.

Of course, both the COMPAQ PAGEMARQ Laser Printers are fully backed by CompaqCare, our extensive service and support program.

Which includes a one-year, on-site limited warranty as well as unlimited toll-free telephone support. All at no additional charge whatsoever.

If you’re interested in learning more, just call us at 1-800-345-1518 in either the U.S. or Canada.

We’ll show you how to keep big ideas in one piece. At least until your client sees them. COMPAQ.

Bold, PAGEMARQ Printers offer two ways to expand your type library, eliminating the need to continually download from your computer. You can add 1- and 2-MB Programmable...

A typographer’s dream, these printers can store 1,500 fonts. Of course, not all of us dream about type. In which case, the 35 fonts that come standard are more than adequate.

Add an Internal FAX modem and you can turn your PC into a personal fax machine. One that will send and receive true Adobe PostScript quality faxes in any size up to 11 x 17.

Bold, PAGEMARQ Printers offer more, just call us at 1-800-345-1518 in either the U.S. or Canada.

We’ll show you how to keep big ideas in one piece. At least until your client sees them. COMPAQ.

Circle 73 on Inquiry Card.
The integration of full-motion video on desktop computers has begun. Out of the box, your system will soon allow you to have live videoconferences, attach video clips to your data files, and view video files from your desk. Leading the way are Apple with its new AV Macintosh series and Silicon Graphics with its Indy workstation.

Once only a fantasy of world’s fairs and Jetsons cartoons, video communication is finally arriving as a serious business tool. But instead of being packaged in a stand-alone, phone-like device, it is riding into the workplace on the back of personal computers. The integration of video into PCs offers much more than the ability to see the person on the other end of the line; Content-rich video will enable new kinds of collaborative work.

New products from Apple and Silicon Graphics exemplify the trend to support motion video in desktop systems. Just as computer makers earlier added color, bit-mapped graphics, and audio to PCs, now they are building in video. The Silicon Graphics Indy and two new Apple Macs—the Centris 660AV and the Quadra 840AV—include hardware for input and output of analog video, video digitization, digital signal processing for image manipulation and compression, and software support for handling video data. The Indy even includes a tiny video camera as standard equipment (see “Apple, SGI Blaze Video Trail” on page 81).

Such capabilities have been available from third-party vendors such as SuperMac, RasterOps, and Creative Labs at considerable cost to purchase, install, and integrate. Apple’s QuickTime and Microsoft’s Video for Windows added system-level software support for handling synchronized digital-video data, but hardware was still extra. Now, with starting prices as low as $2500 for the Centris 660AV and $5000 for the Indy workstation, you can buy a system ready to handle video right out of the box. In effect, video has become nearly free, and the implications for computer users are enormous.
"People are going to be really surprised at how powerful [video] is," says multimedia analyst Denise Caruso, editor of the Digital Media newsletter (San Francisco, CA). When video becomes standard, programmers will write software that takes advantage of it and users will treat it like just another data type, such as text, graphics, or audio.

This will open up new, more effective channels of communication among individuals and workgroups. Presentation packages, word processors, databases, and even spreadsheets will support video clips and annotations. E-mail packages will add support for video attachments to messages. Multimedia titles will become richer, more dynamic, and more widely distributed.

Perhaps the most significant potential lies with desktop videoconferencing. You can, in effect, turn your PC into a videophone by sending pictures captured with your computer's camera in real time across high-speed telephone lines or over a LAN. Or you could employ a store-and-forward architecture, sending those pictures to a central repository for delivery at a later time.

Sarah Dickinson, an analyst at Personal Technology Research (Waltham, MA), has monitored the migration of videoconferencing technology from large room-size systems to the desktop. "When you put this technology on the motherboard," Dickenson says, "it changes everything."

Both real-time videoconferencing and store-and-forward video mail present technical, cultural, and economic hurdles. Each puts stress on the existing communications infrastructure and forces the user to work in new ways.

And, as with any emerging technology, the cost of successfully applying video throughout the enterprise is high.

**New Media**

Built-in video capabilities will be harnessed in a number of ways. Foremost among them is delivery of prepared content in either analog or digital form. Thus, the new Apple and SGI systems can accept analog video signals (NTSC or PAL) directly from cable, a VCR, or a laser videodisc and display the picture in a window. This means that you could watch CNN while you work on a spreadsheet, or view a training videotape for a new software package while using the program in a separate window.

Likewise, digital video, delivered on a CD-ROM or across a network, can be displayed on-screen or merged with other video sources and graphics. A company with networked, video-equipped computers can use this infrastructure to deliver informational or motivational videos. For example, Sun Microsystems sent its employees a digital-video holiday greeting from chairman and CEO Scott McNealy last December, and SGI distributed to its staff a digital video of the visit earlier this year by President Bill Clinton and Vice President Al Gore.

---

continued
Document Conferencing Keeps Your Data Close-By

One of the main advantages of a desktop system is that the video communication occurs on the same machine where you keep your electronic documents. "You're closer to your data," says Chris Herot, director of advanced technology for Lotus Development (Cambridge, MA). "You don't have to bring it with you down the hall." Compression Labs' Canoe, PictureTel's Live PCS 100, and other desktop systems thus typically offer the ability to send—and in most cases to work collaboratively on—documents. Because document conferencing can be done over conventional phone lines without expensive hardware add-ons, it's likely to become prevalent far sooner than desktop video. Consequently, many desktop videoconferencing systems give equal weight to document conferencing.

Document conferencing is typically designed much like a two-way version of remote-control software packages, such as pAnywhere or Timbuktu. The "master" user owns the document and runs the application that created it, while one or more "slave" users see a bit-mapped image of the document that they can mark up and annotate in real time. Document images can be saved at all locations, but the original is usually modified only if the master gives keyboard or mouse control to remote users. Files can also be sent among users, often in the background.

Many of these packages also support whiteboarding, or the ability to draw or type on a blank white window, usually in "ink" color-coded by user. The more sophisticated products also permit multiple simultaneous masters and slaves; i.e., I share my Excel spreadsheet with you while you share your Ami Pro report with me. Some offer better performance by trapping GDI (Graphical Device Interface) calls and keyboard/mouse inputs instead of transmitting compressed bit maps. But at this point, none of the packages permit actual application sharing, where the same document is loaded up on both sides and collaboratively modified, although several vendors say that they are working toward this capability.

Visit, from Northern Telecom (Nashville, TN), was an early entrant in the desktop market. The $3899 product (not including telecom interface) has the distinction of being the only system that now runs on both the Mac and Windows and can interoperate between them. Its video, however, is limited to gray scale. Visit requires digital or leased lines but uses only one 64-Kbps ISDN channel or 56-Kbps switched line (Switched-56) to deliver 10 to 15 frames per second (fps) of video. Northern Telecom plans to enhance the system this year with support for color, H.261 compression, and multipoint bridges, says Jeff Berman, manager of market development for the company.

NCR's TeleMedia Connection is a similar system, but it supports 15-fps quarter-screen color or video over dual ISDN channels—i.e., 128 Kbps. NCR sells the product primarily as a document-sharing system for Windows, with H.261 videoconferencing as a bonus. TeleMedia Connection sells for between $5000 and $7000, depending on whether you already have an AT&T 8510 ISDN phone (to which you run an interface cable) or need to add an ISDN card to your PC. Neil Whittington, assistant vice president of NCR's workstation products division, multimedia business unit, says support for Switched-56 and analog lines (for document sharing only, not video) will be added later.

Another Windows video/document conferencing system is DVTS from GTE (Chantilly, VA). It offers H.261 compression, frame rates of from 7.5 to 30 fps, and a whiteboard feature. It supports ISDN and Switched-56, or you can use it over a high-speed modem.

Creative Technologies, the parent company of Creative Labs (best known for the SoundBlaster and VideoBlaster), has recently acquired the Mac-based ShareView and ShareView Plus, products that set new standards in this category.
because they were designed to run over analog lines. ShareView, which sells for $1195, includes a NuBus board, a 14.4-Kbps modem, a handset, and software that permits audio communications, whiteboarding, and collaborative document sharing. The S4499 Plus version of the product adds a video camera and a second NuBus card that uses a proprietary compression scheme capable of sending images ranging from 80 by 96 pixels up to 160 by 190 pixels at rates of 5 to 12 fps. Creative's plans for the product include expanding to Windows, and supporting digital telephony and standards-based codecs.

Nuts Technologies, a San Jose, CA, based start-up, has announced but not yet shipped a product called Hello 918 that reportedly supports analog and ISDN with video rates of 5 to 30 fps. Eye-Tel Communications (North Vancouver, BC, Canada) recently acquired Tele-America Video Conferencing of Syracuse, IN, and sells a line of products called Tel-Eye-Vision that range from low-cost graphics file transfer and document-sharing tools to a $10,000 conferencing system based on the N.261 and digital lines.

For OS/2, IBM sells Person-to-Person/2, a whiteboarding and document-sharing package that also supports live videoconferencing via IBM's ActionMedia II card. Versions of the software for Windows and AIX are planned for later this year, with Mac support in 1994. The $280 package ($1875 for a 10-user license) lets up to five users at a time share a common chalkboard or mark up documents. The package runs now over Token Ring and Ethernet LANs using NetBIOS, with native IPX support slated soon, and requires ISDN for WAN (wide-area network) connections.

In what may augur a future trend, Peregrine Software (Carlsbad, CA) has developed a software-only networked videoconferencing product that runs on off-the-shelf video hardware. Instead of being sold as a turnkey or integrated solution, Peregrine's as-yet-unnamed package will run on any PC that is equipped with a video camera and a capture card supported by Microsoft Video for Windows. Features include sharing documents and real-time video over NetWare or NetBIOS LANs (and over WAN links faster than 128 Kbps), and network software that manages the video streaming and frame rate.

Computer-based training is the most promising short-term application for desktop video, especially if the materials are interactive and customizable by the user—that is, if they take advantage of the computer rather than working in the linear fashion of videotape. For example, hypertext links can allow you to go through a lesson in the order and at the pace that suit you. "Every company is looking at how to train its people faster and faster," says Markia Ruutum, network manager for HP-TV, Hewlett-Packard's programming network for business partners.

In addition to playing prerecorded content, you can also capture still frames and video clips with the Indy and Mac AV systems. You just plug a camcorder into the video port; the hardware to digitize and compress video is built in. Once the video is digitized, you can attach it to a mail message and send it to a colleague. Or you can use an editing package such as Adobe Premiere 3.0 to alter images, rearrange frames and sequences, and add titles, music, and voice-overs. While this process will not produce professional-quality video, the resulting presentation can be output to analog video—using a so-called print-to-tape capability—for playback on any VCR.

Video Mail

Video Mail REAL TIME VS. STORE-AND-FORWARD

<table>
<thead>
<tr>
<th>Real-Time Video Conferencing</th>
<th>Store-and-Forward Video Mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live, interactive collaboration</td>
<td>Noninteractive</td>
</tr>
<tr>
<td>Parties must be present to use</td>
<td>Send and receive on your own schedule</td>
</tr>
<tr>
<td>Needs few system resources, since video is passed through</td>
<td>Needs more system resources, i.e., CPU, bus bandwidth, disk space</td>
</tr>
<tr>
<td>Needs expensive real-time compression technology</td>
<td>Video compression can be done off-line or in software</td>
</tr>
<tr>
<td>Supports real-time document conferencing as well</td>
<td>Not meant for real-time document conferencing</td>
</tr>
<tr>
<td>Hard for people who speak different languages</td>
<td>Can view video and respond at your own pace</td>
</tr>
<tr>
<td>Conveys innuendo and nonverbal communication</td>
<td>Not much better than voice mail</td>
</tr>
<tr>
<td>Requires special LANs, i.e., synchronized, ATM</td>
<td>Operates over conventional LAN</td>
</tr>
<tr>
<td>Needs fast, expensive telecom services for WAN links</td>
<td>Operates over analog phones</td>
</tr>
</tbody>
</table>

Meet Caruso, who has a deep and abiding interest in video conferences. His system is called Tele-Eye Real-Time Video Conference, and it drives a video camera connected to a computer. The output to analog video using a so-called print-to-tape capability—for playback on any VCR.

Conferencing

By contrast with video mail, real-time videoconferencing is less demanding of the host system, because the video typically passes through the machine without chewing up CPU resources or system-bus.

The advantage of video mail, says Ann Earon, president of Telemanagement Resources International (TRI; Lake Wylie, SC), is that it lets you send and receive whenever you're ready. This is especially important when crossing time zones or dealing in foreign languages. Earon notes that Asian users haven't widely embraced real-time videoconferencing, not only because live sessions with the U.S. involve inconvenient hours, but also because of cultural reasons. "They'd rather receive a video transmission, discuss it, and then respond," she says. For international communications, Earon asserts, store-and-forward video is "very suitable."

Store-and-forward messaging is much easier to accommodate on networks than is real-time communication, because packets can be deferred for later delivery. Unlike videoconferencing, video mail doesn't require vast amounts of synchronous bandwidth. Videoconferencing can demand anywhere from 14.4 Kbps for low-quality analog transmissions to at least 128 Kbps for full-screen digital transmission. Traditional room-size systems use 384 Kbps or more.

However, because video is such a dense data type, mailing and storing it require large amounts of processing power and hard drive space on both ends of the communication link. Caruso dismisses store-and-forward video mail as "bull;" she doubts that users really want or need to send and receive video clips of "talking heads," which often convey little more than a voice-mail message. "I don't see the point of all that overhead for the problem you're trying to solve," Caruso says. Video files could also spell problems for networks: Frequent video-mail file transfers could clog LANs.

Conferencing

By contrast with video mail, real-time videoconferencing is less demanding of the host system, because the video typically passes through the machine without chewing up CPU resources or system-bus.

Cover Story

SEPTEMBER 1993 BYTE 67
Couple its outstanding overall performance with a true optical resolution of 400 dots per inch, an excellent scanning software package (DeskScan II), and HP's well-earned reputation for solid, reliable products, and you have a winning combination.

PC Magazine Labs' performance between the HP ScanJet IIc and the HP ScanJet IIc during every test. In line-a-minute, the HP ScanJet IIc ends up in 115 seconds, while five scans take 115 seconds or more.

In general, you should expect the HP ScanJet IIc to take twice as long for a color scale. With a fast scanner, you can expect to get the job done in minutes. The HP ScanJet IIc is a fast, reliable, and easy-to-use scanner that's a great value for the money.

The ScanJet IIc performed well during all phases of PC Magazine Labs' testing. In terms of speed, this scanner led the field, ranking first in two of five speed trials and best overall. Some scanners, as a whole, and a street price as low as $1,450, and it's hard to imagine a better buy.

An excellent choice for any PC desktop.
We'd hate to brag. So we'll let the PC press do it for us.

Both PC Magazine and PUBS called the HP ScanJet IIC the Best Color Scanner for 1992. While PC Computing named the black & white/grayscale HP ScanJet IIp the Most Valuable Product of the year.

Speed. Simplicity. And accuracy were all applauded. It's no wonder. HP's single-pass scanning delivers both lightning-fast speed and precise color registration. What's more, if you purchase an HP ScanJet IIC between August 1 and October 31, you'll get a $200 rebate when you send in a coupon available from your dealer. Capabilities this advanced have never been so affordable. With the rebate, list price on the HP ScanJet IIC is just $1,399. List price on the HP ScanJet IIp is just $879.

Impressed? Don't just take our word for it, or even the PC press's. Attend one of our scanning seminars that will be held April through September, 1993. To find out more information or the location of your nearest authorized HP dealer, call 1-800-SCANJET, Ext. 7365. And judge for yourself.
Videoconferencing's Evolving Architecture

Room-Size or Rollabout Systems

- To additional sites
  - ISDN, Switched-56, T1/FT1 (56 Kbps-2.048 Mbps)

Desktop Videoconferencing

- Point-to-point
  - H.261 codec
  - Other codec

- LAN/video gateway
  - H.261 or other codec
  - MPEG, QuickTime, etc.

- Switched Ethernet
  - ISDN ATM
  - H.261 codec
  - Other codec

Traditional videoconferencing systems use proprietary compression algorithms and rely on high-speed leased or switched phone lines. PCs running standards-based compression can sometimes attach to these systems. Desktop videoconferencing is less centralized and can't accommodate groups of users, but it may permit more spontaneous and intimate communication.

bandwidth. Because it's live, the data neither comes from nor is saved to a hard drive; users who want to preserve video conferences for posterity usually output them to a VCR.

But the acceptance of traditional videoconferencing has been slow, so many industry observers are skeptical about its potential on the desktop. They argue that users need to share documents and graphics more than they need to view live movies of each other.

Vendors acknowledge this. According to Jeff Berman, manager of market development for Northern Telecom's (Nashville, TN) Visit desktop video system, "Our customers are using Visit as an interactive multimedia conferencing platform for collaborative work, not necessarily as a low-cost videoconferencing system replacement."

The $3899 Visit, an early desktop videoconferencing product, has the distinction of being the only system that now runs on both the Mac and Windows (see "Document Conferencing Keeps Data Close-By" on page 66).

Established videoconferencing players, including such companies as Compression Labs, Inc. (CLI; San Jose, CA), PictureTel (Peabody, MA), Vtel (Austin, TX), and U.K.-based GPT Video Systems, are now bringing out desktop-based products. CLI got an early start in this category with its $4500 Macintosh-based Cameo Personal Video Conferencing System, announced in January 1992, which uses compression technology that was developed jointly by CLI and AT&T. Cameo is designed to work over ISDN lines only and employs a scaled-up version of the algorithm that AT&T uses in its analog-based consumer videophone. The system transmits 15 frames per second (fps) of video, or about half the rate of TV video, and requires an external phone to transmit audio.

PictureTel, which has struck joint development deals with IBM and Lotus, has recently announced the $6000 PC-based PictureTel Live PCS 100. This system supports both PictureTel's proprietary SG3 algorithm and industry standards. As with most of its competitors in this product class, the price of the PCS 100 reflects the cost of hardware-assisted video compression and interfacing to ISDN.

Personal Technology Research's Dickinson believes these systems "may not be the route to desktop videoconferencing." Instead, PC vendors may migrate up into the conferencing business by building in support for video compression and high-speed communications.

Larger videoconferencing systems will remain viable, however. According to Lung Yeh, vice president of technology for the video products group of Creative Technologies (Singapore), the systems will...
Why do they call it a dongle?

He wasn’t famous. He didn’t drive a fancy car, but dressed in his favorite Comdex T-shirt and faded blue jeans, he set out to change the course of the computer software industry. Quite a task for a lonely software developer.

Sitting in front of his computer, drinking pots of coffee and smoking cartons of cigarettes, he’d write pages of code.

It took time. Years in fact. But he did it. He wrote the most powerful computer program in the world. Now came the hard part. Selling it.

But he didn’t know what to call it. He thought of naming it after an exotic place he visited in his travels. Madagascar was a bit too long, though.

“Name it after you, Don!”, urged his peers. So he did. Soon everyone was calling the key a dongle, after Don Gall — the lonely software developer who did what he had to do.

The Global Marketplace

From Paris to Prague, his program was everywhere in Europe. When he got off the plane in Hong Kong he found his program stacked to the ceiling in every computer store. Amazed in disbelief, he bought a hundred cartons of cigarettes and a hundred pounds of Indonesian coffee and flew back to Boston.

Beaten, battered and bruised he went back to the drawing board. This time he would really change the face of the software industry. He would develop a device that would prevent unauthorized distribution of software programs.

Call It What You Like

He developed a hardware key. His peers applauded his efforts. Finally, a solid solution for revenue protection.

Some call it a dongle. Those who know, call it Sentinel.
Imagine if you couldn't send a fax outside your company because the recipient's fax machine recognized a different transmission standard than yours. Or suppose the public telephone system lacked sufficient bandwidth to handle a fax transmission at all. Welcome to videoconferencing, 1993.

But there is hope. The CCITT, which established the Group 3 standard that lets fax machines communicate worldwide, is trying to bring the same order to videoconferencing. It is promoting a specification known as H.261 (pronounced "H-dot-261") or Px64 ("P times 64").

H.261 defines a scheme for sending video at speeds of from 64 Kbps to 2 Mbps. At the low end of the spectrum, H.261 fits into an ISDN channel; at the high end, it needs wider-bandwidth dedicated lines, such as T1. The standard defines a video window of 352 by 288 pixels, known as CIF (Common Intermediate Format). It also supports QCIF (Quarter CIF), a smaller window of 176 by 144 pixels. Related specifications cover still-frame graphics, call-setup protocols, and other issues.

Large conference-room video systems, such as those from PictureTel (Peabody, MA) and Compression Labs (San Jose, CA), traditionally rely on their own proprietary codecs, although they offer H.261 as an option. In the desktop market, not everyone seems to be greeted H.261 with open arms.

"The problem with H.261 is that it lends itself to very, very expensive hardware," says Paul Nahi, a product director at Media Vision (Fremont, CA). "Videoconferencing will become popular when, and only when, you can set up a node for under $200. That's $200 for the plug-in board, the software, and the camera."

Media Vision is pushing its own proprietary codec known as MotiVE (Motion Video Engine) and Captain Crunch. MotiVE is a codec that's licensed to Microsoft for use with Video for Windows. Captain Crunch is a new codec that will be available on a pair of chips for under $40 by the end of the year. Media Vision intends to sell the chip set to other vendors and use it in a line of desktop video products.

Weitek (Sunnyvale, CA) is developing a new family of chips that will improve playback in Video for Windows and eventually support the most popular codecs, including Captain Crunch, Cinepak, MPEG, and Intel's Indeo. Intel (Santa Clara, CA) and Microsoft (Redmond, WA) are backing Indeo for desktop video, although Microsoft has also licensed Cinepak for use with Video for Windows. Intel's Smart Video Recorder, an ISA board for PCs, uses the Intel 750 video processor and Indeo to capture and record live video onto a hard disk in real time.

Although Intel has alliances with Bell Atlantic and Ameritech and is known to be working on desktop videoconferencing products, it's not clear if it will implement Indeo, H.261, or some other codec. "Our policy is to follow existing standards when they make sense, and to introduce new standards if they don't already exist or [existing ones] don't offer a good solution," says Scott Darling, marketing director of Intel's business communications division.

AT&T Microelectronics' (Berkeley Heights, NJ) AVP-1000 chip set supports H.261/Px64 and MPEG for full-motion video, plus JPEG for still-image compression. Motorola (Austin, TX) and BT (London, U.K.) are also developing a chip set that supports H.261, MPEG, and JPEG. Those chips will appear on PC expansion boards from BT next year.

Nearly everyone is focusing on ISDN or LANs as the minimum requirement for acceptable video quality. But startup company KneX (Fremont, CA) says it will soon introduce the Holy Grail of video codecs: a radical new compression scheme that can send 320-by-240-pixel color images at 15 frames per second over POTS (plain old telephone system) with a transmission delay of under 200 milliseconds. "Our goal is to make it possible for any two people on the face of the earth to communicate with each other visually over ordinary phone lines," says Steve Johnson, KneX's chief operating officer.

That goal has eluded everyone since the first prototype videoconferencing units drew curious crowds at the 1964 World's Fair in New York. But until the video codec chaos is resolved, videoconferencing will be more local than global.

Tom R. Halfhill is a BYTE senior news editor. You can reach him on BIX as "thalhill."

---

**CODECS FOR DESKTOP VIDEOCONFERENCING**

<table>
<thead>
<tr>
<th>CODEC</th>
<th>SOURCE</th>
<th>APPLICATIONS</th>
<th>ADOPTERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Captain Crunch</td>
<td>Media Vision</td>
<td>Video playback, videoconferencing, CD-ROM</td>
<td>Citrus Logic, Weitek</td>
</tr>
<tr>
<td>Cinepak</td>
<td>SuperMac Technology</td>
<td>Video playback, videoconferencing, CD-ROM</td>
<td>Apple, Atari, Citrus Logic, Creative Labs, Microsoft, Sega, 3DO</td>
</tr>
<tr>
<td>H.261/Px64</td>
<td>CCITT</td>
<td>Universal videoconferencing over</td>
<td>AT&amp;T, British Telecom, CLI, Motorola, NEC, PictureTel, Video Telecon</td>
</tr>
<tr>
<td>Indeo</td>
<td>Intel</td>
<td>Video playback, CD-ROM</td>
<td>Apple, Microsoft</td>
</tr>
<tr>
<td>JPEG</td>
<td>Joint Photographic Experts Group</td>
<td>Still-image compression and transmission</td>
<td>Widespread</td>
</tr>
<tr>
<td>MotiVE</td>
<td>Media Vision</td>
<td>Video playback, videoconferencing, CD-ROM</td>
<td>Microsoft</td>
</tr>
<tr>
<td>MPEG</td>
<td>Moving Pictures Experts Group</td>
<td>Video playback, videoconferencing, CD-ROM</td>
<td>Philips, many others</td>
</tr>
</tbody>
</table>
Like most color printers, this one works best if you use the right paper.

Color printing on plain paper is, no doubt about it, a remarkable achievement. But we know there are times when you wish you weren't limited to an 8½” x 11” white piece of paper. You know, those times when you need a Phaser™ III color printer.

From vellum to card stock, newsprint to acetate, the Phaser III prints on almost any stock you'll ever need. In any size you wish, from 4” x 6” to 12” x 18” full bleeds. That way, you can do your comps on the paper you’re ultimately going to use. After all, what you print on is just as important as what you print.

To make sure you always look good on any paper, the Phaser III features Adobe PostScript™ Level 2 (the latest version), 300 dpi, PANTONE® certification, and a 24MHz RISC processor to keep your work humming. It also connects nicely to PCs, Macs or workstations. Or all three at once. Above all, it gives you 16.7 million of the brightest, most saturated colors ever printed on the desktop. No wonder it’s won more industry awards for excellence than any other printer.

With the Phaser III, you'll always have the right paper. You'll have the right printer, too.

Call 800/835-6100, Dept. 30-J for a free output sample. If you can't wait and want more information, we'll gladly fax it to you. Just call 503/682-7450 and ask for document 1230.
Lahey F77L - FORTRAN Compiler by Lahey
Version 5.01 includes FORTRAN 90 features: ALLOCATABLE Arrays, CASE Constructs, Cycle and Exit, Construct Names, and many other new features. Package includes Editor, Make Utility, Profiler, Debugger, SLR Linker, Oupa Make, Video Graphics, and Excellent Diagnostics. 386/486 users have the option of generating 32-bit instructions.
List: $295  Ours: $259
FAX # 1476-0001

FORTRAN Compiler

Lahey
Version 5.01
Includes FORTRAN 90 features:
- ALLOCATABLE Arrays
- CASE Constructs
- Cycle and Exit
- Construct Names
- Many other new features
Package includes Editor, Make Utility, Profiler, Debugger, SLR Linker, Oupa Make, Video Graphics, and Excellent Diagnostics. 386/486 users have the option of generating 32-bit instructions.
List: $295  Ours: $259
FAX # 1476-0001

WindowsMAKER Professional 5.0 by Blue Sky Software
Next generation of the most powerful C/C++ Code Generator and Prototyper for Windows 3.1, NT & Win32a. The fastest way to create full-featured Windows apps. This product stands out, does everything—even a toolbar can be created with 1 click! Test run your design, make changes interactively, generate code for multiple platforms—ANSI C, MFC, OWL, etc.; widest compiler support in industry. TrueCode technology—user code is 100% preserved. Highly recommended!
List: $995  Ours: $839
FAX # 2602-0003

CA-dBFast™ for Windows 2.0 by Computer Associates
The complete standalone dBASE/Xbase development language for MS Windows. Create fast, powerful, easy-to-use graphical applications with over 200 extensions to the dBASE III PLUS language. It also includes an interactive editor, compiler, and linker. Challenge your creativity and imagination! Design multiple windows, pull-down menus, check boxes, list boxes, radio buttons, bit-map pictures, and more!
List: $249  Ours: $199
FAX # 1004-0003

Microsoft Visual Basic 3.0 by Microsoft Corporation
New Version 3.0! Now with built-in data access, OLE 2.0 and more! Program for Windows the fast, easy way with MS Visual Basic for Windows. Standard Edition. A visual development environment, flexible programming language, and new access to your data make this the most productive way to go from initial ideas to impressive applications.
Standard List: $199 Ours: $139
Version Upg. List: $49 Ours: $45
Comp. Upg. List: $99 Ours: $95
Prof. Edit. List: $395 Ours: $217
FAX # 1269-0033

PRODUCf OF THE MONTH
Symbantec C++ Professional 6.0 by Symantec
Reach new levels of programming power with Symbantec C++ for Windows. DOS, and Win32a. Breakthrough new IDDE revolutionizes the way you work. Includes the finest visual builders, optimizers, and tools, with MFC 2.0 and Win32a, and 8000 pages of documentation. Your productivity will increase so much you can go on vacation, and included coupon for two travel certificates to Hawaii will get you there.
Special Introductory Pricing $199!
List: $499  Ours: $189
FAX # 2132-0038

CA-Clipper 5.2
Competitive Upgrade
by Computer Associates
Yes, the newly released CA-Clipper version 5.2 is being offered to Xbase language product owners at the low retail price of $199. This competitive upgrade is available for a short time only! What a great opportunity to get the power of CA-Clipper, at a super price! And now when you buy, get your choice of dBFast, Clipper Tools or dBASE Compiler Kit—FREE from CA when you register!
List: $199  Ours: $149
FAX # 5400-0001

G+E Database Library (QELIB) 1.1 by Q+E Software
G+E Database Library provides complete database connectivity to Windows and OS/2 applications using Dynamic Link Libraries. QELIB can read, insert, update, create, or delete database records for the following formats: Oracle, dBASE, SQL Server, Sybase, DB2, Microsoft INGRES, AS/400 (SQL/400), Btrieve, Excel, INFORMIX, Netware SQL, and many more. Gateways supported include: IBM DDCS/2, Micro Decisionware, Sybase NetGateways, and Gupta SQL/Network.
List: $399  Ours: $339
FAX # 2625-0003

OS/2 2.1
by IBM
OS/2 v2.1 lets you take advantage of the award-winning features found in v2.0 and increase your productivity with new enhancements. Includes support for MS Windows v9.1 applications including enhanced mode and full 32-bit graphics engine. Adobe and TrueType Font support gives you the best of both worlds. WIN-OS/2 setup icon allows changes to default values of all Windows applications. Start your DOS and OS/2 apps from a WIN-OS/2 Desktop!
List: $249  Ours: $139
Upgrade List: $199  Ours: $89
FAX # 3142-0009


circle 113 on Inquiry Card.
MetaWare High C/C++

by MetaWare, Inc.

NEW RELEASE! High C/C++ version 3.1, MetaWare's 32-bit compiler and shipping. Includes a 32-bit source-level debugger, and a 32-bit Application Developers Kit for Windows. The “Incremental Strengths” feature enables gradual migration from C to C++ one block at a time. High C/C++ provides optional ANSI conformance, eight levels of global optimization and a full implementation of C++ templates.

List: $795  Ours: $669
FAX: # 1590-0008

WATCOM™ SQL for Windows

by WATCOM

WATCOM™ SQL for Windows is a complete client/server DBMS including a standalone single-user SQL database server. WATCOM SQL for Windows allows you to develop and deploy single-user standalone applications, and to develop applications for use within the WATCOM SQL Network Server Edition. WATCOM SQL for Windows includes support for the Microsoft Open Database Connectivity (ODBC) standard for database applications.

List: $395  Ours: $299
FAX: # 1683-0013

Defect Control System for Windows

by The Software Edge

Take control of what's bugging you! Defect Control System is the award-winning bug tracking tool that gathers software defect data and generates practical management reports used to monitor the health of your software project. Complete Submit, Notification, Update, Query, and Report features help you deliver quality software on time. And easy customization means DOS won't change the way you work.

List: $695  Ours: $495
FAX: # 6011-0001

Multi-Edit Professional

by American Cybernetics

A richly featured, easy-to-use programmer's text editor. Multi-Edit's flexibility and sheer power combine to provide you with unparalleled productivity. Features include: Intuitive user interface, mouse support, syntax highlighting, cross directory multiple file search AND replace, color templates, and much more! Finally, a text editor that thinks like a programmer! Free demo disk available.

List: $199  Ours: $139
FAX: # 1846-0001

ProtoGen+ V4.0 NEW!

by ProtoView Development

ProtoGen+ is the latest in advanced visual programming, just view and select, point-and-click, or drag-and-drop to see menus, screens and dialog come to life right before your eyes. ProtoGen+ creates full-fledged, professional applications with bitmaps, icons, tables, data validation, custom colors, fonts, 3D effects, toolbars, status lines, balloon help, MDI and more! Generate code for ANSI C, MFC C++, OWL C++ or Pascal with Objects.

List: $395  Ours: $199
FAX: # 2553-0002

WATCOM™ C/C++ v9.5

by WATCOM

C/C++ is a professional, multi-platform C and C++ development system supporting 32-bit extended DOS, OS/2 2.x, Windows 3.x, Windows NT, Win32s, and AutoCAD ADS/ADI. The complete toolset includes: C and C++ optimizing compilers, royalty-free DOS extender with VMM support, licensed components from the MS Windows 3.x SDK, interactive source-level debugger, linker, profiler, Supervisor for executing 32-bit applications and DLLs under Windows 3.x, 32-bit run-time libraries for extended DOS, OS/2 2.x, Windows 3.x and Windows NT, and more.

List: $599  Ours: $349
FAX: # 1683-0009

Guaranteed Best Prices!

(Call for Details)

To order call: 800-445-7899
Corporate (CORSOFT): 800 422-6507
FAX: 908 389-9227
International: 908 389-9228
Customer Service: 908 389-9229
For more information on the products featured on these pages call:
FAX: # 908 389-8173

Programmer's Paradise

1163 Shrewsbury Avenue
Shrewsbury, NJ 07702

* All prices are subject to change without notice.
be positioned to serve groups of people and to span multiple sites, whereas today’s desktop systems are aimed at individuals doing point-to-point communications. However, TRI projects that unit sales of large-scale videoconferencing systems will remain relatively flat for the next four years, while sales of desktop-based systems will soar from about 10,000 this year to nearly 800,000 in 1997.

Although the first videoconference systems appeared in the 1970s, the technology is still bogged down by conflicting standards and constricted electronic pathways. Before desktop videoconferencing can be-

**Pandora and the Active Office**

**DICK POUNTAIN**

**CAMBRIDGE, U.K.**—Europe’s largest PC manufacturer, Olivetti, sees its future products converging into a system it calls the Active Office. With the Active Office, digital video and audio services will be able to follow individuals around from room to room via the active badges they wear. Not only will your videophone calls get routed to the workstation you’re nearest to, but your whole desktop might follow, too, so that you’re not forced to wrestle with Fred’s purple-on-green windows and Albanian keyboard layout.

The components of this Active Office are being developed at Olivetti Research, Ltd. (ORL), in a joint venture between Olivetti and DEC that’s sited in Cambridge, U.K. The key enabling technologies are high-speed ATM (Asynchronous Transfer Mode) networks, a distributed multimedia system called Pandora and its successor Medusa, and the active badges themselves. ORL presently runs a network of more than 40 Pandora workstations—spread over four separate sites a half-mile apart in central Cambridge—that provides videophone, video-mail, and conferencing services.

**The Pandora System**

Pandora is an all-digital multimedia system that transports multiple streams of "medium quality" video and audio to each workstation in a network. Every Pandora user gets a high-resolution Unix workstation connected to a video camera, telephone, microphone, and loudspeaker via a unit called Pandora’s Box, which combines the functions of network interface, stream manager, and video mixer.

Each Pandora’s Box contains no less than six Inmos T45 transputers acting as embedded controllers: one to sample the video camera; one to manage an analog video mixer and combine incoming video with the workstation’s X Window System display; one to handle audio, sampled at 8 kHz; one to switch data streams, say, to and from the compression and expansion hardware; and two to act as ATM network I/O processors.

Apart from the total bandwidth of the ATM network, there’s no hard limit on the number of video streams or screen windows that a Pandora system can handle. For example, a four-party videoconference might use 28 simultaneous streams—12 video and 12 audio for two-way connection of all pairs of participants, plus four extra video streams to show participants their own local image.

Pandora is designed to degrade gracefully when it does eventually approach overload. Audio always takes priority, and video packets will be discarded first if the system can’t cope, because users will tolerate degraded picture quality better than fuzzy sound. One of the audio transputers’ duties is to apply echo and feedback cancellation, which ORL has found to be crucial to Pandora’s acceptability in real office environments.

**ATM Networking**

ORL is a strong champion of ATM as the most suitable form of network for real-time multimedia systems. ATM is a variant of packet switching in which short, fixed-length data packets called cells are transmitted via "end-to-end" virtual circuits, rather than by destination or route addressing. Unlike many packet schemes, ATM always preserves the time ordering of its packets. ORL originally implemented 32-byte cells but has now moved to 48-byte cells (with 5-byte headers) for greater ease of interworking with broadband ISDN.

ATM has several advantages for multimedia applications, of which the most
come as effortless and ubiquitous as the videophones on *The Jetsons*, the problems of interconnectivity and bandwidth have to be solved. Unfortunately, transmitting a synchronized stream of audio and video in real time is much more difficult than, say, sending a fax, which consists of a black-and-white bit map of static words and pictures on a page. Consider the volume of traffic required for a videoconference. Assuming a full-screen image of 640 by 480 pixels in true color (24 bits per pixel), and NTSC-standard 30 fps for full-motion video, you’d need to transmit almost 27 MBps for an uncompressed picture the quality of a TV broadcast. And that’s just for a one-way hookup without sound. For a full-duplex, two-way conversation, you’d have to move an equivalent volume of data in both directions simultaneously, along with a pair of audio tracks.

Clearly, such a torrent of data would overwhelm any ordinary analog phone line, often referred to as POTS (for “plain old telephone system”). Even digital ISDN doesn’t come close to offering that much bandwidth.

One answer is to simply increase the bandwidth of the pipeline by replacing copper wire with fiber-optic cable. However, that calls for an enormous investment in infrastructure.

**Compression Critical**

Compression is the obvious solution, but even the best of today’s compression schemes aren’t up to the challenge. To squeeze a TV-quality video signal through a 64-Kbps ISDN channel, you’d have to invent a codec algorithm that discards more than 99 percent of the data without seriously degrading the image.

As a result, desktop videoconferencing systems typically compromise by offering smaller windows (as tiny as 80 by 96 pixels), grainier color (8 bits per pixel instead of 24 bits), and lower frame rates (5 fps or less under certain conditions). These trade-offs reduce the bit stream to manageable levels.

Many codecs can achieve these levels of compression, but some require more time to compress than they do to decompress. MPEG, a standard fostered by the Moving Pictures Experts Group, and Cinpek, a proprietary but widely licensed codec from SuperMac Technology (Sunnyvale, CA), are examples of so-called asymmetrical codecs. They are better suited for store-and-forward applications or prerecorded video on CD-ROMs than for real-time videoconferencing. If an asymmetrical codec is implemented in high-speed silicon, however, it can effectively become symmetrical by supporting real-time conversion at both ends.

Even when a codec works in real time, the data pathway adds a certain amount of time lag. If the pathway is a LAN, the delay might be dependent on the size of the network and the volume of traffic. On a long-distance phone line, delays are inevitable as the signal is beamed from
Announcing the first network printer

Multiple environments are no longer worlds apart. Even if you have Novell Netware on one network, HP-UX on another and EtherTalk on a third, the new HP LaserJet 4Si MX printer easily connects across platforms. Automatically.

The HP LaserJet 4Si MX printer comes out-of-the-box preconfigured for multiple environments. There's nothing more to do than plug-and-play. All interfaces are simultaneously hot, making switching so seamless, end-users won't even notice.

What's more, HP's LaserJet 4Si MX printer is ready to handle whatever needs come down the
that adapts to multiple environments.

pike. More operating systems? No problem. As your network system continues to evolve, the capabilities of this printer are no longer just impressive. They're indispensable.

The HP LaserJet 4Si MX printer is loaded with features that define state-of-the-art. HP's enhanced PCL5 and genuine PostScript® Level 2 software from Adobe® come standard. Printer environments are saved while switching. Setup is a cinch with network software utilities and drivers included in the box. And, if you need any reassurance about trouble-free operation, you have it in our Simple Network Management Protocol (SNMP) support.

At 17 ppm, this is the fastest LaserJet ever, with I/Os and RISC-based formatter capabilities matched to support its speed. It delivers impeccable 600 dpi print quality—thanks to HP's microfine toner and Resolution Enhancement technology. Plus, it comes standard with two 500 sheet input trays.

But what if you don't need the full capabilities of the HP LaserJet 4Si MX printer right away? HP offers another printer that's probably a perfect fit. The HP LaserJet 4Si printer delivers the identical 17 ppm performance and superb 600 dpi print quality. It also has room to grow. The two MIO expansion slots let you add HP JetDirect network interface or third party cards. And you can add on Adobe's genuine PostScript Level 2 software and SIMM memory modules, as you need them.

To find out more about the multiple-network HP LaserJet 4Si MX printer and the upgradable HP LaserJet 4Si printer just call 1-800-LASERJET, Ext. 7299.† Capabilities this advanced make a world of difference—in any environment.

Circle 90 on Inquiry Card.
ground stations to satellites. The goal is to keep the total overhead below 250 milliseconds or so; otherwise, it interferes with spontaneous conversation. Overseas telephone calls usually limit the delay to 200 ms.

After solving all these problems, you've still got to make sure everyone is using the same compression and transmission standards. Otherwise, there's no guarantee you can make a connection with a person across the street, much less on another continent.

In late 1990, the CCITT adopted a worldwide specification for video compression called H.261 (see “Video Compression Standards Vie for Acceptance” on page 72) that made it possible for different systems to interoperate. Suppliers like CU and PictureTel have added support for H.261, typically in the form of an upgrade option, but most suppliers argue that the specification suffers by comparison with their own proprietary algorithms.

Networked Video

Networking with video raises problems that go beyond mere bandwidth. Today's office LANs usually use shared media and are non-real-time. Because video requires predictable delivery, sending it over all but the most lightly loaded LANs can be disastrous. Solutions such as switched Ethernet and FDDI (Fiber Distributed Data Interface) help provide more bandwidth, but they're still not deterministic. The ultimate solution has to be isochronous Ethernet or an entirely new protocol such as ATM (Asynchronous Transfer Mode; see "All-Terrain Networking," August BYTE).

A few companies are now addressing this problem in novel ways. For instance, Fluent (Natick, MA) sells an NLM (NetWare loadable module) that adds synchronization of video data to a conventional NetWare LAN. A combination of server- and client-based software modules dynamically tunes the video frame rate to accommodate the available network bandwidth. Starlight Networks (Mountain View, CA) has taken the different approach of developing a new media-transport network protocol that is optimized for video. And Fore Systems (Pittsburgh, PA) sells an ATM-based network switch that the company says is designed for multimedia. Olivetti is also developing Pandora, an ATM-based distributed multimedia system with videoconferencing capability (see “Pandora and the Active Office” on page 76).

Given the high cost of installing videoconferencing on every desktop, the following model may turn out to be a common architecture: PCs will run software compression such as Intel's Indeo to shrink video data sent over the LAN, and then a specialized video gateway server will cross-translate that video into H.261 or another communication-oriented protocol for transmission over WANs (wide-area networks). A model such as this distributes the cost of hardware compression over more users, and it also eliminates the need to bring ISDN-class telephony to every desktop.

What's Wrong

In the end, user needs and corporate culture will dictate how video technology is used. Mark Lowenstein, an analyst with the Yankee Group (Boston, MA), cites four issues: cost, quality, connectivity, and applications. Systems like CLI's Cameo and Northern Telecom's Visit are too pricey for PC owners, he says. A Yankee Group study found that 50 percent of respondents would consider buying desktop videoconferencing if it cost $1000 or less, but none of them would pay more than $5000.

Clearly, integrating video I/O on the desktop, as the AV Macs and the Indy do, greatly reduces its cost. But since the price of H.261-level compression will likely stay high, either new compression schemes will have to emerge or desktop systems will have to share compression services on a LAN through a video server.

Quality levels will also have to rise if desktop video is to prove useful. William Coggshall, president of New Media Research (Los Altos, CA), argues that what a user sees on-screen has to be "actionable"; that is, the quality has to be high enough that "you can tell whether their smiles are sincere." Otherwise, videoconferencing isn't an acceptable substitute for face-to-face meetings. To achieve this quality level, the frame rate has to be at least 10 fps, preferably 15 fps, and the window size needs to be a quarter of the screen or larger.

The problem with connectivity is simply that analog lines can't support effective videoconferencing given today's compression algorithms and modems. Barring breakthroughs in compression, the only solution is digital telephony services, but more than any other factor, this could be an impediment to acceptance. ISDN and Switched-56 are more expensive than analog and still not available in many places. Worse, the phone companies themselves still seem ambivalent about their commitment to ISDN. Says Lowenstein, "Connectivity is simply not there."

The last factor, applications, will be solved by a combination of developer and user ingenuity. Microsoft, for instance, is moving to provide APIs and back-end service interfaces that will let programmers write video-enabled applications without worrying about the underlying transport mechanisms. Capabilities like OLE 2.0 already permit video objects to be linked into compliant Windows applications.

For now, the question remains whether or not people really want their desktop systems to become videophones. Kenneth Bosomworth, president of International Resource Development (New Canaan, CT), cites studies that suggest people fundamentally don't enjoy videoconferencing—or at least the room-type systems prevalent up to now. Desktop conferencing could be a different story because it is more intimate.

Observers conclude that in the short term, document sharing may be the most easily applied and widely used component of desktop video communication. "Talking heads" video windows are a snazzy, if underpowered, option that will gain in usefulness as the information infrastructure develops. If real-time conferencing is only one of the video-related activities that people harness on their systems, users will eventually get used to it, in the same way that they accoust to telephones and voice mail.

Video computing is the next major step in the evolution of the personal computer. As more media types are integrated into systems, the lines that have separated phones, PCs, TVs, and other consumer electronics will blur. And eventually, the world's-fair videophone fantasy will come true.

ACKNOWLEDGMENTS

News editor Ed Perratore and senior news editor Tom Halfhill also contributed to this story.

Andy Reinhardt is BYTE's West Coast bureau chief. You can reach him on BIX as "areinhardt."
NO ROBIN HOOD,
NO MERRY MEN,
NO JAZZ CLUBS,
NO GOATS IN
PARTY CLOTHES,
NO SCENIC
AFTERNOONS
IN THE COW
PASTURE.

DELL DIMENSION XPS.
PCS DESIGNED FOR THE HIGH
PERFORMANCE USER.
Virtual screen technology is like having two monitors in one. Create the mother of all spreadsheets. Run PageMaker and Excel side-by-side. Use your monitor as a viewfinder and pan across to the place you want to be. All it takes to upgrade to a 2048 x 1024 virtual screen is just 2MB of optional RAM (1MB VRAM, 1MB DRAM).

Our chameleon cursor can double in size and change color so it never gets lost. This is another feature you won't get from Gateway. They would rather have you engage in a game of hide-and-seek.

*Performance measured by running WinBench 3.11 at 1024 x 768, 256 colors. Both cards configured with 1MB Video RAM. Dell and Gateway 2000 systems configured with 66MHz 486DX2 processor, 16MB RAM and 256KB.
Inside your Dell Dimension™ XPS PC is a #9GXE video card that will give you the ride of your life.

This fast and versatile video card uses the VL-Bus™ and ultra high-speed video RAM to deliver 26 million WINMARKS. That's ten million more than you'll get from the ATI UltraPro VLB card that's found in comparably equipped Gateway machines.

But raw speed is just part of the Dell Dimension XPS story.

The Dell Dimension XPS's #9GXE video engine can be accessed on-screen via a control panel that allows you to configure a host of powerful utilities—from time-saving "hot keys" to a chameleon cursor—for total control of your desktop video environment.

Add our optional 2MB RAM upgrade (1MB VRAM, 1MB DRAM) and you have the power to switch the #9GXE into a virtual screen with a resolution of 2048x1024 pixels.

This versatile add-in effectively gives you the desktop equivalent of two monitors. So you can have two full-size applications like Excel and PageMaker displayed side-by-side.

The virtual screen allows you to seamlessly pan across your monitor from application to application.

When you need a closer view of your work, just press a "hot key" and you can zoom in and out of your screen with up to four levels of magnification.

When it comes to video and video-related utilities, Dell Dimension XPS PCs are your ticket to ride.

If you want to plug in a mouse, Dell gives you a dedicated mouse port. Gateway turns you into a serial killer.
With faster access and nearly double the data transfer rate our double-spin CD ROM makes Gateway seem positively sluggish.

Gateway uses a spring mechanism to eject your disks. At Dell, we give you a motorized loading tray like you'd expect from a high-end CD player. The choice is yours. But if your CD disks could talk, we know which one they would choose.

Whistle while you work. Or tap your foot. Or sing along. Our audio center CD ROM software lets you play disc jockey while you carry on with the important work of the day.

*All comparisons based on manufacturers’ specifications. The Dell CD ROM is the Panasonic 563. Gateway's CD ROM is either a LNI 1025 or a Sony CDU-31A. Dell disclaims proprietary interest in the marks and names of
When you buy a Dell Dimension™ XPS 450V or 466V equipped with a CD ROM, you get a CD ROM drive that runs circles around Gateway’s.

Our CD ROM drive gives you nearly twice the performance of Gateway’s thanks to advanced double-spin technology that doubles the transfer rate and helps to speed up access time. In short, it’s faster.

And that’s just the start.

Our drive has the automatic, push-button motorized tray you’d expect to find on a high-end CD player. So your CD disks glide in and out effortlessly.

Gateway’s has a manual spring-load reject, uh, eject button. It’s still push-button, but your CDs don’t glide effortlessly. In fact, they don’t glide at all.

Ours is obviously a lot easier and more pleasant to use. And our CD ROM drive is built to last.

Our CD ROM is Kodak Photo-CD compatible. Which means you can take advantage of the latest in CD technology and view photographs on your PC screen.

What’s more, our CD drive is multi-session. Which means you can print to the same CD on as many as four different occasions. Storing up to 100 pictures in all.

Our CD ROM also comes with software that lets you play your favorite tracks from any audio CD disk. So you can listen to Mozart as you crunch numbers or bop along to the Beatles as you cruise your local BBS.

So if you want the best CD ROM technology for your money, make a fast decision and call Dell today.

After all, there’s absolutely no reason why you should settle for a CD ROM that’s behind the times.
PERFORMANCE MACHINES THAT BLOW THE GATES OFF GATEWAY.

DELL DIMENSION™ 486/335 i486™ SX 33MHz SYSTEM
$1,499
- BUSINESS LEASE: $55/MO.
- 4MB RAM
- 64MB MAX RAM
- 170MB (17m) HARD DRIVE
- UPGRADEABLE PROCESSOR
- 6 16-BIT ISA EXPANSION SLOTS AVAILABLE
- ACCELERATED LOCAL BUS VIDEO
- ULTRASCAN™ 14C MONITOR
- DUAL DISKETTE DRIVES (3.5" AND 5.25")
- 101-KEY KEYBOARD
- MS-DOS® 6.0/MICROSOFT® WINDOWS™ 3.1/MOUSE
- ABOVE, PLUS: 8MB RAM, 230MB (17m) HARD DRIVE
- DUAL DISKETTE DRIVES (3.5" AND 5.25")
- 101-KEY KEYBOARD
- MS-DOS® 6.0/MICROSOFT® WINDOWS™ 3.1/MOUSE
- ABOVE, PLUS: 8MB RAM, 230MB (17m) HARD DRIVE

DELL DIMENSION™ XPS 450V i486 DX2 50MHz SYSTEM
$2,199
- BUSINESS LEASE: $81/MO.
- 8MB RAM
- 64MB MAX RAM
- 230MB (17m) HARD DRIVE
- 128KB EXTERNAL CACHE
- UPGRADEABLE TO PENTIUM™ OVERDRIVE™
- 6 16-BIT ISA EXPANSION SLOTS AVAILABLE
- ACCELERATED LOCAL BUS VIDEO
- ULTRASCAN™ 15FS MONITOR
- ONE DISKETTE DRIVE
- 101-KEY KEYBOARD
- MS-DOS® 6.0/MICROSOFT® WINDOWS™ 3.1/MOUSE
- ABOVE, PLUS: 340MB (17m) HARD DRIVE AND ULTRASCAN™ 15FS MONITOR

DELL DIMENSION™ XPS 466V MULTIMEDIA i486 DX2 66MHz SYSTEM
$2,798
- BUSINESS LEASE: $103/MO.
- 8MB RAM
- 64MB MAX RAM
- 340MB (17m) HARD DRIVE
- 128KB EXTERNAL CACHE
- UPGRADEABLE TO PENTIUM™ OVERDRIVE™
- 6 16-BIT ISA EXPANSION SLOTS AVAILABLE
- ACCELERATED LOCAL BUS VIDEO
- VL DIAMOND VIPER VIDEO CARD
- 2MB VIDEO RAM
- ULTRASCAN™ 15FS MONITOR
- ONE DISKETTE DRIVE
- 101-KEY KEYBOARD
- MULTI-SESSION, DOUBLE-SPIN CD ROM DRIVE
- MS-DOS® 6.0/MICROSOFT® WINDOWS™ 3.1/MOUSE
- ABOVE, PLUS: 340MB (17m) IDE HARD DRIVE AND 256KB EXTERNAL CACHE.

Now that you have been a witness to the impressive technological superiority the Dell XPS PCs wield over Gateway's machines, there are only two small decisions you have left to make. And they're both easy ones:

Which Dell Dimension XPS PC is the right computer for you?
And what kind of software would you like to go with it?

That's right. You can order your software at the same time you order your Dell Dimension XPS. That way, you'll be up and running the minute you open the box and unpack your Dell XPS.

Purchase any combination from 100 of the most popular and competitively priced MS-DOS and Windows applications and have them pre-loaded onto your machine for one low $15 installation fee. Now that's a really good deal.

And should you ever feel the need to add a peripheral, upgrade a software package or order a new application, we're ready and able to help you there too. With DellWare, A great selection of more than 2,400 software and peripheral items that you can order direct from us at discount prices. And if you want your DellWare selections in a real hurry, we'll ship your order to you overnight for only $5 extra. For no charge at all, we'll send you a free DellWare catalog.

Now if there's anything else we can do for you, just pick up the phone and call.

TO ORDER, CALL
800-626-8261
HOURS: MON-FRI 7AM-9PM PT SAT 10AM-4PM PT SUN 10AM-3PM PT
IN CANADA CALL 800-668-3021. PLEASE REFERENCE #115A/H

*Dell, i486, Pentium and Overdrive are trademarks of Intel Corporation. MS-DOS and Microsoft are registered trademarks and Windows is a trademark of Microsoft Corporation. Dell disclaims proprietary interest in the marks and names of others. ©1993 Dell Computer Corporation. All rights reserved.

*Prices valid in the U.S. only. Some products and promotions not available in Canada. *Leasing arranged by Leasing Group, Inc. The Intel Inside logo is a registered trademark and i486, Pentium and Overdrive are trademarks of Intel Corporation. MS-DOS and Microsoft are registered trademarks and Windows is a trademark of Microsoft Corporation. Dell disclaims proprietary interest in the marks and names of others. ©1993 Dell Computer Corporation. All rights reserved.
New computers from Apple and Silicon Graphics signal the start of a new period for desktop systems: the era of video computing. Never before have video I/O and the processing of digital video been so tightly integrated into system hardware and software. By treating video like any other data type, such as text, graphics, or audio, these systems open up more effective channels of communication among individuals and workgroups.

In fact, both Apple and SGI are positioning their new systems primarily as aids to improved business communication. The two companies are also avoiding the word multimedia, the meaning of which has become blurred. SGI calls its new technology digital media, while Apple has apparently latched onto the long-established term audiovisual, or AV. No matter what you call them, these systems are delivering on a key promise of multimedia: the seamless integration of all media types into a single box.

**Mac Audio, Mac Video**
The new breed of Mac not only consolidates new features into a desktop computer but also provides new ways for you to both work in the office and collaborate with other people, whether they’re down the hall or across the country. Telephone services enable the Mac to call people, act as a speakerphone, send and receive faxes, and operate as a modem to access on-line services. Built-in live-video hardware lets you record and play back video and—with the telephone services—handle videoconferencing over a network or an ISDN line. Finally, sophisticated speech-recognition technology allows you to direct the Mac by voice command, while a text-to-speech engine enables documents to be read out loud with 16-bit CD-quality stereo sound, freeing you to do other tasks as you listen.

Two new Macs represent the vanguard of these integrated systems. The high-end system is the Quadra 840AV, which has a Quadra 800 chassis and a 40-MHz 68040 processor. Although Apple has not stated what the “AV” stands for, it’s obvious that it implies audio/video enhancements. At the low end, the Centris 660AV uses a Centris 610 chassis with a 25-MHz 68040 processor. Both Macs use an AT&T 3210 DSP (digital signal processor) to handle most of the digital signal processing in the systems.

The Quadra 840AV’s VRAM frame buffer for its built-in video can be expanded from 1 MB to 2 MB so that it supports 24-bit color on 16-inch monitors and 16-bit color on 19- and 21-inch (1152- by 870-pixel) monitors. This makes the Quadra 840AV better suited for high-end graphics work than is the...
The Mac Quadra 840AV

Quadra 800, whose 1 MB of VRAM limits it to 16-bit pixels for 16-inch monitors and 8-bit pixels for larger monitors. The Centris 660AV has the same frame-buffer size as the Quadra 800 and so supports the same video depths.

Prices were preliminary at press time, but a Quadra 840AV with a 230-MB hard drive will cost approximately $4500. A Centris 660AV with an 80-MB hard drive will cost about $2400. As usual, these prices don't include the cost of a monitor and keyboard, but you'll probably get away with a low-end Centris 660AV system with a 14-inch monitor for roughly $3000.

Video Is the Medium

These AV Macs treat live video as just another data type that's manipulated by the system and applications. Composite video and S-video input ports accept NTSC-, PAL-, or SECAM-format video signals from sources such as a video camera or VCR. Live 16-bit video at 30 frames per second (fps) appears in a draggable, resizable window on the Mac's screen. A menu selection allows you to set the size of the window to 160 by 120 pixels, 320 by 240 pixels, or full-screen (640 by 480 pixels maximum).

Off-the-shelf chips from Philips digitize the video, perform format conversions and color adjustments, and rescale the image. The video data travels through the computer on a separate 64-bit bus, so it doesn't tie up the main processor bus. When live video is active, the Mac's frame buffer is halved; the Mac's screen graphics are placed in one half and the digital video dropped into the other. An ASIC (application-specific IC) then melds the contents of both of the frame buffers into one screen image. A DAV (digital audio/video) connector provides access to the video bus's raw digital video and sound. This connector is mounted in-line with a NuBus slot so that a NuBus board can tap into the DAV to perform data compression/decompression, encryption, or other processing.

Issuing a Copy command from within a supplied Video Monitor application captures a single video frame as a PICT image that can be pasted into documents, and QuickTime-savvy applications can create QuickTime movies of the incoming stream of video and sound. To get you started with recording movies, Apple will provide a basic video/audio capture application called FusionRecorder (licensed from VideoFusion).

The capture rate and quality of the QuickTime movie depend on whether you're saving to memory or to a hard drive, what the image size is, and what the compression settings are. NTSC or PAL video can also be sent out S-video and composite video output ports. The Monitors Control Panel can redirect the video so that a TV connected to these video output connectors can act as a monitor; this way, you can use a large-screen TV as an inexpensive presentation device for a group. Or, by routing the video to a VCR, you can "print" a business presentation or an application demonstration to tape.

You can use the AV Macs' built-in video to have a face-to-face conference with another AV Mac user on an Ethernet LAN. To do this, however, the live-video image has to be small (typically 160 by 120 pixels), the frame rate needs to be reduced to about 10 to 15 fps (which is the low end of what's considered to be acceptable viewing quality),
Introducing
Version 2.1

The new OS/2® 2.1 lets you run the latest Windows™ 3.1 applications, in addition to the DOS, Windows and OS/2 applications you're already running—almost any application in the PC universe. Now we've added TrueType fonts, select Windows applets, File Manager and Windows 3.1 printer and display driver support, including 32-bit seamless SVGA support.

You'll also get Advanced Power Management (APM) support for portables, improved multimedia support, pen-based capabilities, CD-ROM and AS/400® terminal emulation support. Plus all the features that made Version 2.0 an award-winner, like true pre-emptive multitasking, OS/2 Crash Protection™ and the easy-to-use object-oriented Workplace Shell™ interface. But now, you also get a new world of possibilities.

OS/2 2.1 is now also available on a single CD-ROM. It comes with exciting multimedia samplers, full-motion video demos and more. With our free demo diskette, you can find out even more about all the powerful features OS/2 2.1 has to offer. For your copy, to find out more about OS/2 2.1, or to order, call 1 800 3-IBM-OS2. In Canada, call 1 800 465-7999.

With OS/2 2.1 at the heart of your PC, you can run a world of DOS, Windows and OS/2 applications.

Demand OS/2 2.1 preloaded on your next PC.

Operate at a higher level.
and data compression has to be active to prevent saturating the network. Third-party software such as Electronic Studio’s E5.F2F application supplies an interactive storyboard and can share a foreground application window.

Making Connections
The Quadra 840AV and the Centris 660AV have an extensive built-in telephone architecture termed GeoPort. A Telephone Manager lets AV Mac applications dial numbers and handle two-way voice connections so that the Mac can operate as a full-duplex speakerphone. Control signals and digital data travel out an enhanced modem port to an adapter pod called the Telecom Adapter. This adapter pod contains the electronics that connect the Mac to the phone line, provides clock signals, and handles A/D conversions. This modular design reduces system cost while allowing the Mac to be connected to a variety of phone systems—especially important in overseas markets, where different telephone standards abound.

A POTS (plain old telephone system) adapter is available, and ISDN and digital PBX adapters will be available early next year. The modem port uses a new mini-DIN-8 connector (actually a mini-DIN-8 with an extra pin that supplies 5-V power to the adapter) that enables an incoming phone call to switch the Mac on.

In addition to providing these telephone functions, an AV Mac can also operate as a V.32 modem and a fax machine. These capabilities are implemented as programs that run on the 3210 DSP, and new features can be added later via a software upgrade. The DSP handles all heavy-duty real-time digital processing, such as the modem, fax, speech-preprocessing, and audio operations.

These functions don’t have an impact on the main processor because the DSP has its own autonomous, real-time operating system, called the Apple Real Time Architecture, or ARTA. ARTA is a task switcher, jumping to a new DSP task every 10 milliseconds. When handling CD-quality sound, ARTA task-switches every 5 ms. Note that if you’re using the Mac as a modem, this function consumes enough of the DSP’s bandwidth (24 kHz) that you can’t have CD-quality (44.1 kHz) sound generation at the same time.

ARTA can also allocate idle time so that other non-real-time tasks, such as 3-D rendering or image filtering, are able to use the DSP. The Sound Manager now supports 16-bit stereo sound formats at sample rates that range from 8 kHz to 48 kHz.

The Telephone Manager, the Modem API, and the Sound Manager provide consistent device-independent connections to these services for applications. Besides the DSP, nine DMA channels handle sound, SCSI, floppy drive, and serial I/O, relaying the processor of these jobs. The ARTA and the DMA channels are the first components of the future microkernel, which is being added to the Mac OS in stages.

Talk to Me
PlainTalk Speech Recognition (well-known by its code name, Casper) is a speaker-independent, natural-language, voice-recognition technology that is the result of five years of research by Apple’s Advanced Technical Group. Speaker-independent means that PlainTalk requires no operator training for its voice-recognition software to function. It uses the DSP to preprocess and then slice the speech-input signal into 10-ms packets. These are sent to the 68040, which evaluates several hundred possible words simultaneously using a phonetic-based pattern-recognition search.

A 60,000-word dictionary provides a word-matching reference, and back-propagation logic prunes the low-probability matches to boost recognition speed. The reference words are a composite of 500 speakers from all over North America, which eliminates the influence of accent on the recognition process. As you might expect, different dictionaries must be crafted for overseas users.

A Control Panel lets you set recognition tolerances (how much PlainTalk actually guesses at an utterance). It also allows you to set an identifier word (e.g., “Computer” or “Number 1”) to help PlainTalk discern a command directed at it, and you can indicate if the identifier is not required for a user-specified period of time (i.e., if you’re issuing a series of commands, you use the identifier only once, at the start of the command sequence).

Once PlainTalk recognizes a word
Welcome

everyone knows OS/2® gives you more applications to choose from. Now all you need is more space on your hard disk to load them all. Stacker® for OS/2 & DOS is your answer. Stacker lets you quickly and safely double the capacity of your hard disk, so you can take full advantage of OS/2—and virtually any DOS, Windows™ and OS/2 application you want.

You can install Stacker in minutes. With Express or Custom Setup, you can automatically compress the data on the drive or customize the Stacker configuration to fit your needs. And you can be sure your data is safe with the leader in disk expansion technology. In fact, over four million people worldwide already trust their data to patented Stacker LZS™ compression technology.

Stacker fully supports Boot Manager and Dual Boot configurations. And there's full support for OS/2's extended attributes, too. The AutoProtect™ feature detects disk errors at boot-up and immediately protects your Stacker volume. AutoRecovery™ automatically repairs errors on the disk. And Stacker Optimizer™ even defragments a Stacker drive for optimal performance.

With Stacker, you can get the most from your hard drive. And with OS/2 on it, you can get the most from your computer. To order or to find out more about OS/2 2.1 or Stacker for OS/2 & DOS, call 1 800 3-IBM-OS2. In Canada, call 1 800 465-7999.

Operate at a higher level.™

IBM and OS/2 are registered trademarks and "Operate at a higher level" is a trademark of International Business Machines Corporation. Stac and Stacker are registered trademarks and LZS, AutoProtect, AutoRecovery and Stacker Optimizer are trademarks of Stac Electronics. Windows is a trademark of Microsoft Corporation. © 1993 IBM Corp.
Cover Story

synthesized speech. The TTS engine has numerous built-in rules for generating realistic synthetic speech. For example, it recognizes dollar amounts and dates and pronounces them correctly, and it raises the voice on the last word of a sentence ending with a question mark.

The TTS engine doesn’t require a DSP to operate; its output gets routed to the DSP, though, since the DSP handles all generated audio and thus reduces processor overhead. The quality of speech varies with the amount of memory that is available, and a male or female voice can be chosen.

Via the Speech Manager API, any application can select a section of text or an entire document to be read aloud. Using it along with PlainTalk’s Speech Recognition, you might ask an AV Mac to “get my E-mail and read it,” which would start the execution of an AppleScript or QuicKeys macro.

The script or macro would then launch a telecommunications application, connect to the on-line service, download your messages, launch a word processor application, open the message files, and read the messages out to you.

The AV Macs provide new ways to communicate. First, they integrate the telephone, a modem, and fax capabilities into a single desktop system. Next, they supply ready access to video for any application. Finally, PlainTalk allows you to work with your computer more easily and offers aid to the visually impaired.

These features aren’t add-ons—they’re tightly integrated into the system. When the AV Macs become ubiquitous, users will discover new, effective ways to work (as in the last PlainTalk example), and to work with one another, no matter where they are.

The Indy’s most distinguishing external feature is the IndyCam direct-to-digital camera with built-in microphone, mounted atop the monitor.

or phrase, it consults a Speech Rules file and fires off the appropriate Apple Events. A QuicKeys component from CE Software will be provided that lets PlainTalk invoke either AppleScripts or QuicKeys macros in response to a spoken command. The Rules file contains phrases that drive most Finder operations, such as opening and closing windows, volumes, and files. You can add your own rules to the file, perhaps making the phrase “Clean house” empty the Trashcan, or you can have a phrase execute an AppleScript file or QuicKeys macro that starts a complex sequence of operations.

In addition, PlainTalk has a TTS (text-to-speech) engine that translates text to processor application, open the message files, and read the messages out to you.

The AV Macs provide new ways to communicate. First, they integrate the telephone, a modem, and fax capabilities into a single desktop system. Next, they supply ready access to video for any application. Finally, PlainTalk allows you to work with your computer more easily and offers aid to the visually impaired.

These features aren’t add-ons—they’re tightly integrated into the system. When the AV Macs become ubiquitous, users will discover new, effective ways to work (as in the last PlainTalk example), and to work with one another, no matter where they are.

SGI’s Digital Media

SGI wants to redefine the user interface with what it calls digital media communications. Its latest workstation, the Indy, provides all the hardware and software you need for capturing and communicating with sound and image over a network or over a digital phone line. Prices for the Indy will start at $5000, and SGI expects to begin mass production this fall. Eventually, all SGI systems and upgrades will provide this capability standard.

The digital media capabilities of this machine are particularly valuable to workgroups that need to share images and film clips over wide geographical distances—for example, medical teams, distributed engineering and fabrication groups, and research teams that use video as a data source. But as this technology spreads across the boundaries of different networks, nearly every computer user will benefit from communicating with digital media.

High-End Features

Despite its advanced capabilities for creating and displaying information, the Mips R4000PC-based Indy is SGI’s low-end system. Its most obvious feature is the IndyCam, a little digital color camera that sits atop the monitor. It looks more like a squashed Kodak Instamatic than the high-tech device that it is, a direct-to-digital camera connected to the SGI digital video port. It provides a maximum of 512 by 492 8-bit color pixels at 30 fps. It contains two SGI-designed ASICs for AD conversion from the CCD (charge-coupled device), as well as the electronics for color balance, shutter speed, and color space conversion. The output format is a variation of the CCIR-601 digital standard allowing for variable image sizes.

SGI designed the IndyCam to provide an uncomplicated and inconspicuous video input for videoconferencing and quickly capturing images for attaching to mail messages. The resolution is high enough to capture text from a typewritten page, yet it can be set to capture only the color depth and image size that are necessary for a particular application, thereby reducing the data-set size of the images without compression. Without the need for compression and decompression computations, the rate at which the frames can be handled is greatly increased. (You control the IndyCam’s settings for image size, color, and contrast with tools that are
IBM hits a high-tech home run. IBM DATABASE 2™ OS/2® (DB2/2™) brings big league power and reliability to your mission-critical data. It’s a new 32-bit OS/2 relational database for your desktop and client/server LAN workstations.

With OS/2 2.1 as a power base, DB2/2 provides an industrial-strength relational database server that supports functions critical to database users—transaction management, concurrency control, security, integrity and solid recovery functions. DB2/2 exploits the power and open architecture of OS/2. It supports industry-standard SQL and provides DB2 compatibility, allowing development of more portable database applications.

DB2/2 takes a big lead in bringing more versatility to the entire enterprise. You can access DB2/2 data directly from your DOS, Windows® or OS/2 desktops. For even more enterprise-wide information access, these same database clients can also access IBM DB2®, SQL/DS™ and OS/400® databases by installing the DISTRIBUTED DATABASE CONNECTION SERVICES/2™ (DDCS/2) gateway on top of the DB2/2 database servers.

DB2/2 and DDCS/2 deliver the advanced, database functions you’d expect from IBM Programming Systems, the people who invented relational database technology. So you know you’re getting a reliable database solution that puts your business first, second and third. To order or upgrade, or to find out more about OS/2 2.1 or DB2/2, call 1 800 3-IBM-OS2. In Canada, call 1 800 465-7999, ext. 850.

You can strike up the incredible power of DB2/2 right from the OS/2 Workplace Shell."
part of the Indy’s user interface.)

The IndyCam and digital video are only one of the possible paths for video input. You can feed analog video from a camcorder, videocassette player, or video camera directly into the NTSC/PAL video or S-video port. The Indy uses Philips videoprocessing components to convert the analog video formats to YUV multiplexed digital video.

SGI’s IndyCam and analog video input processing are the most obvious indication of the digital media potential of the Indy, but they’re not the key to the Indy’s 2-D image performance. Thanks to the enormous bandwidth (up to 267 MBps) of its graphics I/O bus and the technologically advanced graphics subsystem, the standard Indy can blast 32 million pixels to the screen memory in a second—enough to regenerate an entire 1280- by 1024-pixel screen 24 times in a second, or (more typical of video image resolution) 640- by 480-pixel frames at 50 fps.

Note that the live-video image is not in a separate video memory or even maintained as a separate video signal; it is mapped right there in standard video buffer space. This lets you grab it along with any other elements of your screen image for inclusion in SGI’s standard desktop image capture and manipulation/translation programs.

SGI claims that the X Window System graphics performance is 1.2 million 10-pixel lines in a second. This is even greater performance than that of Sun’s recently announced optional GX and TurboGX plus graphics accelerator boards, which, by Sun’s claims, are only 480 thousand lines per second and 1 million lines per second, respectively.

The baseline Indy 3-D graphics performance is not quite up to the level of the unenhanced SGI Indigo, according to the company. SGI has focused the Indy’s performance on handling images and 2-D objects. If you want, you can order your Indy with the optional 24-bit color 3-D graphics accelerator board, which will run you roughly an additional $2500. (The base Indy simulates 24-bit color by hardwareimplemented dithering.)

The Indy has the same audio subsystem as the Indigo: four-channel stereo input and output with 16-bit sampling rates ranging from 8 kHz to 48 kHz. The sound-sampling manipulation speed and resolution exceed those of CD recordings. The audio system is centered on the Motorola DSP 56001 chip.

The Indy has ports for two-channel digital audio, digital audio out, analog audio in (microphone), and analog audio out (stereo headphones). As with the IndyCam, the microphone and headphones come with the system.

Like any other SGI computer, the Indy comes with no standard floppy drive. But the optional drive is a 20-GB 3½-inch floppy drive that can read and write Macintosh and PC floppy disks directly, as well as read and write standard Unix tar and cpio formats.

As if in anticipation of the data superhighway, the Indy has ISDN among the many digital-media device ports. Other not-so-standard I/O connectors that come with the system are 3-D stereo glasses and 10Base-T Ethernet (as well as the old 25-pin AUI [attachment unit interface]). An R4000SC CPU with 1 MB of secondary cache is an option.

MultiSensory User Interface

The Indy’s sophistication becomes apparent once you boot the system and begin to use it. The term standard user interface has taken on new dimensions: voice and video, not only for output but also for input. The Indy interface is perhaps more appropriately referred to as an SUI (multiSensory User Interface) than as a GUI. SGI calls its new user interface Indigo Magic.

The microphone that comes with your Indy is not just for creating cute voice messages to embed in your documents; it’s also for controlling your system and the applications that run on it. Speech recognition/voice control will have no limit on the number of words in the speaker-independent vocabulary. You should find that a vocabulary of 300 or fewer words will produce an instantaneous response from the system. The commands need not be limited to single-word utterances. The voice recognition can learn to improve as it acquires experience with variations in the pronunciation of the words.

The voice recognition is a Silicon Graphics implementation of a technology developed by Scott Instruments of Denton, Texas. The SGI developer’s kit includes libraries for implementing voice recognition and control that programmers can include in their SGI applications.

The voice-command input may be the most exotic addition to the SGI user interface, but it is not the most important. The entire Motif-based SGI graphics workspace and tools have moved up to a new level of refinement. The new user interface looks like a combination of Hewlett-Packard’s VUE, Siblebourne’s virtual desktop, a little of NextStep, and a lot of the Mac. The goal was to combine an environment familiar to Mac users moving to SGI with the best features of the Unix interface.

SGI knows that many of its workstation users are not Unix system administrators. But since workstations tend to be
Where CA-Unicenter delivers hard core protection.

When the mission is critical, you can’t go soft on stability and reliability. Especially when LANs are at the center of your information processing solution. That’s the thinking at the very core of OS/2. Now Computer Associates adds to those strengths, putting a distributed client/server spin on OS/2 systems management, and raising it to the level of host environments. Even surpassing them.

CA-Unicenter for OS/2 builds on the reliability, stability and productivity of mainframe systems management, taking full advantage of the expertise and technology gained from more than 15 years experience. It combines industrial strength security management, work load management, problem management, console management and file management into one powerful, unified solution. And since it brings many familiar management features from your mainframe, CA-Unicenter for OS/2 protects your existing staff and reduces the need for new staff, making it a highly cost-effective solution, too.

With such rock-solid systems management, you could say CA-Unicenter for OS/2 takes operating at a higher level to an even higher level. To order or to find out more about OS/2 2.1 or CA-Unicenter for OS/2, call 1 800 3-IBM-OS2. In Canada, call 1 800 465-7999.

Operate at a higher level.

IBM and OS/2 are registered trademarks and Workplace Shell and “Operate at a higher level” are trademarks of International Business Machines Corporation. © 1993 IBM Corp.
single-user systems, every user must perform some basic system administration. SGI's new graphical system administration tools make it easier than ever to do the most common tasks. With some enforced uniformity among SGI's software developers, applications installation should approach the simplicity found in NextStep and on the Mac.

It remains to be seen whether software developers start incorporating the same graphical and digital media interfaces inside their applications as SGI has done with its Workspace/File/System management interfaces. Nonetheless, the overall environment in which the user operates is easy, flexible, and attractive.

Unix workstation designers can no longer assume that the world extends only to other Unix workstations; it also includes MS-DOS, Windows, NetWare, Macintosh, and Apple networks. The Indy can reside on any of these networks, and it can read and write both standard MS-DOS and Macintosh disks on the optional 3½-inch floptical drive.

Although the hardware and software tools already exist to make the Indy an ideal live videoconferencing system, the software will not be ready until the first part of 1994. At that time, you will receive an operating-system upgrade that will include the communications programs for multipoint conferencing with shared windows, shared whiteboards, and easy-to-manage remote control with other RTP-compliant Unix workstations. Toward the middle of 1994, the conferencing software will be upgraded to support the H.261 videocoding standard; this will let you trade video with nearly any other H.261-capable system, including the Mac (see "Video Compression Standards Vie for Acceptance" on page 72).

Starting the Wave

Unquestionably, the Indy, with its camera, microphone, and very high image and sound performance, is pushing the envelope of many technologies to provide integrated digital media capabilities. What's important is that the digital media components are matter-of-fact—bundled goodies that you'll find on all new SGI systems and upgrades even though you will probably buy an Indy simply as a general-purpose graphics workstation.

The AV Macs also push the digital media envelope, yet many of the technologies inside these systems have been in use for several years. For example, sound input has been an integral part of the Mac's hardware and operating system for four years; the ability to store and forward video as QuickTime clips has been available for two years; and the PowerBook Duos have literally field-tested the fax/modem API for about a year. The AV Macs continue to build on this solid foundation, adding live-video, speech-recognition, and telephone services.

In theory, once machines like the AV Macs and the Indy have reached critical mass in an enterprise, users will start taking advantage of the rich communications capabilities. In practice, that means upgrading much of the business world's LAN and communications infrastructure. If the payoff in productivity proves to be as exciting as these new systems, it will be well worth the investment.

Tom Thompson is a BYTE senior technical editor at large and a certified Macintosh developer. He has a B.S.E.E. degree from Memphis State University. Ben Smith is a BYTE technical editor and the author of Unix Step-by-Step (Hayden Books, 1990). You can reach them on BIX as "tom_thompson" and "bensmith," or on the Internet at tom@byteph.byte.com and ben@byteph.byte.com, respectively.
Sytron backup and recovery

Together with Sytos Plus, Sytos Rebound extends recovery even further, making recovery of the entire OS/2 operating system easier than ever. Sytos Rebound does it unattended and rapidly—in less than 10 minutes. Nothing helps you bounce back from disaster like Sytos Rebound. And when it comes to OS/2 backup, Sytos Plus is a giant step forward. To order or to find out more about OS/2 2.1 or Sytos Rebound and Sytos Plus from Sytron, call 1 800 3-IBM-OS2. In Canada, call 1 800 465-7999.

Sytos Plus
All is not lost, OS/2® users. It’s Sytos Plus® File Backup Manager for OS/2 to the rescue. Sytos Plus is a complete OS/2 backup solution—a high-performance program capable of handling HPFS files, long pathnames up to 260 characters and Extended Attributes of OS/2 files. And while the performance of Sytos Plus stands alone, its benefits can extend across OS/2 networking environments, including IBM LAN Server.

Sytos Plus delivers the broadest support for the industry’s leading backup devices including diskette, logical device, quarter-inch tape, data cassette, 4mm Digital Audio Tape (DAT), 8mm helical scan and 3½" rewritable optical. For even more complete disaster recovery, there’s Sytos Rebound.

The intuitive graphical user interface of Sytos Plus is a big plus.

The intuitive graphical user interface of Sytos Plus is a big plus.

Operate at a higher level.
DON'T BE EXPENSIVE

DELL® 425s/L
i486 SX 25MHz SYSTEM
$1,499
• Business Lease: $55/MO.
• 4MB RAM
• 120MB (17ms) Hard Drive
• 3 ISA Expansion Slots
• Upgradeable to Pentium® Technology
• Accelerated Local Bus Video
• SVGA 1024 Monitor
(14", 1024 x 768, 28mm)
• One Diskette Drive (3.5" or 5.25")
• MS-DOS® 6.0/Microsoft® Windows™ 3.1/Mouse
• High Performance Windows Drivers
• Embedded System Diagnostics

DELL 433/L
i486 DX 33MHz SYSTEM
$1,999
• Business Lease: $74/MO.
• 4MB RAM
• 170MB (17ms) Hard Drive
• 3 ISA Expansion Slots
• Upgradeable to Pentium Technology
• Accelerated Local Bus Video
• UltraScan 14C Monitor
(14", 1024 x 768, 28mm, NI)
• One Diskette Drive (3.5" or 5.25")
• MS-DOS 6.0/Microsoft Windows 3.1/Mouse
• High Performance Windows Drivers
• Embedded System Diagnostics

DELL 450/M
i486 DX2 50MHz SYSTEM
$2,899
• Business Lease: $107/MO.
• 8MB RAM
• 320MB (17ms) Hard Drive
• 6 ISA Expansion Slots
• Upgradeable to Pentium Technology
• Accelerated Local Bus Video with 1MB Video RAM
• UltraScan 15FS Monitor
(15", 1024 x 768, 28mm, NI)
• One Diskette Drive (3.5" or 5.25")
• MS-DOS 6.0/Microsoft Windows 3.1/Mouse
• High Performance Windows Drivers
• Embedded System Diagnostics

DELL MULTIMEDIA 450/L
i486 DX2 50MHz SYSTEM
$2,498
• Business Lease: $92/MO.
• 4MB RAM
• 230MB (17ms) Hard Drive
• Upgradeable to Pentium Technology
• Accelerated Local Bus Video
• UltraScan 14C Monitor
(14", 1024 x 768, 28mm, NI)
• One Diskette Drive (3.5" or 5.25")
• MS-DOS 6.0/Microsoft Windows 3.1/Mouse
• Internal CD ROM
• High Performance Windows Drivers
• Embedded System Diagnostics

DELL 466/M
i486 DX2 66MHz SYSTEM
$3,199
• Business Lease: $118/MO.
• 8MB RAM
• 450MB (12ms) Hard Drive
• Upgradeable to Pentium Technology
• Accelerated Local Bus Video with 1MB Video RAM
• UltraScan 15FS Monitor
(15", 1024 x 768, 28mm, NI)
• One Diskette Drive (3.5" or 5.25")
• MS-DOS 6.0/Microsoft Windows 3.1/Mouse
• High Performance Windows Drivers
• Embedded System Diagnostics

*Guarantees available in USA only for registered owners of Dell Performance Series systems purchased after 7/1/92. For a complete copy, please call our TechFax™ line at 1-800-950-1329 or products and promotions not available in Canada or Mexico. Leasing arranged by Leasing Group, Inc. MS-DOS and Microsoft are registered trademarks and Windows is a trademark of Microsoft Corporation. The names and names of others. ©1993 Dell Computer Corporation. All rights reserved.
FOOLED BY IMITATIONS.

DELL 450/ME
i486 DX2 50MHz SYSTEM
$3,499
- Business Lease: $129/MO.
- 8MB RAM • 450MB (12ms) HD
- 128KB SRAM Cache
- 4 EISA/ISA Expansion Slots
- Upgradeable to Pentium Technology
- Accelerated Local Bus Video with 1MB Video RAM
- UltraScan 15FS Monitor (15"; 1024 x 768, .28mm, NI)
- One Diskette Drive (3.5" or 5.25")
- MS-DOS 6.0/Microsoft Windows 3.1/ Mouse
- High Performance Windows Drivers
- Embedded System Diagnostics

DELL 433/T
i486 DX 33MHz SYSTEM
$2,999
- Business Lease: $111/MO.
- 8MB RAM • 450MB (12ms) HD
- 128KB SRAM Cache
- 8 ISA Expansion Slots
- Upgradeable to Pentium Technology
- Accelerated Local Bus Video with 1MB Video RAM
- UltraScan 15FS Monitor (15"; 1024 x 768, .28mm, NI)
- One Diskette Drive (3.5" or 5.25")
- MS-DOS 6.0/Microsoft Windows 3.1/ Mouse
- High Performance Windows Drivers
- Embedded System Diagnostics

DELL 466/ME
i486 DX2 66MHz SYSTEM
$3,849
- Business Lease: $139/MO.
- 16MB RAM • 450MB (12ms) HD
- 128KB SRAM Cache
- 4 EISA/ISA Expansion Slots
- Upgradeable to Pentium Technology
- Accelerated Local Bus Video with 1MB Video RAM
- UltraScan 15FS Monitor (15"; 1024 x 768, .28mm, NI)
- One Diskette Drive (3.5" or 5.25")
- MS-DOS 6.0/Microsoft Windows 3.1/ Mouse
- High Performance Windows Drivers
- Embedded System Diagnostics

DELL 466/T
i486 DX 66MHz SYSTEM
$3,399
- Business Lease: $126/MO.
- 8MB RAM • 450MB (12ms) HD
- 128KB SRAM Cache
- 8 ISA Expansion Slots
- Upgradeable to Pentium Technology
- Accelerated Local Bus Video with 1MB Video RAM
- UltraScan 15FS Monitor (15"; 1024 x 768, .28mm, NI)
- One Diskette Drive (3.5" or 5.25")
- MS-DOS 6.0/Microsoft Windows 3.1/ Mouse
- High Performance Windows Drivers
- Embedded System Diagnostics

Here are just a few of the latest and greatest Dell systems. By the time we're done custom configuring, you could have quite a few more affordable options ... 9,990 to be precise.

But we don't stop at great systems and great choices at great prices. We also give you some of the greatest service and support in the industry. If you ever need support you can call us 24 hours a day, seven days a week. If needed, we'll send a trained technician the next business day, guaranteed. And with Dell ReadyWare, you can choose from a selection of over 100 different applications which can be pre-loaded for one small $15 installation fee. Saving you time, energy and aggravation. Not to mention money.

Now let's talk accessories. No matter what else you want with your system, you can probably get it through Dell. In fact, you can order over 2,400 items from our free DellWare catalog. Just one toll-free call is all it takes to get these systems and practically all the other computer options you could need. None of those expensive companies can even come close to imitating that.

TO ORDER, CALL
800-545-1583

HOURS: MON-FRI 7AM-9PM CT SAT 10AM-5PM CT SUN 12PM-5PM CT
IN CANADA: CALL 800-668-3021. IN MEXICO CITY: 228-7811. #1155A

Dell USA L.P., 9505 Arboretum Blvd., Austin, TX 78750-7299. Attention Guarantees. *Prices valid in the U.S. only. Some of the Intel Inside logo is a registered trademark and the Pentium family of processors are trademarks of Intel Corporation. Dell disclaims proprietary interest in.
You know there's more information locked in your documents than you're using. Electronic publishing is your key to opening up and circulating your organizational know-how.

CARY LU
It’s fashionable these days to talk about knowledge workers—the people whose knowledge drives modern organizations. But how do many organizations distribute that know-how for internal or external consumption? Mostly through paper documents, routing slips, and filing cabinets.

Electronic publishing changes all that. Whether through a client/server system or on CD-ROMs, electronic publishing lets you build, circulate, and enhance your organizational knowledge base with greater speed and flexibility than ever was possible with paper.

Paper is easy to read but often impossible to find a week later, never mind a year later. With an electronic document database, however, you can search and retrieve a file often in a few seconds using common indexing and retrieval software, such as ZyLab’s ZyIndex.

But publishing your data electronically is not a trivial matter. Before you can distribute your documents electronically, you have to digitize your paper documents, index them, and put your digital documents for search and retrieval operations, and ensure that these electronic documents can be read across platforms and applications. You also have to figure out how to integrate data from external sources, such as commercial CD-ROMs or on-line services. You even have to devise strategies to compensate for the idiosyncrasies of the individual components in your electronic publishing system.

A one-size-fits-all solution to these problems does not exist. And none may ever exist because each organization has different needs and processes for getting the job done. Yet solutions to several of the technological barriers to electronic publishing have emerged. Document-exchange formats, for instance, have evolved from plain ASCII into formats that let you create files that retain the look and feel of the original document across any platform or application. You can even embellish your cross-platform documents with audio, graphics, and full-motion video.

Electronic publishing means bringing together a wide range of technologies, such as image scanners, indexing software, and computerized conferencing systems. Its challenges require you to meld and adapt individual component strategies to create a better whole. When implemented, electronic publishing gives you the keys that unlock all the information in your documents, information that you couldn’t find before or even knew that you had.

**Imaging Your Documents**

Key to building an in-house publishing arm is the ability to get existing paper-based documents and those that arrive daily onto your computer. Document-imaging systems, with about 100,000 users, according to BIS Strategic Decisions (Norwell, MA), a research and marketing-analysis consulting firm, are the most common method of achieving this goal in use today.

Document systems essentially emulate microfiche and microfilm. With an imaging system, you pass a paper document through a scanner that renders it digital. Your system then stores on disk a bit-mapped image of the document. While scanning, you enter keywords to help you retrieve the document later.

The problem with the imaging-system approach is that your main storage consists only of images, not computer-readable text. Consequently, you cannot use your computer to search the text of documents for any reference. You can find only the keywords that you used to categorize documents. And without a specific, well-designed list of keywords, you can end up with a massive amount of imaged documents and not have a clue as to what kind of content they contain.

But imaging systems have their place. Large companies often use imaging systems for processing high volumes of routine yet critical documents, such as supplier invoices. The benefit of being able to retrieve paperwork in minutes instead of days is obvious—time is money.

The Costco retail store chain in Kirkland, Washington, uses a large-scale imaging system based on software from Optika Imaging Systems (Colorado Springs, CO) for processing invoices. Vince Carney, Costco’s assistant controller, says that Costco’s imaging system has cut the company’s cost of processing invoices in half. “A large department store I visited still uses microfilm for their invoices,” says Carney. “They spend five times the money for one-fifth the work.”

Although most imaging system software runs on large-scale computers, several products, such as KeyFile’s (Nashua, NH) KeyFile and Westbrook Technologies’ (Westbrook, CT) FileMagic, run on desktop computers on either a network or stand-alone basis. Both run on PCs.

**Bridging Images and Data**

The bridge between the traditional “pure” imaging system and a computer file manager is OCR (optical character recognition). An OCR system consists of a scanner to image text and software that translates text into a computer-readable format. Among the better-known OCR programs are OmniPage Professional from Caere (Los Gatos, CA) and TypeReader from ExperVision (San Jose, CA).

OCR systems do an excellent job producing computer-readable files from cleanly printed documents that are minimally formatted, such as legal contracts. But, highly formatted documents, such as a newsletter or a manufacturer’s technical brief, resist easy processing. One
reason for this is OCR programs cannot distinguish between two columns of text and a table with two columns. Your OCR operator has to decide which it is and instruct the program accordingly.

Another problem with OCR is that it requires a good deal of manual checking and reworking to ensure that all the information in a document has been scanned into your computer properly. As a result, many organizations have given up on OCR as an input method. Terry Butler, manager of automated systems for Financial Systems Products (Seattle, WA), the company that installed Costco's imaging system, notes that only one of the company's more than 100 clients uses OCR.

Some organizations look for a middle ground by storing both the bit-mapped image and the OCR results. In this scheme, you inspect what the OCR creates during the scanning process to ensure that it stores enough information so that keyword retrieval is possible later on. Corrections, if necessary, are made manually. Any other OCR error arising from, say, a poor-quality copy, a handwritten note on the page, or a hair across the image is ignored. Later, when you retrieve the document, you can switch to the imaged version whenever the OCR text isn't intelligible. But double storage means that you have to maintain capacious disk drive, magnetic tape, or optical-storage units, regardless of the fact that you can almost always compress the bit-mapped image to save storage space.

"What's missing," says Mary Bamford, an analyst at BIS Strategic Decisions, "is the ability of people on a broad scale to understand when to use OCR. [What's needed] is intelligent OCR, not for reading printed text but for identifying the type of document and applying the correct reading technology."

Serge Blanc, vice president of engineering for Caere, responds that newer OCR programs are adding document-analysis features, but the human element will remain essential because paper documents come in so many forms. "If you scan a financial document, the program could identify and automatically create a spreadsheet," says Blanc. "But for which spreadsheet application? What is the filename? A completely automatic process will create a new set of problems."

Indexing and Retrieval
Once you have determined how to input paper-based data into your electronic publishing system, you will need a way to index and retrieve your information. Although many products can handle full-text searches to find and retrieve files, locating information on your multimegabyte knowledge base is not a trivial matter.

Retrievals of no more than a few seconds are possible with a product such as Odyssey Development's (Denver, CO) Ilyx, because it creates an index for the document and supports both full-text and Boolean-search strategies to locate files. For example, a Boolean search lets you find every instance of the word inventory within 50 words of the word problem.

Unfortunately, full-text and Boolean searches break down when you search through a large number of files. For example, unless you are a skilled searcher, your query is likely to return too many documents, and generally you have no way to filter out the documents of interest except by inspecting each document one at a time. Additionally, you never know if you have found every document of interest to you.

The greatest problem with searching for information is human. "The native ambiguity of language leads us to describe what we are searching for in different ways," says Matthew Koll, CEO of Personal Library Software (Rockville, MD). "If you ask book indexers to index the same document two weeks apart, they will use different index words." According to Koll, one way to compensate for this is to have two people do the search so that you will
Voice recognition remains a difficult challenge. Today's microcomputers don't have the power to process the input and output of voice signals and the related algorithms that voice recognition requires. In particular, speech recognition stumbles on error and noise correction, and it has trouble differentiating between phonemes, such as $b$ and $p$.

Nevertheless, voice recognition is manageable, according to Cliff Reid, executive vice president at Verity. "There isn't a technology barrier to audio," he says, provided enough computing power is brought to bear on the problem. Music usually only needs identification for retrieval from a library of recordings. Similarly, many ambient sounds may only need labeling for time and place rather than analysis of contents.

Indexing and retrieving visual information is truly difficult, according to Reid. Several research organizations, such as MIT's Media Lab, have been investigating ways to index and retrieve graphics and video by shape and color, but no commercial products have yet been marketed.

IBM hopes to offer the first commercial video search-and-retrieval product by year's end. Currently in beta test, IBM's Ultimedia Manager/2 is said to give your IBM PS/2-class machine (with at least 8 MB of RAM and running OS/2 2.1) the ability to search and retrieve images based on their color, texture, shape, and layout. According to IBM, Ultimedia will also let you analyze, annotate, classify, identify, and sort images by their content. It reportedly can recognize such simple shapes as triangles, circles, and squares, as well as complex forms such as a fish or a tree.

Ultimedia Manager/2 is a relational database that stores information on image color, texture, shape, and layout. It supports a wide range of image formats, including PCX, TIFF, and Targa, and you can use it to build and link image libraries to common database formats, such as DB2/2, dBase, and Oracle, allowing you to link text information to each image.

Once you build your image library, you can use Ultimedia Manager/2 to create sample pictures and query by image content. For example, you can set up a visual query by dragging and dropping colors and textures into an image window. Queries match the colors, layout, shapes, and textures you specify against the image database. To avoid receiving, say, every square figure in your image database, you can weigh individual elements of your query and limit the amount of matches displayed. You can use standard text queries to find images by the database records to which you have linked them.
It all started when you asked them to share an HP LaserJet...
HP's JetDirect card solves the problems of shared printing.

Shared printing has been a great way to make the most of your resources. Unfortunately, it also made printing a hassle. Until now.

With HP's JetPrint utility, printing status is delivered to each user's PC. This powerful Windows-based utility for Novell Netware networks, included with HP's JetDirect card, provides users easy access to printer information. Users no longer have to jog over to the printer to check on job status. Just a simple click of the mouse and they can find out everything they need to know:

- Online/offline.
- Paper out/paper jam.
- Toner low.
- Printer cover open.
- Print job queues and priorities. And more.

No more hassles for them. No more complaints for you.

And no more network performance degradation or PC parallel-port bottlenecks. Print data zips along. Even graphics move along at breakneck speed. Network printer performance is maximized. It just doesn't get any better. Or faster.

HP's JetDirect card makes your printer easy to manage.

How easy? Installation takes just minutes. And implementation is a breeze.

HP's JetAdmin utility provides remote management capabilities for Novell networks. Now printers can be placed anywhere on your network. Users can even automatically download Windows drivers for most popular PC applications. Which all makes the HP JetDirect card the preferred solution. With users. And with people like you.

Next time you buy an HP LaserJet printer, get an HP JetDirect card.

Call 1-800-533-1333, Ext. 7569.

After all, why suffer with problems, when HP offers the perfect solution?
Publish It Electronically

State of the Art

IBM's Ultimedia Manager/2, currently in beta test, enables you to store, classify, annotate, and retrieve pictures by color, shape, and texture.

Ultimedia Manager/2 Retrieves Pictures by Colors

IBM's Ultimedia Manager/2, currently in beta test, enables you to store, classify, annotate, and retrieve pictures by color, shape, and texture.

Clicking on View pulls down a menu of tools for controlling the amount of information displayed in a color-, shape-, or texture-selection database. The Size selection lets you choose among the three Ultimedia Manager/2 image sizes. The images below are an example of the largest color swatches. (Photo courtesy of IBM)

This line tells you where you are in the Ultimedia/Manager2 database. Here, you are in the color-selection database.

This identifies the location of the color-selection database. C:PETERTY.CLS is the name of the directory in which swatches of color are stored in such files as "color.dbf."

You define what is the proper shade of the color you're looking for by framing it in. You can then drag the image to an Example Image Window (not shown) to query your color database.

C:

PETERTY.CLS

COLOR

DBF

Tracking Content

Document databases provide indexing and retrieval while giving you the ability to keep track of document content. Document database managers, such as those from SoftSolutions Technology (Orem, UT) and PC Docs (Tallahassee, FL), run on a network server. They take files produced by popular word processing and spreadsheet programs and index the contents for later retrieval. Administrative functions give you control over document revision, tracking, storage location, and authorized access. These document databases mostly track and retrieve internally generated documents. A typical installation would be in a legal office, where they would manage the storage of all legal contracts.

A key feature of document databases is that you always receive the most recent version of a file. For example, Mezzanine from Saros (Bellevue, WA) is a network librarian running as a client under Microsoft Windows. Mezzanine keeps track of file versions, sets up access control for files, and synchronizes several document servers so that all versions of a document are up-to-date. In addition, Lotus Notes performs a number of these tasks.

Apple (Cupertino, CA) has entered the document-database market with AppleSearch, a program that runs on Macintosh servers and uses the WPL search engine. Apple has given WPL a simpler user interface and has extended its search engine to work on many common file formats—including Microsoft Word, MacWrite, and WordPerfect—in both PC and Mac forms through translators.

AppleSearch, Mezzanine, and similar document databases mostly run on servers instead of stand-alone computers, because servers generally have the large storage devices and sufficient computational power to perform the indexing and retrieval operations without disrupting your work flow. But Saros reports that a single-user version of Mezzanine will be available this year.

Integrating External Data

On-line services, such as the Dow Jones News/Retrieval Service, and CD-ROMs from commercial publishers like Macmillan New Media (Cambridge, MA) offer a wide variety of data that can supplement your internally generated documents. Some of the information available from on-line services is highly structured, such as stock-market prices, but other data is found in a free-wheeling magazine-like format (see "Magazines Without Paper" on page 108).

The problem is that the only way to integrate data from external sources into your in-house knowledge base is to download the external documentation and run it through indexing software before incorporating it. This, of course, is inefficient because there is no standard for indexing information. If there were an indexing standard, the search engine could simply send a query to the CD-ROM or on-line database and get the selected documents back. With current systems, you must either run a separate search query for each type of document database or download the entire document database for indexing on your own system. An industrywide standard specifying search commands and an index format will eliminate this inefficiency by making feasible a document database that could search and retrieve from many sources.

Unfortunately, such standards are unlikely any time soon. "The marketplace is experimenting with different functionality," says Verity's Reid. "The different retrieval engines cannot be decoupled from the details of the underlying index." A unified indexing scheme will have to be flexible enough to address the idiosyncrasies of a range of indexes and data types.

However, new developments indicate that this lack of standardization can be overcome in some situations. For example, you can program AppleSearch to regularly comb through data feeds from on-line services such as the Dow Jones News/Retrieval Service and create "newspapers" containing the search results. Further, the document-oriented interface promised by Microsoft's Cairo and Taligent's Pink operating systems should offer far better integration among documents from many different sources than possible with today's software (see "Objects for End Users," December 1992 BYTE).

Reading Complex Documents

Once you have established the input methodologies for your computer-based electronic publishing system, what will you see when you try to view a document? To view a file, anyone who retrieves it must have a compatible program. While
Free Money.

Over One Million Americans Have Already Responded!
Call Right Now To Get New Kiplinger's™ CA-Simply Money™ For FREE!
Operators Are Standing By - Call 1-800 FREE MONEY Today!

Introducing The Easiest, Quickest And Smartest Personal Finance Software In The World.
Is your spending out of control? With Kiplinger's CA-Simply Money, you can get off the financial rollercoaster and on to the path to financial freedom. Write checks with a click of the mouse. Balance your checkbook. Create a monthly budget and control your expenses. What used to take hours now takes just minutes.

It's that quick and easy. And it’s just plain smart. Kiplinger's CA-Simply Money puts you in total control of all your finances so you can make smarter decisions.

"Kiplinger's CA-Simply Money makes everything simple and easy. For the very first time, I'm in total control of all of my finances."

A Personal Financial Advisor Filled With Expert Advice From Kiplinger.
For more than 70 years, Kiplinger has been the first name in personal finance. Now their expert financial and tax advice will be right at your fingertips.
To prove how simple and easy Kiplinger's CA-Simply Money is, we're giving away millions of copies for FREE.
That's right. You can get this $69.99 product FREE.

But you have to act fast. Pick up the phone right now and order your FREE copy of Kiplinger's CA-Simply Money today.

For A FREE Copy Of Kiplinger's CA-Simply Money
Call: 1-800-FREE-MONEY
Dept. J-3501.

Kiplinger's CA-Simply Money

"There is a nonrefundable $6.95 shipping and handling charge. Have your credit card ready: Visa, Mastercard, AmEx, Discover accepted. One copy per household. Only available in the US. IBM PC or PC compatible with Windows 3.1 and minimum 2MB RAM required. This offer is subject to availability. Computer Associates reserves the right to end the offer at any time. © Computer Associates International, Inc., Islandia, NY 11789-7000. Kiplinger's is a trademark of The Kiplinger Washington Editors, Inc. All product names referenced herein are trademarks of their respective companies.

Circle 283 on Inquiry Card."
that's not a problem for simple documents, since all the major Windows and Mac word processors can read each other's files. It is a big problem for highly designed pages from a page-layout program, such as Aldus PageMaker or QuarkXPress. Page-layout programs themselves are too specialized for universal use, yet everyone needs electronic access to the kind of pages they produce.

To produce files that everyone can read regardless of the type of computer or applications they use, you will need a universal file format that supports fonts, graphics, and layout and one that you will use as widely as people use ASCII for plain text. Adobe Systems (Mountain View, CA), the originator of the PostScript PDL (page-description language) for laser printers, is working to address that need with its print-to-screen technology called Acrobat. Acrobat extends PostScript to produce a universal output file in PDF (portable document format). Acrobat viewers running on IBM PCs or Macs display PDF files, complete with all the graphics and typography used in the original document.

Recently, Adobe Systems demonstrated Acrobat for BYTE editors. Running on a Mac Quadra 950, Acrobat captured the general design of approximately 89 pages of a recent issue of BYTE, requiring about 5 MB of storage to do so. The image files were a little grainy, depending on what resolution they were stored at, and the text was a bit hard to read on a 72-dpi screen. Nonetheless, Acrobat is suitable for the electronic publishing of company phone lists, spreadsheets, and the like. Adobe reports that Acrobat will be available for Unix systems later this year.

Adobe isn't the only company trying to establish a document-exchange standard. No Hands Software (Belmont, CA) competes with its DigitalPaper technology. DigitalPaper converts documents into computer-searchable text, which is platform-independent, and into a 300-dpi print image. No Hands Software's first product, Common Ground for the Macintosh, has two components: a maker and a viewer. The maker is used to produce DigitalPaper. The viewer, which is distributed as freeware, takes up only 62 KB and can be embedded in a document, allowing you to create portable text that can display DigitalPaper images on screen without the Common Ground application. No Hands anticipates unveiling a Windows version of Common Ground later this year.

Still, the information in a document isn't limited to its text and formatting; its structure and purpose are just as important. For example, you might want to identify every part of a document database that dealt with safety regulations. This would enable you to create a subset of documents that would be easier and quicker to search in an emergency than the entire database. SGML (Standard Generalized Markup Language) supports such coding for content and structure as well as for pure formatting features. DEC's (Maynard, MA) CDA (Compound Document Architecture) technology and the ISO's Open Document Architecture are also emerging as popular universal file-format strategies (see "Unlocking Data's Content" on page 111). Unlike SGML, these standards are designed to handle not only text but also audio, graphics, and full-motion video.

Electronic Publishing Pluses and Minuses

<table>
<thead>
<tr>
<th>TECHNOLOGY</th>
<th>PROS</th>
<th>CONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image scanning</td>
<td>Captures images of important documents; lets you retrieve paperwork in minutes; preserves original layout and feel; images are a good complement to OCR files.</td>
<td>The bit maps of the text you capture are not computer-readable; you must assign keywords to each one.</td>
</tr>
<tr>
<td>OCR</td>
<td>OCR software digitizes scanned documents and produces computer-readable files, the full text of which you can search.</td>
<td>Works well with minimally formatted documents, but flunks on highly formatted newsletters and the like. It requires manual inspection and correction to ensure data was captured properly.</td>
</tr>
<tr>
<td>Index/retrieval software</td>
<td>Files and finds your documents; full-text searches can pinpoint the data; relevance-ranking systems give you the most likely documents.</td>
<td>Searches breakdown over large databases; queries can return too much data; no way to filter responses; you may never know if a crucial document was overlooked; audio files found by keywords; voice and visual recognition in developmental stages.</td>
</tr>
<tr>
<td>Document-exchange formats</td>
<td>Produce platform- and application-neutral data; keep text formatting and styling; some support audio, graphics, and full-motion video.</td>
<td>Complex standards that require expertise to use; you can define a document in such a way that it is unreadable by files that support the same standard; SGML does not support context elements.</td>
</tr>
<tr>
<td>Document databases</td>
<td>Provide indexing and retrieval with added control over file revisions, tracking, storage location, and access; give you the latest version of a document; good for managing such documents as legal contracts.</td>
<td>Large computational and storage requirements; desktop versions in development.</td>
</tr>
<tr>
<td>External data streams</td>
<td>Comprehensive databases that can greatly expand your knowledge base.</td>
<td>No standards for searching or indexing, so you're on your own to get the data and integrate it with your knowledge base.</td>
</tr>
</tbody>
</table>

Alternative Delivery Mechanisms

Document distribution through a LAN works fine for E-mail and the typical corporate document database. But the distribution frequently must extend beyond a LAN. A company may have multiple, unnetworked sites or need...
June 14, 1963.
Cindy Smith plays with color.
Thirty years later her business depends on it.
Introducing the QMS ColorScript Laser 1000. Now your business has total freedom of expression.

For Cindy, communicating decision-critical information quickly, flawlessly and in brilliant color is now her livelihood. That's why she depends on the QMS ColorScript Laser 1000 Print System. It frees her to print entire forms and letterhead with color logos, images and high quality text without changing paper. It saves her the cost of stocking special forms, letterhead and multiple sets of supplies and uses standard paper and transparencies. It improves her message by highlighting key data with color in multipage presentations and documents. Add direct connection to a variety of networks and anyone can realize both greater productivity and a per user cost that rivals personal printers. Plus, our easy software loadable upgrades virtually eliminate obsolescence.

Save money. Save time. Free yourself from limitations. Discover the advantages of the QMS ColorScript Laser 1000 Print System.

- Laser color and monochrome printing
- Compatibility with PostScript Level 2 and Level 1, HP PCL5C and HP-GL
- TrueType font scaling
- Automatic collation
- All four ports accept data simultaneously
- Automatically interprets incoming data and selects correct language from those available
- 65 resident type fonts, all with multilingual character sets
- EfiColor and Colorimetric color dictionaries and Apple ColorSync device profile
- Supports DOS, Windows, Macintosh and Unix applications
- Software loadable system upgrades
- QMS Crown multitasking technology

Expression is a serious business. Call QMS today at 800 841-0760 or 205 633-4300 for more information.

QMS, QMS ColorScript and the QMS logo are trademarks or registered trademarks of QMS, Inc. PostScript is a trademark of Adobe Systems Incorporated which may be registered in certain jurisdictions. All other product and company names mentioned are trademarks or registered trademarks of their respective companies.

Circle 111 on Inquiry Card (RESELLERS: 112).
Reading Data from a CD-ROM

Pits are a quarter of a wavelength deeper than lands. When laser light enters a pit, high-intensity light is reflected back to the photodiode. The photodiode converts this condition into a positive-voltage signal, which is interpreted by software as a 1.

Laser light never fully strikes on a land because its width is always greater than that of a land.

Clear polycarbonate coats a CD's top and bottom to protect data from dust and minor scratches. Laser light passes through the bottom coating but is stopped and bounced back by the reflective layer.

A coating of aluminum reflects laser light diffused by pits and lands back to the photodiode.

The objective lens targets the parallel bands on a pit or a pit/land combination, and it directs reflected light back to the collimation lenses.

The collimation lenses adjust the light and dark bands' line of sight, keeping them parallel for either the objective lens or for redirection toward the photodiode on the return passage.

The parallel bands pass from the diffraction grating into a polarizing beam splitter, which intensifies the light's focus. When the light is on its return trip, the beam splitter redirects the reflected light away from the laser diode toward the cylindrical lens.

Laser light first enters the diffraction grating, which divides the laser light into two parallel wavelengths of light and dark bands.

Laser light enters the diffraction grating, which divides the laser light into two parallel wavelengths of light and dark bands.

Unfocussed, high-intensity light bursts from the laser diode.

The photodiode measures the reflected light's intensity, converting the results into high- or low-voltage signals (i.e., positive or negative). A high-voltage signal is interpreted as a 1, while a low-voltage signal is translated into a 0. Shown here is a low-voltage condition, with the incoming light widely diffused. High-voltage conditions produce highly focused light.

When laser light strikes a pit/land combination, it diffuses unevenly. Due to the extra distance into and out of the pit, the light reflected from the pit is 180 degrees (0.25 wavelength in + 0.25 wavelength out = 0.50 wavelength) out of sync with that reflected off the land. Consequently, the two low-level light beams cancel each other out. The photodiode converts this condition into a minus-voltage condition, which is translated by software into a 0.

CD devices use a binary system of electrical signals to play back data. In its simplest form, a CD is made up of a reflective layer sandwiched between a protective polycarbonate coating. The reflective layer's surface has alternating hills and valleys, known as pits and lands, that spiral out in tracks from the center of the CD to the edge. Track density is 16,000 tracks per inch; one strand of hair is wide enough to cover 50 tracks. Laser light bursts up from a laser diode and passes through a series of lenses that intensify and focus the light in on a track. Pits and lands diffuse laser light, reflecting it back in the direction from which it came. It terminates in a photodiode. Depending on the reflected light's intensity, the photodiode converts the bounced beams into a series of positive and negative signals that are translated into the ones and zeros of a computer-readable binary system.
When protecting your software against piracy and unauthorized use, make sure that your protection system has all the following qualities:

**A GOOD HARDWARE KEY**

Hardware-based software protection systems are now the standard worldwide. However, not all keys are the same. A good key should have all the following features:

- Compatibility and transparency. The key should work without any problem on your customers' computers. The user should be able to forget the key after connecting it.
- Unbreakable electronics. A customized ASIC (Application Specific Integrated Circuit) component should be integrated in the key. This prevents reverse engineering and makes cracking virtually impossible.
- A unique and inaccessible software developer's code burnt into the ASIC. (This code should not be held in the key's memory, where it can be read and altered.)
- A Read/Write Memory inside the key should be available on demand. The memory should be writable in the field, on any PC, without any special programming equipment.
- Very low power consumption, enabling the key to work even under the worst power conditions, on PCs and laptops, with or without a printer.

**POWERFUL SOFTWARE**

- A Linkable Protection Module with which calls can be made to the key from any point in the protected program.
- An "Envelope" installation program. Such programs enhance security while making it possible to protect a software even without its source code.
- Sophisticated antidebugging and encryption mechanisms.

---

**HASP® - The Professional Software Protection System**

**WHAT OTHERS ARE SAYING ABOUT US:**

In all the products we tested, except the HASP, we could see through the encrypting and questioning procedures and crack them.

- **CT Magazine (Germany)**
  MemoHASP: ...of all the protection devices tested is without any doubt, the one which combines the best features.

- **Micro Systems (France)**
  Trying to crack a program... that was protected utilizing all of HASP's features - is like searching for the Holy Grail.

- **Program Now (Britain)**
  Of all keys tested, HASP is the most ambitious one... the quality of HASP manufacturing seems excellent.

- **PC Compatible (France)**
  PC dongles... come with varying claims as to their transparency. The majority suffer from problems when a printer is connected... the DESkey and HASP-3 are not affected...

---

**OPERATING ENVIRONMENTS**

- **PC:** DOS, WINDOWS, WINDOWS NT, OS/2, SCO UNIX, SCO XENIX, INTERACTIVE UNIX, AIX, AUTOCAD, DOS EXTENDERS, LAN
- **MAC (ADB port):** System 6.0.5 and up
- **NEC (Serial Port):** DOS, WINDOWS

**AND THE BOTTOM LINE:**

We offer some of the most competitive prices in the market. There are no hidden costs! Since 1984, HASP has enabled thousands of software producers in more than 40 countries, including several Fortune 500 companies, to protect their software.

Please call us for our HASP evaluation package.

---

**NETHASP- THE ULTIMATE SOFTWARE PROTECTION FOR NETWORKS**

- Only one NetHASP key is needed to run a protected program from many stations in a network. NetHASP provides full support for protecting DOS and WINDOWS software under network environments, including Novell dedicated & non-dedicated servers, Lan Manager, Lantastic, Banyan, DLink, and NET-SIGS based LANS.

**HASP® OFFERS YOU ALL THESE FEATURES AND MORE:**

HASP was designed by a team of computer experts, professional cryptologists, and electrical engineers. As a result, HASP keys are supported by dozens of programs using only one key.

- A Full Authorization System for protecting programs on any computer it has been tried on. In addition to all the features mentioned above, HASP provides:
  - A Pattern Code Security System (PCS) enabling parallel processing of multiple calls by the Linkable Protection Module.
  - A Virus Detection option that can be incorporated in the protected program to check whether it has been infected by a virus.
  - Several HASP keys can be connected one behind the other. Small physical size ensures maximum convenience for your customers.

---

**NETHASP- THE ULTIMATE SOFTWARE PROTECTION FOR NETWORKS**

- Only one NetHASP key is needed to run a protected program from many stations in a network. NetHASP provides full support for protecting DOS and WINDOWS software under network environments, including Novell dedicated & non-dedicated servers, Lan Manager, Lantastic, Banyan, DLink, and NET-SIGS based LANS.

**WHAT OTHERS ARE SAYING ABOUT US:**

In all the products we tested, except the HASP, we could see through the encrypting and questioning procedures and crack them.

- **CT Magazine (Germany)**
  MemoHASP: ...of all the protection devices tested is without any doubt, the one which combines the best features.

- **Micro Systems (France)**
  Trying to crack a program... that was protected utilizing all of HASP's features - is like searching for the Holy Grail.

- **Program Now (Britain)**
  Of all keys tested, HASP is the most ambitious one... the quality of HASP manufacturing seems excellent.

- **PC Compatible (France)**
  PC dongles... come with varying claims as to their transparency. The majority suffer from problems when a printer is connected... the DESkey and HASP-3 are not affected...

---

**OPERATING ENVIRONMENTS**

- **PC:** DOS, WINDOWS, WINDOWS NT, OS/2, SCO UNIX, SCO XENIX, INTERACTIVE UNIX, AIX, AUTOCAD, DOS EXTENDERS, LAN
- **MAC (ADB port):** System 6.0.5 and up
- **NEC (Serial Port):** DOS, WINDOWS

**AND THE BOTTOM LINE:**

We offer some of the most competitive prices in the market. There are no hidden costs! Since 1984, HASP has enabled thousands of software producers in more than 40 countries, including several Fortune 500 companies, to protect their software.

Please call us for our HASP evaluation package.

---

**NETHASP- THE ULTIMATE SOFTWARE PROTECTION FOR NETWORKS**

- Only one NetHASP key is needed to run a protected program from many stations in a network. NetHASP provides full support for protecting DOS and WINDOWS software under network environments, including Novell dedicated & non-dedicated servers, Lan Manager, Lantastic, Banyan, DLink, and NET-SIGS based LANS.

**WHAT OTHERS ARE SAYING ABOUT US:**

In all the products we tested, except the HASP, we could see through the encrypting and questioning procedures and crack them.

- **CT Magazine (Germany)**
  MemoHASP: ...of all the protection devices tested is without any doubt, the one which combines the best features.

- **Micro Systems (France)**
  Trying to crack a program... that was protected utilizing all of HASP's features - is like searching for the Holy Grail.

- **Program Now (Britain)**
  Of all keys tested, HASP is the most ambitious one... the quality of HASP manufacturing seems excellent.

- **PC Compatible (France)**
  PC dongles... come with varying claims as to their transparency. The majority suffer from problems when a printer is connected... the DESkey and HASP-3 are not affected...
Magazines Without Paper

KEVIN M. SAVETZ

The common wisdom has been that freedom of the press is limited to those with access to one. However, global-computer networks such as the Internet are giving more people a quick and inexpensive means to express their point of view through a form of electronic publishing known as electronic journals or E-journals.

Through E-journals, anyone with access to a computer and a modem can produce and distribute an electronic magazine through a computer network. CICNet, a cooperative academic network, maintains a large collection of E-journals. At last count, there were more than 350 E-journals in the CICNet collection, covering every conceivable topic, including AIDS awareness, fiction, legal information, music, and telecommunications. When there isn't an E-journal that fits a need, starting one requires only a computer, access to a network, and the will to succeed.

For instance, Unplastic News is the sort of nutty fun that probably couldn't exist without electronic distribution. A recent edition, for example, had the unlikely title "The Psychic Net Godmother Issue," while another was dedicated to bald people "because we have bald friends who demand their human rights."

"Unplastic News is really only a silly magazine with no real writing in it," says publisher Todd Tibbetts. Yet "we have thousands of readers, [and] we don't pollute the world with paper. We get feedback that people enjoy reading it. It is pure silly entertainment."

E-journal editors and publishers range from "crackers" (those who gain illegal access into computers and telephone systems) to respected scientists and journalists. For example, Jason Snell, editor and publisher of InterText, a bi-monthly fiction magazine, is a student at the University of California at Berkeley working toward a master's degree in journalism.

Most E-journal publishers would be unable to produce a traditional magazine, due to cost and time constraints. But online publishing offers them the ability to create a publication using minimal resources. "We can go head to head with other media as far as getting information out there," notes Andrew Moss, an editor for Unplastic News. "It costs nothing but our time to send this thing out."

Accionados of computer networks are by nature dabblers in many things, being "more sophisticated about technology" in the words of David Dodell, D.M.D., publisher of Health Info-Com Network Newsletter. Thus, E-journals usually have a more diverse, although smaller, audience than traditional magazines. Since they are distributed and read online, it's difficult to track their readership. For instance, Snell estimates that any given issue of InterText is read by 5000 to 20,000 people. Despite having only 1100 registered subscribers, Snell says that InterText is read by "untold numbers" on BBSes or the Internet.

If there's a problem confronting the entire E-journal concept, it's that they are useful only for transmitting text. "There is no easy way to transmit photographs," says Dodell. And, of course, you have to produce your own hard copy if you want to read an E-journal while commuting to work.

Like most E-journals, InterText is free. Subscribing means nothing more than asking to receive new issues in your electronic mailbox automatically. E-journals generally lack advertising, often because many network operators forbid it. Consequently, until there is a method for profit in electronic-magazine distribution, E-journals are not likely to become a mainstream medium, even though such commercial publications as BYTE, Urne Reader, and V.A.R Business offer varying forms of electronic publishing through on-line ser-
vices such as BIX and Prodigy.

While there's some worry among E-journal editors that traditional publishers will bring their capital and clout into the arena, ethical and legal matters surrounding the free flow of information over global networks may be a greater concern. "The lines between personal liberty, invasion of privacy, civil-rights violations, and government regulation of technology intersect when it comes to electronic publishing," says Geoff Duncan, a software tester for Microsoft and assistant editor of InterText.

Still, in Tibbetts' view, the future for E-journals looks exciting, despite such concerns. "There are many out there who believe this [ungoverned flow of information] will destroy the planet," Tibbetts says. "But I believe it will free us."

Duncan agrees that information technology is leveling the playing field in a society where information increasingly equals power. He's just not so confident about the future of E-journals. "Maybe E-journals will fade as information access becomes faster and, arguably, as attention spans decrease."

Kevin M. Savetz is a freelance writer based in Arcata, California. He specializes in networks and telecommunications. You can reach him on BIX c/o "editors" or on the Internet at savetz@raul.net.

Conferencing systems provide you with the ability to create your own database of free-form messages that you can read, comment on, and search. Your discussions can be highly structured, as in a business meeting, chaotic like an idea session, or a mixture of the two. Discussions can be open to all, or you can set up small, closed-group discussions. You can augment these capabilities up and running, setting up internally or externally, and you can set up gateways to global E-mail systems, free-form messages that you can read, and telecommunications. You can reach him on BIX c/o "editors" or on the Internet at savetz@raul.net.

At first—it is simply a matter of loading the program, organizing disk files, and setting up your discussion groups. But it gets complicated once you get going. One of the biggest problems is with storage. Disk space disappears faster than you believed possible as message after message are stored. Program libraries and supplementary news and data feeds quickly eat up more space. Both situations force you to cull out messages and data, which undermines the expansion of your knowledge base through electronic publishing. To get around this, you can add more storage capacity, but that gets expensive.

Another difficulty with running your own conferencing system arises when you are using it for communications between widely dispersed offices. To do this, you'll need external data-network connections or your own modem bank, both of which are notoriously finicky. With modems, you'd set up a bank of modems connected to a telephone router. The router redirects incoming calls through a series of modem connections to the first available open line. Depending on the number of callers you anticipate, you can run up quite a bill with your local telephone company. The rule of thumb is that you need one connection for every 10 system users.

Data networks come with their own problems. For example, response speed can be variable because of network usage, network relay failure, and the condition of the local telephone line. The X.25 protocol, a common network communications protocol, has a variety of software settings that require knowledgeable experts to set and maintain properly.

Data networks can also be expensive. Pricing generally is based on such factors as time of day and location of the call, number of characters sent and received, and the number of data packets sent and received. Unless you anticipate huge usage, connecting to an external third-party data-network operator may be prohibitively expensive.

Rather than set up your own network and conferencing system, CompuServe (Dayton, OH), General Videotex (Cambridge, MA), and other on-line service companies will set up private conferencing facilities tailored to your specifications. You can select from a variety of facilities, such as private software file libraries to send your data back and forth, external news feeds, and the like. The beauty of using third-party service providers is that they handle all computer management, disk storage, software development, and other tasks related to running an electronic conferencing system, letting you stick to running your own business. You can also open up separate discussions for your customers and for potential customers.

Pricing for such private conferencing services varies depending on number of users, network usage, and services desired. For example, General Videotex charges $39.95 to set up a private service on its Delphi on-line system; custom features are extra. Additional users in your area would pay the normal Delphi subscription and telecommunications fees, but they would have access to all Delphi features, such as full Internet access and private E-mail. For large organizations with a number of users, fees would range from between $500 and $10,000 to set up a private conferencing service, dependent on the type and level of customization you require, according to General Videotex spokesman Rusty Williams.

**Spreading Knowledge, Not Paper**

The in-house document publishing business is growing rapidly. For example, looking only at desktop-based document management systems, the root of any in-house publishing capability, analyst Bamford at BIS Strategic Decisions projects growth from 59,000 users this year to 345,000 users in 1997.

Several companies have put off installing a document publishing system due to the lack of a complete, packaged solution for the problems confronting electronic publishing. But given the diverse range of needs, there may never be a single solution.

While electronic publishing is a fairly new field, and many of the products do not work well together, it's clear that more and more industry leaders such as Adobe, Microsoft, and WordPerfect are giving you the ability to spread your organization's knowledge base further than before through products that create platform-independent data files. The trick is to use your computers as a way to unlock the information in your documents and build your knowledge base rather than simply as a way to generate ever more paper to stuff into file cabinets.

Cary Lu is the author of The Apple Macintosh Book (Microsoft Press, 1992). He has advised several companies on document management systems. He can be contacted on BIX c/o "editors."
"ALR has built a screamer."
Computer Shopper - May, 1993

"Expect to hear a lot more about the EVOLUTION V... ALR did its homework when it came to optimization."
Computer Shopper - May, 1993

With memory and data paths wide enough to support the new chip, the EVOLUTION VQ becomes an excellent file server...
Computer Shopper - May, 1993

The ALR EVOLUTION VQ/60

MODEL SCM
ALR's high performance Quadplex Architecture, state-of-the-art Pentium Processing, tremendous expandability, ... the ultimate network server with 66-MHz Processor ... $4495

MODEL 480-16CVM
includes above features plus:
- 16-MB RAM total
- 480-MB IDE Hard Disk
- ALR MULTUS™ multitasking disk interface
- 16-bit Local Bus Master controller

$5995

MODEL 1.2-16CVM
includes Model 8CM features plus:
- 16-bit Local Bus master controller
- 16-bit Local Bus Video Adapter

$7595

MODEL 1.2-16CVS
includes Model 8CM features plus:
- 16-bit Local Bus master controller
- 16-bit Local Bus Video Adapter

$7895

ALR Advanced Logic Research, Inc.
9401 Jeronimo Irvine, CA 92718
(714) 581-6770 FAX: (714) 581-9240

Circle 286 on Inquiry Card (RESELLERS: 287).
UNLOCKING DATA’S CONTENT

The changing structure of data types lets you leverage the information content in your data in ways you never imagined. But exchanging data across platforms requires lots of hard work.

RANDALL D. CRONK

Over the years, the amount and kinds of information you could store in a data type have evolved from the simple binary zeros and ones to hypermedia documents in which objects are just as capable of being computed as the records in a database or the numbers in a spreadsheet. Data types have come to mean ASCII characters, as well as multimedia documents containing text, graphics, sound, and video.

The trend is to expand the information content of data and leverage that content in ways never before possible. For example, a value in a record field may tell you more than how many widgets are in stock; it may tell your purchasing program when to order more. Or you can use the same document database to generate a technical manual or a parts list. And the same content driving the presses for The Wall Street Journal can resurface as a CBR (content-based retrieval) service and an on-line data feed to a brokerage.

To squeeze more content into data, the structure of data has had to evolve. Bit for bit, a document is one of the richest forms of content, yet only recently has it been put to work as a computable data type. "Only about 10 percent of all data is in a form computers traditionally deal with," says Bill Arms, vice president of computing services at Carnegie Mellon University in Pittsburgh, Pennsylvania. "The other 90 percent is in documents, and the vast majority of those are still of the paper rather than the electronic variety."

One reason for making documents computable is that most of your data is found in documents. Another reason is that documents are inherently richer and more flexible in their content than are more conventional data types, such as spreadsheet cells or relational database records. Still, simply using documents to store tabular data would miss the content advantages of documents, which include the use of graphics, document formatting, and text
In the old days, exchanging documents meant filtering text. But now that word processors and desktop publishing programs routinely include graphics with their documents, exchanging these files without a standard file format for interchange is becoming increasingly difficult.

New, object-oriented technologies promise to change the way we create and interchange documents.

—Mark Walter, a consultant at Seybold Publications

When SGML encodes a document, it accomplishes its task using a different technique than CDA or ODA. Rather than dynamically creating new and different data types, as do CDA and ODA, SGML uses special character sequences known as markup tags to embed control information within the text stream. Markup tags can separate a document's logical elements or specify processing functions to be performed on them.

An example of applying markup would be tagging the beginning and end of a character string with special codes to indicate that the character string is in a different typeface than the rest of the text. For example, you would use the character string \(<D>aggregates</D>\) to indicate that the word aggregates is in italics and that your normal typeface resumes after the final letter of the word.

Markup tags let you access, edit, manipulate, publish, and store document objects by specifying the structural and procedural information that the computer programs that perform those operations require. To do this, SGML uses DTDs (Document Type Definitions) that determine the specific processing rules for encoding or decoding a document's structure and the markup tags that express that structure. For instance, a DTD rule might specify that the markup tag \(<D>\) symbolizes both the end of a character string specified by some other markup tag and the resumption of your default typeface.

Rules are specified within the DTD itself. The language in which the DTD is written is SGML. Consequently, you can have two DTDs that conform to the common SGML standard yet are incompatible because they specify different rules. For example, instead of using \(<D>\) to indicate the conclusion of a markup tag as in the previous example, a DTD could specify \(<E>\) as the end of the markup tag.

SGML only describes text-handling
Now, creating a multimedia CD-ROM is as easy as point and click.

Introducing the Multimedia Formatter from Sony Electronic Publishing.

If you demand a simple, comprehensive solution to creating multimedia CD-ROMs, here's everything you need. The Multimedia Formatter software series from Sony Electronic Publishing combined with the Sony CDW-900E CD-ROM write-once recording unit gives you the premier multimedia CD-ROM mastering system. Available for both PC and Macintosh, Multimedia Formatter software enables you to output a real or virtual ISO 9660 premaster image, CD-XA, CD audio, electronic book (8cm) or CD-I. Plus, it supports the new Sony MMCD. Engineered to support Red Book audio and Mode 1 and Mode 2 files, Multimedia Formatter doesn't require a huge hard disc and accommodates 2X speed recording. Plus you can master multiple discs simultaneously. So if you're in the market for a multimedia CD-ROM solution, choose Multimedia Formatter for PC or Mac. It makes mastering your next CD-ROM as easy as point and click.

The Multimedia Formatter software and the Sony CDW-900E are available through the PDSC division of Sony Electronic Publishing, which specializes in software development products, training and engineering.

For further information:
TEL: (800) 654-8802
FAX: (408) 372-9267

The Multimedia Formatter with the Sony CDW-900E CD-ROM recording unit, delivers a total CD-ROM mastering system.
State of the Art Unlocking Data’s Content

tags. Non-SGML processes such as a video editor handle nontext data (e.g., video). This is true even if video data is part of a text document, such as with a screen menu.

Although it cannot construct nontext documents or parts of documents for different kinds of content, SGML may have the inside track when it comes to industry acceptance. One reason for this is the U.S. government’s CALS (Computer-aided Acquisition and Logistical Support) program. CALS is an industry-government project with an agenda to define a universal document encoding structure for the U.S. military. The CALS DTD mandates the use of SGML for encoding documents for the U.S. Department of Defense.

Mark Walter, a consultant for Seybold Publications (Media, PA), cites SGML’s flexibility as a reason for its prominence. “SGML has caught on the fastest [of all the tagging languages], thanks to its versatility and adaptability to a variety of applications,” says Walter.

SGML No Panacea

SGML has its weaknesses. For one, it does not actually specify documents. It specifies DTDs, and incompatibles defeat the purpose of universal document exchange. Another shortcoming is that DTDs do not indicate how to process nontext objects. When nontext objects are encountered, DTDs simply specify special markup tags called escape that cause the processing program to jump outside the SGML-defined process to an application that can cope with the nontext object. Also not standardized is how objects are tagged for transfer to those other applications or how those applications will interpret those objects once they receive them.

A partial remedy for this weakness is the Hypermedia/Time-based (HyTime) structuring language, currently under draft consideration by the ISO. HyTime provides a standard way to tag text or nontext objects so that they can be rendered as a complete document or processed as independent objects. However, HyTime does not specify how document objects are encoded or interpreted by computer programs. But by using standardized linking, alignment, and addressing methods, it ensures that those objects are made available to programs in a standardized way.

Other Possible Approaches

Formatting content according to an encoding standard is one way you can make it more computable. Another approach is to invent new data types that combine documents and more conventional record-oriented data.

Work on such hybrid data types is proceeding from two directions. First, traditional database vendors—including DEC, Informix, Oracle, and Sybase—have added limited document support to their relational databases. Meanwhile, document-processing vendors, such as Information Dimensions (Dublin, OH), are adding relational fields to objects that contain documents. This means that you can map objects from within documents to fields inside relational records, where you can manipulate them in a conventional data-processing manner.

About two years ago, relational database vendors introduced BLOBs (binary large objects) as an extension of RDBMS (relational database management system) technology designed to address nonrelational data. BLOBs are free-form data buckets embedded within relational data records that you can search on using key fields.

More recently, vendors have added CBR capabilities that let you search for text objects inside of a BLOB, rather than searching just for the BLOB itself. For their part, vendors in the content-delivery businesses of document management, electronic publishing, and videotex have invented new data types that combine aspects of documents and relational records.

Content-Directed Paradigm

Rather than force-fit content into either documents or conventional data-processing structures, content-directed software uses whatever content package fits its particular needs. For example, Lotus Notes is a collaborative application that gives you a great deal of flexibility over the manner in which documents are accessed and how information in those documents affects your work-flow processes. To facilitate document lookup and manipulation, Notes implements a record, called a form, that allows you to append relational keys to your documents. To aid interprocess cooperation, Notes lets you attach hypertext links to internal document objects of virtually any format, size, or type. Thus, you could link a controller’s spreadsheet to a workflow process that generates dunning letters to past due accounts, enhancing your work-flow by combining both operations.

Even though it borrows from both data and document processing, the content-directed paradigm is more than the sum of its parts. Content-directed products, such as Notes, have capabilities you can’t find in either pure document or data-processing applications. For example, DEC’s VTX, a content-directed videotex product, lets you build infinitely large data types so that you can have as much content within a single document, over as many machines, and in as many locations as you want. In other

DEC’s VTX is a network-level videotex application that lets you organize data into knowledge bases called stories. A story is made up of one or more pages. A page can store any amount of data in any format. Pages can provide cues to external applications that process or present the data contained in the page. (Screen courtesy of DEC)
For years, capability and affordability were mutually exclusive features of laser-quality printers. But the new microWriter™ PS23 from Texas Instruments has changed all that. Now you can get sharp, crisp laser-quality images, rapid 5 page-per-minute operation and the reliability of LED technology. All in one very affordable printer. Thus enabling you to print more. Produce more. Do more. In other words, to extend your reach. The new TI microWriter PS23. It can make a small business look a lot bigger. And a big business look a lot smarter. For more information and your nearest dealer, please call 1-800-527-3500.
**State of the Art**  Unlocking Data’s Content

## Universal Content Access

### The Code Behind the Screen

```c
static Widget viewer_id = 0; /* CDA Viewer widget */
static MnrCount regnum = 2;
static MnrRegisterArg regvec[] = {
    "open_file_proc", (caddr_t) open_file_proc
};

main(int argc, char *argv[]) { 
    unsigned long stat; /* condition status */
    MnrInitialize(); /* initialize Motif Resource Manager */
   DrvRegisterClass(); /* Register the CDA Viewer widget class. */

toplevel = XtInitialize("examp", "examp", NULL, 0, &argc, 
    argv);

MnrOpenHierarchy(uid_count, &uid_filename_vec, NULL, my_MoundHierarchy);
MnrRegisterNames(regvec, regnum); /* Register our callback routines */

/* The CDA Viewer widget has been defined in the application's 
 * UML.
 */

/* MnrFetchWidget(my_moundHierarchy, "My_main", toplevel, 
 * &main_window, &dummy_class);

XtRealizeChild(main_window);
XtManageChild(main_window);
XtAppMainLoop(XtWidgetToApplicationContext(toplevel));
} /* end main routine */

/* This callback is called when the CDA Viewer widget is created 
 * while the UID hierarchy is fetched.
 */
static void create_viewer_proc(Widget w, caddr_t tag, caddr_t reason) 
    viewer_id = w; /* save the CDA Viewer widget for future reference */

/* This callback routine is called when the user selects 'Open' from 
 * the CDA Viewer's file menu.
 */
static void open_file_proc(Widget w, caddr_t tag, caddr_t reason)

    /* Tell the CDA Viewer to display text1.doc */
   DrvViewerFile(viewer_id, "text1.doc", "diff", NULL, NULL, NULL);
```

**DEC's CDA (Compound Document Architecture)** defines a set of ground rules and services for the interchange of compound documents between applications. CDA-compliant applications can revise each other's documents even if the applications are written in different languages, run under different operating systems, and are located on the far corners of a distributed network.

CDA was designed from the outset to be independent of computer platforms, according to Mark Walter, a consultant for Seybold Publications (Media, PA). Over the last two years, DEC's CDA has become the compound document architecture of choice for such heavyweights as Lotus Development, Microsoft, and WordPerfect.

CDA includes an overall strategy for compound document interchange. It encompasses both a specific set of encoding rules, or DDIF (Digital Document Interchange Format), and a set of run-time services to help programmers develop applications that support those rules. CDA run-time services give you tools such as the CDA Viewer, which allows applications to display compound documents.

CDA has been employed in a variety of applications, including document-format converters, real-time data acquisition, and work-flow management. Among the more well-known products supporting CDA are FrameMaker, Interleaf, Lotus Notes, and SAS.

CDA is an under-the-hood technology, meaning that applications developers work with CDA directly, while end
users benefit indirectly. One way that CDA benefits you as an end user is that it simplifies the task of working with graphics, text, images, and other data types in a single project. It also lets you receive and manipulate documents generated by foreign applications and from different computing environments. CDA opens up documents so that different applications can work on pieces of them. This gives you the ability to, say, publish all the diagrams in a repair manual as a separate book with its own table of contents.

**How DDIF Works**

DDIF's document-encoding scheme ensures that every application that understands the code has sufficient information to faithfully render a properly encoded document. Document encoding differs from document rendering, which is the job of PDLs (page-description languages) such as PostScript, in three key respects. First, document-encoding schemes determine the nature of a document's content and how that content is organized logically (i.e., by sections, paragraphs, chapters, and so on). Document encoding also determines how your content is presented—meaning it determines such styling information as italics, underlines, and bold headings.

Every digital document has three stages in its life cycle. In its first stage, a digital document exists as a rendered page—the printed page. Then, it is encoded document existing as the sequence of bits transmitted in a data packet or formatted on a disk. Last, it's an in-memory structure that an application works on.

ASCII-encoded documents are considered flat, which means that they are a sequence of 7-bit character strings. Their in-memory structures are also flat. Document structure and styling information is carried in application-specific tags embedded within the ASCII. The meaning of these tags is defined using a DTD (Document Type Definition), which is specified using a markup language such as SGML (Standard Generalized Markup Language). To successfully interchange and edit each other's documents, applications must employ identical DTDs.

Unlike ASCII, DDIF conveys structural information such as layout and text styling, not just a document's contents. DDIF's in-memory structures consist of linked lists of entities called aggregates and items. Aggregates reserve and initialize space for document components, such as text and picture frames. Items are the values that size or populate aggregates. Therefore, an item specifies how large a frame should be, at what coordinates it should be positioned, and what text is enclosed within the frame.

DDIF uses ASCII to encode text. The above sample code shows a C-language version of an aggregate that defines a gallery for some text. The sample code to the right shows an aggregate item that positions the gallery on the page.

Values for these structures (the status = lines) are supplied by the application through an in-memory array defined earlier in the program. Aggregate definitions are not a part of C or any other language CDA supports. CDA provides a run-time service that is embedded in the compiled application to let the application create, populate, and delete aggregates.

The in-memory form of a CDA document is a link list of aggregates (some with items attached) that can be parsed from top to bottom to define content, logical structure, layout, and presentation style. To render a list of aggregates as a printed or screen-displayed document, CDA runtime services include a PostScript driver. To render this list on disk, CDA uses a TLV (type-length value) encoding scheme that is patterned after the ASN.1 (Abstract Syntax Notation One) standard, ISO number 8825. An aggregate list is encoded as a series of 8-bit data frames or octets. The type octet indicates the kind of information encoded (e.g., text or graphics). The length octet indicates how many octets are needed to encode the complete series of aggregates from this point in the list.

A value octet contains the value of this aggregate (e.g., ASCII text or a frame position) if it is "content only," meaning that this aggregate does not contain sub-aggregates or structural information. Otherwise, the value octet contains the TLV encoding of the next subaggregate attached to this aggregate (i.e., this aggregate is a structure containing subordinate structures, content, or both).

CDA can encode virtually any structure in a platform-neutral way. Because of this, when a document is sent between applications, the sender and receiver don’t have to agree in advance on the size, type, or complexity of the data types involved. They just accept the document and let you get on with your work.

**Items Position Aggregates**

```c
aggregate_item = DDIFS_SGA_ITEM_POSITION_C;
integer_value = DDIFS_FRAME_GALLERY;
status = CDAStoreItem ( root_aggregate_handle
aggregate_handle_stack[ahs_index],
aggregate_item,
integer_length,
& integer_value,
0, 0)
```

**Aggregates Cast in ASCII**

```c
aggregate_type = DDIFS.TXT;
status = CDACreateAggregate ( root_aggregate_handle,
aggregate_type,
&aggregate_handle_stack[ahs_index]
```
PC DIAGNOSTICS THAT REALLY FIND THE BUGS!

THE TROUBLESHOOTER™, a self-booting disk, is unlike other diagnostic programs that rely on DOS. The Troubleshooter™ bypasses DOS and tests all major hardware directly for true accuracy while other programs frequently give erroneous test results. Loaded with all the tests you need to quickly and accurately isolate the source of PC failures. Full battery of tests included: Motherboard, RAM, Hard Drive, Floppy, Video, IDE plus full system information, benchmarks and utilities. UNIVERSAL APPLICATION: THE TROUBLESHOOTER™ runs on any PC (with Intel or compatible processor) and under any operating system — UNIX, NOVELL, XENIX, OS/2, DOS and others. Priced far below all competitors. The only diagnostic with IRQ/DMA testing that works with other operating systems and other hard drives. The Troubleshooter™ is a safe alternative to low-cost Hard Drive Boot Fixes. THE TROUBLESHOOTER™ runs on any PC (with Intel or compatible processor) and under any operating system.

RESCUE DATA RECOVERY SOFTWARE™ is the FASTEST, EASIEST & SAFEST method in data recovery anywhere! For the first time you can recover a file in less than 30 seconds even when DOS cannot read the disk or drive. RESCUE DATA RECOVERY SOFTWARE™ Version 4.0 does all the work. No more complicated time consuming steps. No more manually reconstructing your file. RESCUE DATA RECOVERY SOFTWARE™ does it all AUTOMATICALLY!

Recover Text: .Exe, Graphics files, etc... You can even recover entire sub-directories with a single key stroke. CALL NOW FOR PRICING! Some failures may be beyond RESCUE's ability to recover data.

TUNE, OPTIMIZE & TROUBLESHOOT WINDOWS for optimum speed & performance through hundreds of reports!

SKYLIGHT™ is the first true Windows troubleshooting utility written in Windows that reports information as Windows sees it! Uncover the mystery of how Microsoft Windows is using your computer’s resources.

- All memory areas are displayed with a text display and graphic map.
- Saves backup copies of the files it edits for easy restoring.
- Diagnose Windows from DOS Prompt even if Windows won’t load.
- Detailed descriptions of hardware, CMOS, and the BIOS memory area, allowing you to troubleshoot DOS and hardware problems.
- CD-ROM and USB installation is a witch in determining how Windows applications are performing and the resources they are using.
- Task information screens so users can determine which programs perform the best.
- Testing of multimedia devices’ output, including WAVE and MIDI devices.

 skaoyght™ does all the work. No more complicated time CALL NOW FOR PRICING! saving

ENCYPCOLOPEDIA OF HARD DRIVES™ — 3 volumes with over 1500 pages! The largest compiled reference on hard drives ever published!

Volume One...SET-UP GUIDE • Interface Types and Installation • Hard Drive Spacing for 201 drives from 1984 to present: Make, Model, Formatted Capacity, Data Heads, Cylinders, Average Seek Times, Form Factor, Height, Interface, Encoding, Landing Zone, Sectors Per Track, Write Precompensation Cylinder, Reduced Write Current and Mean Time Between Failure. • BIOS Drive Type Tables • Directory of Manufacturers • The Floppy Drive Cable • Power Connector • Pin Assignments and Specifications

Volume Two...DRIVE SETTINGs • Explanation of jumper Types, Changes in Make & Model and Default Jumper Settings • Diagrams for over 1000 drives with: Specifications, Drive Sizes, Interface Types, Jumper Settings and Locations, Terminal Resistor Locations, Pin Assignments, Pin 1 Locations, Cable Type and Locations

Volume Three...CONTROLLERS • Over 350 Diagrams of Controllers with: Specifications, Card Sizes, Largest Head and Cylinder Sizes, Interface Type, Detailed Jumper Settings, Pin Assignments and Cable Locations • Controller to Drive Power Connections, Drive Activity LED Connections, Common BIOS PIN Formal Codes and Default Jumper Settings.

THE HARD DISK TECHNICAL GUIDE™ — Comprehensive field version of the Encyclopedia with over 400 pages of vital special Compact to carry in the field.

EVENYTHING YOU NEED TO INSTALL, SET-UP & MAINTAIN HARD DRIVES!

DRIVE PRO™ — The all-in-one software utility for the most efficient and correct installation and maintenance of any hard drive! • Install IDE Drives in less than 60 seconds! Automatically sets CMOS, Partitions, and DOS formats without booting or user intervention. • DOS Format any size drive in under 30 seconds! • Drive Table Over-ride allows almost any BIOS to have a user definable drive type. • Drive Boot Fix is a safe alternative to how level formating bad IDE Drives. • No more DEBUG, FDISK, SETUP, or FORMAT. Plus too many other features to mention!

MAXIMIZE THE ADVANTAGE OF WINDOWS!

- PC Magazne 7/93
- Windows Watcher 8/92
- PC Computing 10/92

CALL NOW FOR PRICING!

Free Tech Support
Performance Guaranteed
Next Day Shipping

ORDER DIRECT — CALL (800) 653-4933
800-OX-FIXED

AllMicro, Inc.
1250 Rogers St. • Suite D • Clearwater, FL 34615
(813) 446-6660 • Fax (813) 446-8075

Copyright © 1993 Rescue Data Recovery Software™, The Hard Drive ™, and The Troubleshooter™ are trademarks of AllMicro, Inc. All other trademarks are the property of their respective owners. Specifications subject to change.
products, such as Information Dimensions’ docXform document database, you can do a relational database search not just on a document but in a document.

VTX is a network-level application that lets you create and publish on-line knowledge bases, called information services, of virtually any size. At the heart of VTX is a data structure called a story. A story is a structured set of information, such as a policy manual, that’s carried over the network and is of unlimited size. What distinguishes VTX from other on-line applications is its ability to manage an unlimited number of stories, users, clients, and servers.

The structure of a VTX story is built around one or more pages. The key to VTX’s extensibility is that each page can contain data of any format. In addition, you can tag pages with attributes that provide cues to external applications that process or present the data in the page. For example, an attribute tag can tell you that the page is a Lotus spreadsheet.

A story can also provide cues to such VTX routines as “set this up as a menu page” or “set this up as a query page.” A menu page is an interactive screen that lets you select specific pages from a list (e.g., “current jobs listings” or “van pools”). A query page lets you construct ad hoc queries such as “list all jobs that pay over $75,000.”

Stories can indicate whether a page is remote, meaning that the page seen locally is really a window through which you are viewing a page from a story physically located on another machine. If you select a remote story, VTX puts that story’s topmost menu page on your screen and marks it as a remote page. You can then access the remote menu’s selections as if they were extensions of your story’s address space, which, in fact, they are until you break the remote link. Except for network delays, once you select a remote story, you have the perception of reading a local story.

Employees at Hughes Aircraft in Malibu, California, log in to their VTX service more than 40,000 times each month. Hughes installed the system seven years ago to maintain and distribute data on U.S. Air Force policies and practices. Today, it has more than 200 information services that publish everything from in-house job listings to surplus equipment inventories. Client systems connected to VTX include Windows, Macs, DOS-based PCs, and VT-100 terminals. In total, Hughes has 90 VTX server processes distributed among five clustered VAX 8800s. Everything is tied together over TCP/IP and Novell IPX networks. Hughes reports that in just the first six months of its operation, the surplus equipment service alone saved the company over $400,000.

The docXform Method
DocXform for MS-DOS, SunOS, and Unix systems uses a novel data type described by its manufacturer, Information Dimensions, as a “component-level document database.” DocXform’s data type is a structure made up of 9000 sections, each of which can be 128 MB in length. You can assign a category of document content (e.g., chapters), which has been marked up using SGML tags, to a section.

Unlike BLOBs, where finding a document in a relational database is an all or nothing proposition (except for CBR), docXform lets you access individual parts...
of documents as if they were conventional database records. To mark up documents prior to loading into the database, docXform uses FastTag from Avalanche Development (Boulder, CO). FastTag scans a document, which can be a paper-based or a PostScript file, and creates a file of marked up content that docXform imports into its proprietary relational database.

"IDI makes better use of SGML structures because users can map them into a relational database," says Carl Frappaolo of Delphi Consulting in Boston. "Users can manage their document-bound information at the component level with the same speed and efficiency that they apply to managing their other information assets."

Extending Data’s Domain
Electronic publishing, multimedia, videotex, and work flow are all part of a growing list of seemingly disparate applications that enable you to communicate your data in new and different ways. Since information content, especially document content, is no longer something that is just read or achieved, it has begun to control organizational work flow in the same way that data in “just-in-time” process-control programs affect the movement of a car engine on an automobile assembly line. The difference now is that human work flows are being automated, not conveyor belts.

For example, work-flow products such as Lotus Notes route and store information. But they can also determine who does what job and when it gets done. Thus, they don’t simply remind you that, say, the vice president of your company must approve purchase orders of more than $50,000, they also route the purchase order to the vice president and keep it there until he or she acts on it.

The evolution of data types from elementary items of information to complex objects that can affect external events signifies the breakdown of the predefined limits that determined both the make up of a data type and how your information content could flow from one data type to another. Moving beyond computing that information packaging restricts means that your knowledge-based activities can use a common technology to exchange, expand on, and react to your data. Soon, the idea of building an application around a particular data type may seem arbitrary and, perhaps, even a bit primitive.

Randall D. Cronk of Boston, Massachusetts, is a freelance writer who has been researching and writing about document interchange for more than two years. You can reach him on BIX c/o "editors."

---

DATA COMPRESSION LIBRARIES™

PKWARE's® Data Compression Libraries™ allow software developers to add data compression technology to software applications. The application program controls all the input and output of data allowing data to be compressed or extracted to or from any device or area of memory.

- All Purpose Data Compression Algorithm Compresses Ascii or Binary Data Quickly with similar compression achieved by the popular PKZIP software, however the format used by the compression routine is completely generic and not specific to the PKZIP file format.
- Application Controlled I/O and memory allocation for extreme flexibility.
- Adjustable Dictionary Size allows software to be fine tuned for Maximum Size or Speed.
- Approximately 35K memory needed for Compression, 12K memory needed for Extraction.
- Compatible with most popular Languages: C, C++, Pascal, Assembly, Basic, Clipper, Etc.
- Works with any 80x86 family CPU in real or protected mode. $295.00
- No runtime royalties.

RUNNING OUT OF EXPENSIVE DISK SPACE?

PKZIP can help! PKZIP compresses your files to free up disk space and reduce modem transfer time. You can compress a single file or entire directory structures with a single command. Compressed files can be quickly returned to their normal size with PKUNZIP.

Software developers can reduce the number of diskettes needed to distribute their product by using PKZIP. Call for Distribution License information.

The included PKZIP utility lets you store compressed files as a single self-extracting .EXE files that automatically uncompressed when run. Only $47.00

PKWARE®
9025 N. Deerwood Dr.
Brown Deer, WI 53223
(414) 354-8699
Fax (414) 354-8559
BY993

Circle 134 on Inquiry Card.
There was a time when your worst technical nightmare wouldn't go away till the morning after.

Aaron Matas
Product Support Specialist
IBM Personal Systems HelpCenter®

IBM Personal Systems HelpCenter® Product Support Specialist Aaron Matas knows from personal experience that emergencies don't keep bankers' hours. That's why our HelpCenter stays staffed and ready around the clock. So if a system goes down, you won't have to wait till sometime the next day to find out if it's your hardware, software, or who knows what. After all, it's just common sense that the company who sold you the system should be there for you when you need them. Whatever your question, experts like Aaron are wide awake and ready to help you get back in business. Fast. It's all part of IBM HelpWare®.

If you've ever bought computers "direct," we want you to know one important thing.

IBM PC Direct
We're putting the personal in personal computing.

This time, it can be different.
ValuePoint SpaceSaver
- Compact size: 14.2" W x 4.8" H x 16.7" D
- 3 slots (includes 1 VESA Local Bus slot) and 3 bays
- Also available in medialess (no drives) configuration to function as an economical LAN client workstation!

ValuePoint Desktop
- Plenty of room to grow: 5 slots (includes 1 VESA Local Bus slot), 5 bays
- A super combination of speed, power, upgradability and expandability!

ValuePoint Mini-Tower
- Convenient, compact Mini-Tower processor case measures 9.5" W x 16.8" H x 16.9" D
- Enormous room for growth: 8 slots (includes 1 VESA Local Bus slot), 6 bays
- Perfect format for high powered computing (CAD/CAM, graphics, multimedia, etc) or as a low-cost network server!

IBM PC Direct
We're putting the personal in personal computing.
If you don't see it here, call us. We'll custom build a system just for you.

It's a personal commitment from Alice, Gregg, Jeff, Beverly and their associates at the IBM Personal Computer Company. Thousands of IBM people — many working around the clock — to keep you personally delighted with everything we do for you.

It starts — but doesn't end with — our hot-selling IBM ValuePoint™ PCs. Take a closer look at the systems shown here. Super PCs. Super prices. But if you don't see the system you want, call us. We'll build your PCs to your specifications — and your budget.

Remember, ValuePoint is backed by IBM HelpWare, including our 30-day money-back guarantee. No quails. No quibbles. No questions asked. And for 1 year with free around-the-clock telephone assistance and fast onsite service (even in the most remote locations!) from more than 10,000 IBM service representatives in over 1600 locations nationwide.

Call us today. And discover how we're putting the personal in personal computing.

All ValuePoint systems feature:
- 101-key IBM Enhanced Keyboard and IBM Mouse
- Intel® i486™ processors
- SVGA VESA Local Bus Video
- A 32-bit VESA Local Bus slot for local bus speed on SCSI drives and other peripherals!
- IBM HelpWare
- Upgradability via Intel OverDrive™ technology all the way up to Pentium™
- Zero Insertion Force (ZIF) socket for fast, easy processor upgrades.

ValuePoint SpaceSaver
- Processor: i486SX/25 MHz
- Hard Drive/Memory: 120MB/4MB
- Display: 6312 14" SVGA NI
- Operating System: IBM DOS & WINDOWS
- Price*: $1,579 / $57 per month

ValuePoint Desktop
- Processor: i486SX/25 MHz
- Hard Drive/Memory: 120MB/4MB
- Display: 6312 14" SVGA NI
- Operating System: IBM DOS & WINDOWS
- Price*: $1,659 / $60 per month

ValuePoint Mini-Tower
- Processor: i486DX/33 MHz
- Hard Drive/Memory: 340MB/4MB
- Display: 6318 14" SVGA NI
- Operating System: IBM DOS & WINDOWS
- Price*: $2,579 / $93 per month

ValuePoint ValuePoint SpaceSaver
- Processor: i486SX/33 MHz
- Hard Drive/Memory: 120MB/4MB
- Display: 6312 14" SVGA NI
- Operating System: IBM DOS & WINDOWS
- Price*: $1,779 / $64 per month

ValuePoint Desktop
- Processor: i486DX/33 MHz
- Hard Drive/Memory: 120MB/4MB
- Display: 6312 14" SVGA NI
- Operating System: IBM DOS & WINDOWS
- Price*: $2,029 / $75 per month

ValuePoint Mini-Tower
- Processor: i486DX/33 MHz
- Hard Drive/Memory: 340MB/4MB
- Display: 6318 14" SVGA NI
- Operating System: IBM DOS & WINDOWS
- Price*: $3,499 / $126 per month

ValuePoint ValuePoint SpaceSaver
- Processor: i486DX/33 MHz
- Hard Drive/Memory: 120MB/4MB
- Display: 6312 14" SVGA NI
- Operating System: IBM DOS & WINDOWS
- Price*: $2,029 / $75 per month

ValuePoint Desktop
- Processor: i486DX/33 MHz
- Hard Drive/Memory: 120MB/4MB
- Display: 6312 14" SVGA NI
- Operating System: IBM DOS & WINDOWS
- Price*: $2,029 / $75 per month

ValuePoint Mini-Tower
- Processor: i486DX/33 MHz
- Hard Drive/Memory: 340MB/4MB
- Display: 6318 14" SVGA NI
- Operating System: IBM DOS & WINDOWS
- Price*: $3,499 / $126 per month

Call 1 800 IBM-2YOU
refer to: FAZ
1 800 426-2969,
8am-midnight M-F, EDT; 8am-7pm Sat., EDT.
Purchase order is available for qualifying customers.
This time you can have it all.

Save space inside your multimedia PC!
The Mwave™ WindSurfer™ Communication Adapter is a V.32 Data Modem, 9600bps Fax/Modem and CD-quality sound system. Mwave MIDI synthesizer with instruments and MIDI port...all in one! Mwave WindSurfer Communication Adapter (9214057). $319

Eliminate LAN processing bottlenecks!
The IBM LAN Streamer MC 32 Adapter can help you increase your network's capacity and set new standards for speed and performance. No new hardware or costly facility rewire. Stavvos frames directly between system memory and Token-Ring without storing them directly in adapter. LAN Streamer MC 32 Adapter (9218067). $859

Give your PC gigantic storage capacity!
This 3.5" ReWritable Optical Drive lets you put all your large project files on one 127MB optical disk. You can store this disk in your desk, and free up precious hard drive space! Upgrade - data when you want, use the disk over and over. IBM Enhanced 3.5" ReWritable Optical Drive (6451085). $1,499. SCSI External Enclosure (535000V). $299

The easy, affordable way to go to a speedy CD-ROM.
The ISA Internal CD-ROM has a fast 300KB/sec maximum data transfer rate - double the speed of most CD-ROM drives! You can load your operating system and applications software from a typical 600MB CD-ROM disk. You save precious hard drive space and load onto your ISA system faster. It's priced to move fast too! IBM ISA Internal CD-ROM Drive (3262926). $319

Upgrade to 256KB L2 Write Back Cache Memory.
Here's a super way to boost system performance without buying a new system. This 256KB L2 Write Back Cache Memory Kit gives you an easy, standardized growth path for your ValuePoint systems. 256KB L2 Cache Write Back Memory Kit (60G1625). $299. Cache Memory Kit 256KB (60G1625). $229. Cache Memory Kit 128KB (60G1624). $119. IBM Video Memory Upgrade Kit (60G1623). $89

Super Prices on popular software!
IBM PC Direct has the popular software you want, at prices you'll love. Remember, if you don't see it here, or in our catalog, call us. Chances are we can get it for you fast!


FREE!
The IBM PC Direct Source Book: ValuePoint, ThinkPad, peripherals, add-ons, popular software...it's all here and it's all yours for the asking. Call 1 800 IBM-2YOU today!

It's as simple as calling Angela Hardy, or any one of our other PC consultants. ValuePoint PCs, ThinkPad notebooks, peripherals, printers, displays, add-ons, the most popular software and more (IBM and non-IBM) are all yours - at prices you'll find personally pleasing - when you call 1 800 IBM-2YOU. You'll speak to a PC consultant who'll either answer any question you have, or get you in touch fast with an expert who can. If you don't see it here, it's in our free catalog. And if it's not in the catalog, we can probably get it for you anyway. Either way...call!

Call 1 800 IBM-2YOU
refer to: FAZ
1 800 426-2YOU
8am-12 midnight M-F, EDT;
8am-7pm Sat., EDT.
Purchase order is available for qualifying customers.
Digital documentation helps you find answers fast. But if you’re considering publishing your own, prepare for a bewildering array of tools, interfaces, and data models.

PHILIP C. MURRAY

Electronic reference documents, or ERDs, serve the same purpose as hard-copy reference documents. Also known by such names as softcopy, enhanced documents, and hypertext, ERDs let you use computer power to locate answers to your problems quickly. While they can contain graphics, sound, and video, ERDs differ from most multimedia documents in that their primary role is to give you fast access to data so that you can solve a problem efficiently. Most multimedia documents, on the other hand, are designed to assist with learning and mastery or to entertain.

ERDs offer a variety of features that are beyond the ability of hard copy. For example, some let you browse through a table of contents in one window while a synchronized companion window presents the text of the section under your cursor. Others offer graphical access tools to help you locate information. With careful analysis, you can tailor an ERD to the specific needs of your intended audience.

But ERDs are not a mature technology. For example, consistent end-user features and interfaces have not appeared. And ERD production practices and techniques still need standardization. Real growth in ERD use will occur only when improved authoring tools, clear data models, and product standards emerge.

Signs of Acceptance

Digital delivery of reference information is growing increasingly popular. For example, Shared Medical Systems (Malvern, PA), a health-care information-systems provider, produces electronic documentation for most of its IBM-based software, and the U.S. Department of Defense has mandated electronic delivery of maintenance manuals for new weapons systems.

Producing more than 30 million printed pages per year of supporting documentation, SMS is a large-scale commercial
information provider. Fred Drake, software product communications manager for SMS, is helping to transform the company's information delivery from paper to CD-ROM. SMS uses IBM's BookManager ERD publishing system for creating and delivering ERDs. BookManager's Build component serves as the engine that creates electronic documents that can be used with BookManager's Read software on five different operating systems commonly used in IBM environments, including MVS, OS/2, and DOS. BookManager's full-text search and hypertext linking features make it especially useful for organizations such as SMS that have applications requiring large reference documents.

Drake cites two reasons for SMS's switch to electronic document delivery: ease of updating and speed of information access. SMS's products change rapidly. Electronic documentation obviates the need for errata sheets, new typesetting and print runs, and the like. SMS applications are accompanied by comprehensive technical manuals; some applications have 10 or 12 400-page handbooks. This volume of information makes it difficult to find answers in the paper manuals, no matter how well-designed and written they may be. CD-ROMs unlock the barriers to better access and use up less shelf space.

Drake lists cost of delivery as last among the major reasons for SMS's transition to ERDs, but only because the company is phasing in documentation on CD-ROMs. Drake expects to also realize savings in publishing costs as ERDs become the company's primary method of documentation delivery. SMS is also evaluating BookManager's DOS. BookManager's Build component serves well-designed and written documents that can be used with BookManager's Read software on five different operating systems commonly used in IBM environments, including MVS, OS/2, and DOS. BookManager's full-text search and hypertext linking features make it especially useful for organizations such as SMS that have applications requiring large reference documents.

Windows Help: Like a Book

The flood of applications available for Microsoft Windows is blurring the distinction between on-line help and electronic reference documents. While on-line help for character-based applications is often marked by extreme brevity and carefully crafted, fixed-size screens, on-line help for GUI-based applications is often structured and formatted more like a book.

The on-line help for Lotus's Freelance Graphics for Windows, for example, has help documents with relatively long topics and built-in browsing paths that maintain access to the linear organization of the document. The versatile formatting options of Windows Help and its ability to display text in a variety of fonts and sizes are the agents of this gradual transformation.

On-line documents for Windows Help can be prepared with any method that creates code compliant with Microsoft's RTF (Rich Text Format), an ASCII-based coding system that can be used to describe the appearance of word processor and desktop publishing documents. However, a spate of new applications dedicated to this purpose, including Blue Sky Software's (La Jolla, CA) RoboHelp and Softronics' (Colorado Springs, CO) Universal Help, simplify not only the coding but also the complexities of designing and maintaining hypertext links, including tracking the identity of target nodes for hypertext links, generating tables of contents, and recording browsing paths.

Such tools are indicative of the growing level of interest in using the Windows Help viewer. In addition, commercial usage of the Windows Help viewer is growing. For example, DEC is using the viewer as a mechanism for its on-line support manuals. The viewer has even been used for such applications as the FAQ (frequently asked questions) file for the Internet's alt.hypertext newsgroup.

The Windows Help viewer does not have all the features needed for many forms of ERD publishing. For example, the current version lacks full-text search capabilities, making it inappropriate for many long documents. However, the lack of run-time fees and its ready availability make it attractive to potential publishers.

Will the Windows Help viewer push innovative solutions from other vendors out of the market? It's still too early to say. However, the increasing sophistication of comprehensive on-line help for Windows and other GUI applications, coupled with an insistence on user-friendly interfaces, is producing a generation of computer users who often prefer on-line help to bulky printed manuals. The growing level of comfort with this particular form of electronic document may help win broad acceptance for ERDs in desktop publishing applications.
as a way to tie the documentation closely to its applications so that end users can have context-sensitive, on-line help instead of separate on-line reference manuals. The key requirement is adding code to the applications software that maps program states or contexts to specific points in the help system. This is the type of coding that lets you press, say, your F1 key to get help about the current drop-down menu in a Windows application.

However, help systems typically are compiled for a specific operating system, which poses thorny development and maintenance problems for multiproduct applications such as those from SMS. But if programs can invoke direct calls to spe-

cific sections of a BookManager document, then multiproduct ERD development and maintenance problems can be solved, because the same BookManager documents can be read with BookManager Read software on five different operating systems in the IBM product line.

SMS is not an isolated case. For example, the U.S. Postal Service supplies its employees with copies of the Domestic Mail Manual, the bible of U.S. postal clerks, in Window Book's (Cambridge, MA) format. And Folio's (Provo, UT) Folio Views is in use by more than 80 commercial publishers.

Obstacles to Acceptance

Many obstacles block broader acceptance of ERDs at the desktop level. For example, there are some 200 ERD authoring and publishing products. By contrast, a few well-known systems serve as yardsticks for desktop publishing software, making it easier to narrow and identify requirements when choosing such software.

Narrowing your choice of ERD systems to two or three can require substantial research. Requirements for multiproduct delivery and displaying complex material (e.g., display equations) may limit your choice of systems. Among the other considerations you have to weigh are the types of graphics and external program links you need to support, the types of search features that you can use, and the acceptability of the user interface.

For example, if you want to produce long reference documents but you don’t want to hand-craft thousands of hypertext links, you’ll want a product that supports full-text search. KnowledgeSet's (Mountain View, CA) Knowledge Retrieval System and Flambeaux Software's (Glendale, CA) xText would be appropriate for such an application.

To deliver documents digitally, you must first identify the principles behind ERD creation and choose the particular strategy that meets your objectives and then choose the best tool for the job. Most important, however, is to begin the process by carefully analyzing the needs and use patterns of those for whom your are creating your ERD.

For all but the smallest projects, extensive prototyping is a worthwhile investment. After you identify your objectives, you should create a sample ERD and test it on end users in the environment in which it will be used. Remember, ERDs are for finding information as rapidly as possible. You, not the ERD authoring software, might have introduced a problem by, say, using too few hypertext links. In addition, in any testing that compares the performance of printed documents to on-line documents, you should attempt to account for skewing factors. For example, people often perceive any change of routine as an improvement.

continued
Anatomy of an Electronic Document

Ntergaid's HyperWriter ERD authoring system converts documents that already exist in digital form into electronic documents complete with $\Theta$ tables of contents, $\Theta$ back-of-the-book indexes, $\Theta$ chapter outlines, and $\Theta$ maps of hypertext links. HyperWriter runs on DOS- and Windows-based computers. A Mac version is in development. (Screens courtesy of Ntergaid)

1. When coupled with its optional AutoLinker module, HyperWriter can construct a table of contents for your ERD automatically.

2. A HyperWriter back-of-the-book index. You can click on an entry in the index to go right to the specific information you need.

3. Pop-up outline windows created automatically by AutoLinker can show the hierarchical blueprint of a chapter.

4. A HyperWriter screen-mapping command window in HyperWriter lets you see the web of hypertext connections in a chapter without displaying the entire text of the cross-references. You can click on any hypertext link to view the full text.

Finding and Using Data

Keeping what's good about printed books in your ERD seems like a logical thing to do, but sometimes the wrong things are kept and the right things are discarded. Ironically, chief among the often-discarded features is the most frequently used method of information access in books: the back-of-the-book, or "conceptual," index.

Full-text searching is not an adequate replacement for indexes in electronic documents, as studies of the effectiveness of searching have shown. For example, writing in the December 1992 issue of Communications of the ACM, Peter W. Foltz and Susan T. Dumais report that keyword matching often fails because of the natural ambiguity of the English language. For example, a single word such as chip can have more than one meaning. Conversely, many different words can describe a single concept (e.g., human factors and ergonomics).

In an ERD that supports hypertext links, a conceptual index can provide direct access to all significant ideas in the document from any point in the document, not just the names of things that can be found easily by search features. In addition to familiar conventions that help you find information easily, such as directing you from synonyms to primary listings, good indexes include parent-child and "see also" entries that show relationships among the ideas.

The manner in which conceptual indexes point to information and describe relationships brings up other questions about how hypertext links should be used. For example, are one-to-many hypertext links essential? Is it essential to have one style of indicators for hypertext links that the reader to more detail and a different style for links that take the reader to closely related information?

Information Navigation's (Durham, NC) Train of Thought supports most features of
BEFORE SURE!MAPS, THIS WAS THE ONLY WAY TO ACHIEVE PIN-POINT ACCURACY.

Now there's a better way: Sure!MAPSTM CD-ROM based desktop mapping software from Horizons Technology. No more colored stick pins. No more holes in your office wall. Sure!MAPS brings detailed mapping capabilities directly to your DOS or Windows PC. Import your database into Sure!MAPS to reveal geographic trends that will help you make faster and better business decisions. Whether it's real estate listings, office locations, customer sites or virtually any kind of point-specific data, Sure!MAPS can open your eyes to a world of valuable insights.

The Sure!MAPS base product includes a continental U.S. map and two world maps. You can expand your map coverage by ordering full-color raster USGS Map Sets of major metropolitan areas, complete with terrain contours and details like airports, parks, rivers, buildings and bridges. Street-level maps and satellite imagery are available, too. All you have to do is pick the Map Set that contains your city or region and Sure!MAPS does the rest. It even imports spreadsheet and database files, calculates distance and area, and scrolls from map to map in one seamless presentation.

Pin-point mapping will never be the same after Sure!MAPS. So throw away those little pins and call 1-800-828-3808. Or plot a course to your local distributor, reseller or computer store to get your copy today.

Horizons Technology, Inc.
5990 Ruffin Rd.
San Diego, CA 92123-1826
(800) 828-3808

Sure!MAPS is a trademark of Horizons Technology, Inc. Street-level maps are copyrighted by Etak, Inc.

Circle 296 on Inquiry Card (RESELLERS: 297).
conceptual indexes, but few other ERD authoring systems directly support the construction of conceptual indexes at the present time. But you can find ways to construct them. For example, Ntergaid’s (Fairfield, CT) AutoLinker software can trap embedded indexing codes for print applications and convert them into indexes for ERDs produced by its HyperWriter ERD authoring system.

Limitations of the Page
While Thaumaturgy Software’s (Redmond, WA) Eddars PostScript file-viewing system and Adobe’s (Mountain View, CA) Acrobat technology promise to display complex pages on virtually any platform, the slavish adherence to a printed document model stays the course laid out by Gutenberg. It limits the implementation of new ways of providing access to data and transferring knowledge. In spite of their comforting familiarity, physical pages actually impede access to information in some cases. For example, pages often contain illustrations at locations that are far removed from their in-text references, and breaks in information can occur at awkward points. Pages also provide only a single view of the information, and they aren’t easily resizable.

Yet to be defined are techniques for making documents more capable of responding to the needs of end users with substantial variations in skills, levels of understanding, and interests. However, some software that is now available hints at some of the many possible methods of making documents more adaptive. For example, Knowledge Garden’s (Setauket, NY) KnowledgePro has expert-system features that allow end users to profile their own needs interactively.

Managing Document Development
Document production is only a small part of the overall process of generating digital documents. While the time that must be spent researching, writing, reviewing, and revising the content of long printed documents constitutes as much as 80 percent or 90 percent of the process, the time that’s spent formatting them for delivery constitutes perhaps only 10 percent to 20 percent. Given the speed with which you can revise electronic documents, the purely mechanical tasks of building and formatting ERDs will become an even smaller component of the overall development process.

Valuable information often outlives the tools used to create and process it, making it important to store data in a format that accommodates technological change and multiple delivery modes. Document tagging and encoding standards are intended in part to address this need (see “Unlocking Data’s Content” on page 111). You can use documentation management systems, text-retrieval systems, and even customized relational database management applications to reduce your management effort. Unfortunately, outline processors, word processors, and other applications do not produce neutral data that’s acceptable to all ERD publishing systems. Transferring textual content is generally not a problem, but important information about content architecture, as well as basic formatting, usually is lost in the translation. A universal, platform- and time-independent storage and interchange model for notes and ideas—not just documents—does not yet exist. In fact, such a standard may never exist because lack of transferability is not generally recognized as a problem.

The focus on documents as discrete, rigid, highly structured entities is another inheritance from print models that has outlived its usefulness. Adding a web of hard-wired hypertext links, which is comparable to adding extra crosspieces in a steel bridge, makes electronic documents more rigid and harder to change than printed documents. For example, what happens when you remove text that is a target of a

New Ways to Find Data

ERDs cannot match the feel of a book or the sense of context provided by browsing through pages and looking at illustrations or subheadings. But hard copy cannot match the new ways of finding data that ERDs give you.

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>WHAT IT DOES FOR YOU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computed hypertext</td>
<td>A full-text search specified by pointing at or marking one or more words in text, as opposed to authored or hard-wired hypertext links embedded in text or graphics.</td>
</tr>
<tr>
<td>links</td>
<td></td>
</tr>
<tr>
<td>Full-text searching</td>
<td>Using a full-text search, you can scan the entire length of a document for every instance of a word or phrase.</td>
</tr>
<tr>
<td>Graphical browsing</td>
<td>Available in some hypertext applications, graphical browsing tools display the logical connections between units of information by using connecting lines or other visual cues to turn relationships of meaning into easy-to-understand art.</td>
</tr>
</tbody>
</table>
| Hypertext links        | Hypertext links embedd
|                        | in text give you live cross-references. This lets you hop directly from a word or a phrase to closely related information or to greater details in another part of the document. |
| Keyword searching      | Keywords, added by a document’s author and accessible through specialized search facilities, help you pinpoint ideas and data that might be missed by a full-text search. |
| Live tables of contents| Often coupled with an outline-style expansion capability, a live table of contents helps you move quickly from general topics to details and back again. |
Acma 486 Multimedia Computer
The Complete Business/Education Solution.

The Acma 486 Multimedia Computer is ideal for home and school applications such as multimedia games, encyclopedias and financial managers. A recent winner of a PC World Best Buy, this system includes a copy of three of your favorite audio CDs, four CD software packages and two stereo speakers. This system features an Intel 486 microprocessor, 250MB hard drive, and a 14" SVGA monitor. Open a whole new world of sight, sound and information.

Order Yours Today
Acma 486SX/33... ...$1895
Acma 486/33... ...$1995
Acma 486DX2/66... ...$2195

• Seven Compact Discs
• One Year On-site Service
• 45 Day Money Back Guarantee
Call for Details

COMPUTERS, INC.
47988 Fremont Blvd., Fremont, CA 94538
(510) 623-1212 FAX (510) 623-0818
800-786-6888 Ext. 097

Circle 302 on Inquiry Card.
Finding Text Fast

Binary-tree indexes store words by splitting them alphabetically. A search of a binary-tree index begins looking at the first letter of the first word in the index—in this case, H. It then uses a process of elimination to hone in on its target.

PETER WAYNER

The purpose of a search engine in any indexing system is simple: to find every item that matches your query, no matter where it is located in your file system. The trick for the software designer is to create a search engine that carries out this job quickly and accurately while taking up as little disk space as possible.

To accomplish accuracy and conserve disk space, some text-indexing software uses file-level information to structure words stored in your index. This means that each indexed word is complemented by a list itemizing all the files in which that word appears at least once. A file-level index does not carry any additional information about the location of words within files. Such an index uses disk space economically, usually taking up about 10 percent of the size of the main text that it indexes.

More sophisticated indexing software uses word-level information about the location of every instance of a word. Word-level indexes let you search for complete phrases or words that are in close proximity. ZyIndex from ZyLab (Buffalo Grove, IL) is an example of a word-level index program.

Operationally, there is a vast difference between file- and word-level index searches of a document database. For instance, say you entered a query on President Clinton into a file-level index. Such an index might return the sentence “in 1805, George Clinton was the U.S. vice president.” A word-level index, on the other hand, contains the location of each word in your file system, so it avoids such mistakes by ensuring that President and Clinton are adjacent.

The problem with word-level indexing schemes is that all the extra information they contain gobble up a lot of disk space—anywhere between 35 percent and 100 percent of the size of the original text. They also can be slower than file-level indexes because they have more information to search through.

Faster Searches

Indexes are really just lists of lists. Lists are a sensible way to store information in alphabetical order. But they are slow for text-indexing purposes, because the average search has to go through about half of your word list before finding the word you want. Enhancements, such as binary-tree index structures, can make list searches faster, especially on rapid-access media such as RAM disks.

Binary-tree structures work by splitting your indexed words alphabetically so that words beginning, say, with the
letters A through L are on the left-hand side of the tree while those beginning with M through Z are on the right. If the tree is well balanced, the search time is proportional to the logarithm of the total number of words in the tree—that is, the number of bits in the binary expansion of the total number. When the trees are unbalanced, however, they begin to act like lists, which, in turn, slows down search-response times.

The problem with binary-tree structures is that each word in the index needs to have pointers to find words on its left and right. A list, on the other hand, has to store directions only to the next word—50 percent less overhead. More important, binary-tree structures often store the left and right branches in separate segments of a disk file. This fragmentation slows searches when the data is stored on a slow-access medium such as a CD-ROM. A list, however, can be stored in a linear fashion without pointers, lessening disk-space consumption and increasing speed. Additionally, the next element in a list is almost always in the same disk block as the current element. When these practical considerations are taken into account, lists will often perform substantially faster than a binary-tree structure.

Depending on the medium holding your index, the space you save by storing only the directions to the next word is not always worth the increased speed. CD-ROM searches, for example, are slower than hard disk searches anyway, because a laser takes more time to align with its data track than the head of a hard drive takes to align with its data track. Consequently, your CPU might be able to run through a list of 1000 words in the time it takes to load the data pointed to by the binary tree.

Converting Words

Hashing functions, such as those used in On Technology’s (Cambridge, MA) On Location, produce the smallest indexes. Unfortunately, they are also the most error-prone indexing approach.

Hashing functions work by converting words into short integers. For example, a function might convert each letter of a word into numerical equivalents and add these values together: A would be equal to 1, B would equal 2, and so on, with Z equaling 26. Thus, the numerical equivalent of the name Abby would hash to 30, because $1+2+2+5+3=30$, and the number 30 would become a surrogate for the four-letter word, taking up less storage.

However, hashing functions can fail when two words have the same hashed value. For example, such functions do not discriminate between anagrams like Elvis ($5+12+22+9+19=67$) and lives ($12+9+22+5+19=67$), because both have the same numeric value. While this confusion can be significantly minimized with hashing functions that are statistically tuned to the structure of English, it is never completely eliminated.

Text-indexing systems such as the public domain WAIS (Wide-Area Information Server) system on the Internet give you the ability to input long phrases for partial, fuzzy matching. With WAIS, you can search for words and rank the matches according to a complex formula of the number of matches and their proximity to each other. These fuzzy-logic solutions can also use, say, the contents of a magazine article as the basis of a query to find other articles in the database with similar contents.

Consequently, you can find documents even if they don’t contain the keyword for which you are searching. If you do a fuzzy search on a 100-word phrase, your search can take a great deal of time. Searches of this nature can be prohibitive on some CD-ROM databases, but they are reasonable on databases that are maintained on fast hard drives.

The process of indexing data is a simple problem in theory. While software engineers go through many different iterations to determine the best way to create the smallest, fastest indexes, your best bet is to evaluate indexing software based on the type of storage medium you intend to use and the amount of disk space you can allocate to indexing your data.

Peter Wayner, a BYTE consulting editor, has written several text-indexing systems. You can contact him on BIX e/o "editors" or on the Internet at pcv@access.digex.com or at wayner@bix.com.

Peter Wayner, a BYTE consulting editor, has written several text-indexing systems. You can contact him on BIX e/o "editors" or on the Internet at pcv@access.digex.com or at wayner@bix.com.

Philip C. Murray, president of Knowledge Management Associates (Virginia Beach, VA), is an ERD consultant. He is the author of From Ventu­ra to Hypertext (Knowledge Management Associates, 1991) and the editor of ACM SIGLINK’s hyper/text/hypermedia newsletter. You can contact him on BIX e/o "editors" or on the Internet at p00327@psilink.com.

hypertext link? The process of finding and fixing a few resulting dangling links may not be any problem, but repairing hundreds of such connections can become a nightmare.

Systems such as Information Dimensions’ (Dublin, OH) BasisPlus document management system can help large publishing environments overcome some of these problems. For example, BasisPlus stores building blocks of information in a relational database and provides features that allow publishers to build documents, including ERDs with hypertext links, from these building blocks.

You may not be able to afford an off-the-shelf solution, which can cost tens of thousands of dollars, but adopting a clear strategy for treating information as building blocks will help. Implementing a formal scheme for classifying those building blocks according to their meaning—a form of conceptual indexing—can help you replace the ad hoc generation of hypertext links that might prove costly whenever changes are made or new documents are created.

What’s Needed

At one time, desktop publishing systems were better suited for producing newsletters than they were for producing long documents, because they lacked long-document-handling features. What made the difference with desktop publishing? Vastly improved software, such as PageMaker, QuarkXPress, and Ventura Publisher, helped. But the growing base of experience with the principles of good design and understanding of efficient methods of production helped more.

ERDs have not yet reached that stage of development, because the development and use of electronic documents of all kinds are still in their earliest phase. ERDs are a new delivery mechanism. Consequently, a knowledge base from which you can learn about past mistakes and successes has not yet been assembled. ERD technology awaits the kind of focus and standardization that experience brings to technology. ■

September 1993 BYTE 129
The BYTE Lab tests five C++ compilers to find out if C++ really simplifies Windows development

RICK GREHAN

The ultimate benefit of an object-oriented language like C++ depends on how well it can be made to simulate the system in which you're working. Windows is an event-driven system whose respiration is the flow of messages triggered by devices and windows and sent to menus, scroll bars, and suchlike. An object is just a useless lump of code and data until it's wired into that flow. Windows, which is a world of objects and events where procedural development requires back-breaking work, appears to be a perfect target for the object-oriented wonderland that C++ promises.

In this review, I'll cover the latest crop of C++ compilers for Intel's 80x86 series of processors (including the Pentium) and the Windows 3.x operating environment. This harvest includes Microsoft's Visual C/C++ 1.0, Borland C++ 3.1, Symantec C/C++ 6.0, MetaWare's High C/C++ 3.1, and Watcom C/C++32. Each simplifies Windows to some degree, but they mostly fall into two camps: The Microsoft, Borland, and Symantec compilers come with a rich set of tools aimed at easing the burden of Windows programming, while the compilers from MetaWare and Watcom focus more on speed than on comfort.

**Microsoft's Visual C/C++ 1.0**

Microsoft's Visual C/C++ 1.0 will probably be your first stop in the search for a development system. After all, this is the company that makes Windows, and you might reasonably assume that the Microsoft compiler would be the most tightly woven into the Windows environment.

As far as the set of development tools goes, that's truly the case. Visual C/C++'s IDE (Integrated Development Environment), Visual Workbench, is a concert of development tools that includes AppWizard, AppStudio, and ClassWizard. AppWizard is the jump-starter in program

**Borland C++ 3.1's Windows-based IDE provides an excellent development environment with good tools. Application Frameworks class libraries are Borland C++'s greatest strengths. In this screen, Borland's ObjectBrowser provides a graphical view of class hierarchies within an application.**

**MetaWare's High C/C++ is built for speed more than comfort. MetaWare's extended-DOS debugger allows access to 32-bit flat-model executable files running under Phar Lap's DOS extender. Multiple windows allow views of C++ source code, the equivalent assembly language, and processor and coprocessor registers.**

**Symantec C/C++ 6.0 is a strong newcomer to the Windows development field. Its IDE is built around a workspace paradigm and incorporates tear-off tool palettes. Here, the current workspace is "Editing," but the "Debugging" workspace is instantly available by clicking the folder tab near the topmost menu bar.**

**Watcom C/C++32 supports a wide variety of platforms. Although Watcom C/C++32 has no Windows-hosted IDE, the package comes with Windows-based tools, Dr. Watcom is a crash-analysis tool, Watcom Spy lets you examine messages headed for a selected window, and the Heap Walker permits exploration of an application's local or Windows' global heap.**
MFC follows this link up the chain to the parent class and searches the parent's message map. This process continues until MFC either encounters a map entry corresponding to a handler function that can deal with the message or "pops out the top" of the class hierarchy. In the latter case, the message is passed to the default message-handler procedure.

AppStudio and ClassWizard together form a simple environment for quickly building complex applications, and MFC 2.0 makes a solid foundation for professional-level applications. One significant addition to Visual C/C++ is a Windows-hosted debugger. (Visual C/C++ also includes CodeView.

At $495, the Visual C/C++ Professional Edition falls somewhere in the middle of the price range. Counting all the supporting tools—there are so many it's sometimes hard to find the compiler among all the icons—the price is quite good. Programmers interested in a less expensive route into Windows programming might want to look at the Standard Edition, a $195 product that lacks CodeView, a profiler, and DOS target compilation.

Borland C++ 3.1

Borland C++ 3.1 comes with two IDEs: one for DOS and one for Windows. The DOS-based IDE can generate Windows and DOS applications; the IDE for Windows produces either Windows executable files or DLLs. Both of these IDEs allow rapid development of application projects; you add files to a project by selecting them from file lists, and the IDE handles the chore of chasing down dependencies for you. You can convert a project into a make file.

Although Borland's C++ environment doesn't include an equivalent to Microsoft's AppWizard and ClassWizard, it comes with plenty of Windows tools, including Borland's Resource Workshop, help compiler, and resource compiler. Borland C++ also has a free copy of ProtoView Development's ProtoGen, a reasonably useful code generator that lets you rapidly build menus and link their components to dialog boxes. ProtoGen will crank out the corresponding user-interface code for you.

Borland C++ includes class libraries for both DOS and Windows: TurboVision and Object Windows Library. TurboVision can build DOS applications under a character-based windowing system, while OWL targets the Windows environment. Unfortunately—and this is a major gap—the two class libraries are completely incompatible.

Although the ultimate goals of OWL and MFC are quite similar, OWL builds a thicker layer between the programmer and the Windows API than does MFC. By thicker, I don't mean less efficient—in fact, OWL does a better job of abstracting Windows objects than MFC does. You can generally construct OWL programs in less source code than MFC equivalents. OWL achieves this goal thanks to Borland's modifying its compiler to accept new (and nonstandard) syntax that expresses the connection between a function within an object and the Windows message to which that function responds in a single line of code. MFC, on the other hand, requires two or three lines to express the same connection.

This nonstandard syntax gives OWL another advantage over MFC, in that the documented coupling of message ID to function is recorded in one place. MFC forces you to declare message-handling functions in one place and associations elsewhere.

Internally, OWL operates much like MFC: The compiler builds tables in the executable file that link the message ID to a function address. Because OWL is built into Borland's C++, it has access to the language's internal pointers that link derived classes to parent classes and thus doesn't need MFC's additional links further up in the class hierarchy. Dispatching Windows messages is potentially faster under OWL than under MFC, because OWL uses optimized assembly language for table searching, while MFC must search using C++ code.

However, Borland may be willing to sacrifice OWL's conciseness for portability's sake. The upcoming OWL 2.0 abandons the language extensions of OWL 1.0 and takes a strict C++ approach, with the addition of (among other things) support for templates and true C++ exception handling.

OWL is an outstanding class library. In a direct comparison of Borland C++ 3.1 to Microsoft's Visual C/C++, however, Borland C++ suffers primarily from its lack of an equivalent to ClassWizard. Additionally, at $749, the price is somewhat steep. But where Borland has equivalent tools, they are excellent. The real strengths of Borland C++ are OWL, an excellent IDE, and accompanying DOS and Windows development tools that make for a kingly development system.
C++ COMPILERS COMPARED

Naturally, compilers vary in the types of tools they supply. However, these packages also vary in the nature of the code they produce. Executable files built by High C/C++ 3.1 and Watcom C/C++32 include pure 32-bit code: Consequently, the DOS executable files run under DOS extenders, and the Windows 3.x executable files must be bound with a supervisor that translates from the 32-bit code to the 16-bit API of Windows. (Symantec C/C++ 6.0 can also produce 32-bit code running under a DOS extender.) Borland C++ 3.1 and Visual C/C++ can create DOS executable files that exceed the 640-KB boundary via an overlay mechanism. Finally, Microsoft's compiler optionally emits p-code that can optimize space savings. (o = yes, o = no; N/A = not applicable.)

<table>
<thead>
<tr>
<th>Host platforms</th>
<th>MICROSOFT</th>
<th>BORLAND</th>
<th>WATCOM</th>
<th>METAWARE</th>
<th>SYMANTEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows 3.1</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>DOS</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>OS/2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target platforms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Windows 3.1</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>DOS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extended DOS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OS/2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>Overlaid DOS, p-code</td>
<td>Overlaid DOS, p-code</td>
<td>.NLM, .Pen, Windows, NT</td>
<td>N/A</td>
<td>Win32s, NT</td>
</tr>
<tr>
<td>Processor support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8086</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>386/486</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pentium*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cront 3.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANSI C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unix C (K&amp;R)</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Included tools</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assembler</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Symbolic debugger</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Remote debugging</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Profiler</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Run-time source</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Class library source</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Precompiled headers</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Class browser</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Memory*</td>
<td>6 MB</td>
<td>2 MB</td>
<td>4 MB</td>
<td>2.5 MB</td>
<td>8 MB</td>
</tr>
<tr>
<td>Disk space*</td>
<td>52 MB</td>
<td>45 MB</td>
<td>25 MB</td>
<td>15 MB</td>
<td>50 MB</td>
</tr>
<tr>
<td>IDEs</td>
<td>Windows</td>
<td>Windows, DOS</td>
<td>N/A</td>
<td>N/A</td>
<td>Windows</td>
</tr>
<tr>
<td>Debugger environments</td>
<td>Windows, DOS</td>
<td>Windows, DOS</td>
<td>DOS</td>
<td>Windows, Extended DOS</td>
<td>Windows, DOS</td>
</tr>
<tr>
<td>Windows specific</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class libraries</td>
<td>MFC</td>
<td>OWL</td>
<td>None</td>
<td>None</td>
<td>MFC</td>
</tr>
<tr>
<td>Utilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heap walker</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Message spy</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Crash analysis</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Resource builder</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Help compiler</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Price</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With Frameworks, 32-bit:</td>
<td>$795</td>
<td>$795</td>
<td>$795</td>
<td>$795</td>
<td>$795</td>
</tr>
<tr>
<td>Standard:</td>
<td>$195</td>
<td>$195</td>
<td></td>
<td>$195</td>
<td>$195</td>
</tr>
<tr>
<td>No Frameworks, 16-bit:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$495</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Many vendors support OS/2 with other compiler products.
2. High C/C++ produces DOS programs that require Phar Lap's 386/DOS-Extender package, an additional $495 cost.
3. The entry in this field indicates whether the compiler produces code structured for Pentium execution.
4. No strict K&H/1 support, but it will support K&R function headers.
5. Although Symantec C/C++ does not include a separate assembler, it has a full-featured in-line assembler.
6. Memory and disk requirements are approximate.
7. Windows development requires Microsoft's Windows SDK, which brings the total disk requirement to 24 MB.
8. Symantec C/C++ lets you debug DOS applications from within Windows.
9. Price does not include Phar Lap's DOS extender. A DOS extender/compiler package is available for $995.

Symantec C/C++ 6.0

As this article headed for press, Symantec was deep into the final stages of its new Windows-based C++ compiler. I worked with a late beta version of the package that should match the functionality of the final product. Symantec expects to release version 6.0 in August, so it should be available as you read this.

This product is a vastly updated version of Zortech C++. It's so heavily rewritten that the only similarity might be that both are C++ compilers. The Symantec compiler is also escorted by so many tools that it rivals Visual C/C++ in ancillary support. And unlike Zortech C++, Symantec C/C++ provides a solid class library—a licensed version of MFC 2.0—to provide a framework for Windows development.

Symantec's C/C++ takes its Windows-based IDE to new heights, breaking from the usual MDI (Multiple Document Interface) approach and instead creating an environment of loosely coupled windows and toolbars organized within workspaces. Each workspace (you can have several active simultaneously) offers you a particular view into a project (e.g., one workspace may be where you do your compiling and editing; another may have all your debugging tools active).

Symantec's IDE incorporates tear-off tool palettes that you can position and resize to customize your workspace. Icons within these palettes operate on a drag-and-drop paradigm. For example, you can grab the source tool icon, drag it out of the palette, and drop it on the desktop. An empy edit window opens. Go into the file list within your project view window, grab a filename, and drag it into the new edit window. The file's source code appears, ready for work.

The Visual Programmer is Symantec's answer to ClassWizard. Many of the functions that you would find in a resource editor are here. You can create dialog boxes and menus from within the Visual Programmer. The real strength of the Visual Programmer, however, is its ability to rapidly associate Windows controls with messages and to define actions for events. For example, your program may respond to an OK button by launching the Windows Edit program. In the Visual Programmer, you can quickly build all the code needed to accomplish this by mousing through dialog boxes. (The only typing you have to do is to enter Edit's path.)

Symantec's debugger is also well developed. You can examine changing data structures, as you can in most debuggers.
Performance Comparisons

a) NIH class library compilation

<table>
<thead>
<tr>
<th>Compiler</th>
<th>Speed Optimizations</th>
<th>Size Optimizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borland C++ 3.1</td>
<td>Better</td>
<td>Better</td>
</tr>
<tr>
<td>MetaWare High C/C++ 3.1</td>
<td>Better</td>
<td>Better</td>
</tr>
<tr>
<td>Microsoft Visual C++ 1.0</td>
<td>Worse</td>
<td>Worse</td>
</tr>
<tr>
<td>Symantec C/C++ 6.0</td>
<td>Worse</td>
<td>Worse</td>
</tr>
<tr>
<td>Watcom C/C++32</td>
<td>Worse</td>
<td>Worse</td>
</tr>
</tbody>
</table>

b) BYTE portable benchmarks

<table>
<thead>
<tr>
<th>Compiler</th>
<th>CPU</th>
<th>FPU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borland C++ 3.1</td>
<td>Better</td>
<td>N/A</td>
</tr>
<tr>
<td>MetaWare High C/C++ 3.1</td>
<td>Better</td>
<td>N/A</td>
</tr>
<tr>
<td>Microsoft Visual C++ 1.0</td>
<td>Worse</td>
<td></td>
</tr>
<tr>
<td>Symantec C/C++ 6.0</td>
<td>Worse</td>
<td></td>
</tr>
<tr>
<td>Watcom C/C++32</td>
<td>Worse</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
- Times shown for Borland C++ are using its Windows-based IDE. The DOS-based IDE took nearly 1 min. 50 secs. longer to compile.
- MetaWare's engineers did not suggest a size optimization.
- Times for Visual C++ are for running MAKE from the DOS prompt. Running the compiler under windows added nearly 50 seconds. Creating class browsing information added about 5 seconds.
- The NIH results for Symantec C/C++ were derived using MAKE from the DOS prompt. Running the compiler under windows added nearly 50 seconds. Creating class browsing information added about 5 seconds.
- N/A = not applicable.

Compiler benchmark results. (a) These tests involve the compilation of nearly 98,000 lines of source code based on the National Institutes of Health class library. The intent is to measure compilation speed, as well as the size of the generated executable file. Compilation was performed twice, once optimizing for speed and then for size. All compilers were required to emit 32-bit code. Headers were not precompiled.

(b) This benchmark uses the CPU and FPU portions of BYTE's portable benchmarks. As above, all compilers were required to generate 32-bit code. All compilers were set so that they emitted floating-point code that searched the machine for a coprocessor and used that coprocessor for floating-point-intensive operations. The results for each test were normalized to the lowest score of all compilers for that test. These results were then combined using a nonweighted average to generate a CPU index and an FPU index for each compiler.

watch windows; however, Symantec's debugger also lets you explore those structures graphically. Suppose your program builds a binary tree in memory. Symantec's debugger will show that structure as a block diagram with boxes and arrows. As you single-step through your program, the displayed structure will be automatically updated to reflect the goings-on in RAM.

All in all, Symantec's C/C++ compiler is an enticing entry. A full-blown system costs $499, but entry-level developers can get started with the more reasonably priced $129 version. Although the latter's compiler is not an optimizing compiler and doesn't produce 32-bit code, it still provides a full Windows 3.x development and debugging environment, as well as the Visual Programmer.

MetaWare's High C/C++ 3.1

MetaWare's High C/C++ package is the most Spartan of all the products reviewed here. You'll find no heap walkers or message spy programs. It's just a C++ compiler that produces 32-bit code compatible with either Phar Lap's DOS extender or Windows 3.x, a 32-bit debugger for extended DOS or Windows applications, and a handful of Unix-like DOS command-line tools (e.g., cat, ls, and fgrep).

Because High C/C++ emits only 32-bit code that uses the flat addressing model, creating a Windows application involves binding resources and protected-mode executable files with a Windows extender supplied as part of MetaWare's Windows ADK (application development kit). This supervisor acts as an intermediary between your 32-bit flat-memory-model MetaWare application and the 16-bit segment/offset Windows environment.

Wherever a call to a Windows routine appears in your application's source code, the High C/C++ compiler aims that call at a function in the supervisor. The supervisor function makes any adjustments to arguments, switches to 16-bit mode, and calls the corresponding Windows routine. Because callback functions require that Windows be able to call functions in your application, the supervisor must also perform translation in the other direction.
Extending the Language

At the time of this writing, the ANSI C++ committee was at work producing a standard description of C++ that is often referred to as C++ 3.0. C++ 3.0 includes all the features of Cfront 3.0, a version of C++ from AT&T implemented as a preprocessor.

Cfront 3.0 includes two new syntactic elements: templates and nested classes. All the compilers reviewed here support both. Exception handling, a third new C++ construct, is part of the ANSI specification but not part of Cfront 3.0.

Class templates let you specify a kind of class recipe. That is, you spell out how the class works—its member variable names, member function names, and how the member functions operate—but you leave out type-specific details. Those are filled in only when you instantiate a class built from the template.

For example, suppose you’ve built a class that defines array objects that sort themselves. Without templates, if you want to define such a class for arrays of integers, longs, and floats, you’d have to type in (and maintain) three class definitions. With templates, you type in the class definition once, leaving a placeholder wherever a type specifier would have appeared in the definition. When you define an object of such a class, you specify not only the class name, but also the type specifier to be filled into the placeholders you wrote into the template.

Cfront 3.0 also extends the idea of templates to functions. Continuing with the example, function templates would allow you to write a single function template for sorting an array of any numeric type.

A nested class is a class defined within another class. The enclosed class has scope only within the enclosing class. Nesting can provide relief from name-space pollution. Since a nested class is invisible outside its enclosing class, it won’t clutter your program by adding another global name you’ll have to keep track of. Nesting provides yet another dimension in the factoring of objects into their component parts.

Finally, the latest addition to the C++ language syntax is the catch-throw exception-handling construct. A class that supports exception handling includes exception class names as public members. A member function that can trigger an exception “throws” the exception to one of the exception classes. The exception class “catches” the exception as part of a try...catch structure.

For example, assume you’ve defined an Array class. Array includes the exception-handling class RangeError. Additionally, you’ve overridden Array’s subscript operator ([]) so that any out-of-bounds references will throw an exception to a function that is designated as the RangeError handler. Examine the following code:

```cpp
Array av(100);
try {
    read_array(av);
}
catch (Array::RangeError) {
    // Handle array range error
}
```

Should an out-of-bounds error occur anywhere inside read_array, an exception will be thrown to the RangeError handler (i.e., the code defined after the catch() statement).

The beauty of exception handling is that no matter where inside read_array() the exception is triggered, no matter how deep the stack nesting, the stack will be unwound so that the RangeError code executes at the proper stack level. Most important, unlike a setjmp...longjmp structure, C++ unleashes the proper destructors on any temporary objects that come from the stack as it is unwound. In essence, dealing with an exception won’t leave bits and pieces of incompletely initialized objects lying around taking up memory.

Of the compilers reviewed here, only Watcom supported C++ exception handling, even though the other vendors promised such support in upcoming releases. Borland expects exception handling to play a major role in the next release of Object Windows Library.

from Windows to 32-bit mode.
High C/C++ can also build a 32-bit DLL. In this case, you must bind into your code a special DLL supervisor whose job is similar to the supervisor described above.

At the time of this review, MetaWare’s High C/C++ was one of only two C++ compilers that could emit code optimized for the Pentium. Other compilers should follow suit shortly.

High C/C++ is definitely a compiler for the high-octane, 32-bit programming crowd. It turned in the best performance results for CPU-intensive operations. However, its $795 price certainly won’t break any price barriers, and that price doesn’t include the Phar Lap DOS extender that you’ll need to create extended-DOS applications.

Watcom C/C++32
Watcom C/C++32 is a compiler that emits code for more operating systems than most developers will ever target. At the top of the list of supported systems are extended DOS—Watcom C/C++32 can produce code for Rational Systems, Ergo Computing, and Phar Lap DOS extenders—and Windows, where Watcom C/C++32 can generate Windows 3.x and Win32s code.

You perform all compilation from the DOS prompt. Also, because the output of the compiler expects to execute in a 32-bit flat address space (referred to as a linear executable file), you must bind your application and resources to a supplied Windows extender. The company does produce a 16-bit version of C/C++ that can create 16-bit Windows 3.x applications directly.

You won’t find an IDE in Watcom’s package, although the software does come with some useful tools. Watcom’s capable debugger, Video, is at home in as many...
Essential Development Tools At Your Fingertips.

MKS Toolkit — All the Tools of the Trade for Professional Programmers and Application Developers.

MKS Toolkit puts a powerful suite of easy-to-use development utilities within your grasp. MKS Toolkit was designed by developers for developers. That’s how we knew precisely which programming instruments to give you — and how to make them work together so you can achieve levels of productivity you’ve only dreamed about — until now!

Developers working on DOS can now get the extraordinary power of tools that were once available only on UNIX. Only MKS Toolkit delivers a full suite of these essential tools on your PC, and allows you to switch quickly back to your DOS applications. For multi-platform environments, MKS Toolkit is fully compatible with UNIX systems, and tracks both POSIX and z/Open standards.

Now it’s easy to take hold of all the tools of your trade. MKS Toolkit enables you to develop the technology of tomorrow — today.

Start shaping the applications of the future! Call now to order your copy of MKS Toolkit.

Some of the 180+ utilities in MKS Toolkit 4.1:

- A new, easy-to-use, efficient UUCP communications package that connects you to the world.*
- MKS AWK, the fast prototyping and report generating language, now with a new AWK compiler.
- MKS KornShell, the full-featured programming language that allows you to interchange scripts with UNIX and POSIX systems.
- MKS Make, the software construction utility that lets you update files automatically.
- MKS VI, the full-screen editor.
- New Windows icons for frequently used commands.
- Interoperability with Open VMS, CTOS and MPE/iX.
- A full array of commands for profiling, compression, archiving, file processing and customizing your PC environment.

MKS
35 King Street North
Waterloo, Ontario, Canada
N2N 2W9

Call for multi-user pricing, 30 day money-back guarantee.
For information on how to order, call MKS at 1-800-265-2797 (US and Canada) or (519) 884-2251. Fax (519) 884-8863. International customers please call:
AUSTRALIA +61 03 506 1315 • BELGIUM +32 20 732 40 40 • BRAZIL +55 83 333 1904 • DENMARK +45 45 87 72 00
FINLAND +358 90 206 2000 • FRANCE +33 1 87 72 22 44 • USA 1 800 265 2797 • GERMANY +49 0721 985 280 / +49 0251 205702
ITALY +39 02 4920 8153 • JAPAN +81 3 3255 4171 • KOREA +82 2 561 0521 • NETHERLANDS +31 80 614244 • NORWAY +47 22 11 09 50 • SINGAPORE +65 747 2366 • SWEDEN +46 013 111588 • SWITZERLAND +41 44 421 32 01
UK +44 079 587 9111 / +44 071 833 1022 / +44 016 463 4100

MKS and MKS Toolkit, MKS KornShell, MKS AWK, MKS Make, MKS UUCP and MKS VI are trademarks of Morris Kerr Systems Inc. UNIX is a registered trademark of UNIX System Laboratories, Inc. All other trademarks are acknowledged.
I passed all products through two waves of tests. The first wave was designed to measure each product's compilation time and the resulting size of the executable files. For these tests, I used a subset of the public domain National Institutes of Health (NIH) C++ class libraries tacked onto a couple hundred lines of exercising code. All told, building this project required the compilers to chew through nearly 98,000 lines of source code.

The second wave was designed to measure the accuracy of the compilers. These tests were strictly C code and consisted of the CPU and FPU portions of BYTE's portable systems benchmarks.

In both waves, I ran the compilers through the wringer twice: once with compiler and link switches set to generate the fastest code, and once with those switches set to generate the smallest code. Consequently, each compiler ran the gauntlet at least four times. (Some took more trips. For example, I performed an additional set of tests to explore Visual C/C++'s p-code generation.)

All compilers were required to generate 32-bit code. The performance tests were run under DOS, so that none of the overhead of Windows would corrupt the execution time. Three of the packages—MetaWare's High C/C++, Watcom C/C++, and Symantec C/C++—produced code that ran in conjunction with a DOS extender. In the case of High C/C++, I used version 5.0 of Phar Lap's 386/DOS-Extender. For Watcom C/C++32, I used the bundled run-time version of Rational Systems' DOS/4GW. Zortech's DOS extender (DOSSX) was also bundled with the compiler.

The results of the tests are shown in the figure on page 133. In the NIH-class tests, all compilers generated code in the range of 100 to 150 KB. Three of the compilers—Visual C/C++, Symantec C/C++, and Watcom C/C++32—turned in compilation times that were startlingly close to one another. Borland turned in the best compilation time, and High C/C++ was significantly slower than the others. Interestingly, Borland's fastest compilation time was from its Windows-hosted IDE (Integrated Development Environment); Microsoft's fastest compilation time was from the DOS command line. Note that High C/C++ has no compile options for optimizing code.

BYTE's portable benchmarks for CPU and FPU formed the basis of performance tests. It's obvious from the results that those compilers using a 32-bit DOS extender (High C/C++, Symantec C/C++, and Watcom C/C++32) had an easier time of things in the CPU tests than did Borland C++ and Visual C/C++, which had to deal with the segment/offset overhead of the huge memory model.

In the FPU tests, all compilers generated emulation code that used a coprocessor if one was present (one was in our test system). MetaWare's compiler appeared to have the hardest time with the FPU test, with Watcom C/C++32 at the top.

operating-system platforms as is the compiler.

Watcom's offering fits in a niche somewhere between MetaWare's High C/C++ and Microsoft's Visual C/C++. Still, Watcom's compiler has a different kind of plenitude: the vast number of supported platforms. This support exacts a high toll: $995 for the 32-bit version, and $599 for the 16-bit version.

Plus-Pluses and Minuses

The C++ compilers covered here partition themselves into two categories: Those operating primarily from the command line (High C/C++ and Watcom C/C++32), and those providing GUI-based development environments (Borland C++, Visual C/C++, and Symantec C/C++). In addition, Borland C++, Visual C/C++, and Symantec C/C++ make available class libraries designed specifically for Windows development, while the others are satisfied to provide access to the Windows API.

Neither OWL nor MFC holds a clear advantage. Both at least hold a source code advantage over the strict C approach to Windows programming and its miles of switch statements. On the execution side, neither is an improvement over tradition, because they add a layer of decision making that messages must navigate. OWL is more concise; MFC does not require extensions to the language.

For sheer executable performance, High C/C++ and Watcom C/C++32 are probably the best choices. Watcom C/C++32 is a likely choice for programmers whose target environments are in flux, given the range of target platforms Watcom supports.

But programming for Windows is about more than all-out performance. If you are looking for a development environment that will truly simplify Windows programming, choose between Borland C++ 3.1, Visual C/C++ 1.0, and Symantec C/C++ 6.0. My choice is Symantec C/C++. With its full complement of excellent tools and good performance, it strikes the proper balance between a high-performance compiler and a full-featured, Windows-hosted development environment. 

Rick Greihan is technical director of the BYTE Lab. Before coming to BYTE, he worked as a professional programmer. He has a B.S. in physics and applied mathematics and an M.S. in mathematics/computer science. You can reach him on BIX as "rick_g."
The Choice Is
No Longer
Black And White.
inches. Its footprint measures only 11.7 x 8.5 inches, and it weighs just 5.4 pounds.

486 Power

You don’t have to sacrifice performance to have color, either. ColorBook models are based on Intel® 486 processors. Both ColorBook models include a floppy drive, 4MB or 8MB of RAM (upgradeable to 20MB), and a large, fast hard drive. These notebooks are powerful enough to become your only computer!

Integrated Track Ball And PCMCIA Slots

The ColorBook includes a built-in track ball, which is much easier to use than a mouse in most portable situations. You also get two PCMCIA Type II card slots so you can plug in dozens of available PCMCIA peripherals.

Greener Pastures

The grass is greener on the ColorBook side of the fence! It’s an extraordinary value even by Gateway’s standards — and we wrote the book on value! We have a reputation for offering the best prices on high-quality products with exceptional service from friendly folks in the Midwest. That’s why the choice of a computer supplier is black-and-white, even when you’re buying a color notebook! Give us a call.
For the same money, you can have a black-and-white 486 notebook. Or you can have a color 486 notebook. Which is it going to be? Hay, it's not too hard to spot the best deal: the ColorBook from Gateway 2000! The new ColorBook has everything you're looking for in a portable at a price you'd expect to pay for a monochrome system. That's a special breed!

Exploding The Myth

Why do you expect to pay so much more for a color portable? Because other manufacturers always charge a plump premium for color. They've been milking the market, brainwashing you into thinking high-quality color costs a lot more to manufacture. It doesn't! We're selling the ColorBook for our usual cost-plus-small-margin. Now other companies will have a hard time perpetuating the color portable price myth. (Competitors absolutely hate us! Isn't it great?)

Experts' Reaction

We gave several PC trade publication editors a sneak preview of the ColorBook. Here's what they said about it: "Way cool!" "Dead on." "You won't be able to make enough of these."

Dazzling Color Display

The editors were impressed by the bright, crisp color graphics from the latest-technology, dual-scan STN display. It's a 9.4-inch VGA LCD, backlit for use in any lighting conditions. The editors said the ColorBook has the best STN color display they had ever seen! When they learned one model was priced less than $2,000, they were convinced the ColorBook will cause a stampede in the industry.

No Compromise On Size

Adding color to a portable usually means adding weight and bulk. Not so with the Gateway 2000 ColorBook. The ColorBook is the thinnest color notebook on the market — 1.77
Introducing The ColorBook!

The ColorBook is the thinnest color notebook on the market — 1.77 inches. Its footprint measures only 11.7 x 8.5 inches, and it weighs just 5.4 pounds.

You’ll appreciate the convenience of using PCMCIA cards. They’re as easy to carry as credit cards, and they plug right into your ColorBook.

The integrated track ball slides out from a compartment by the space bar on the keyboard. You simply pull it out and go to work. Finished? Just slide the track ball back into the ColorBook.

Size

With the ColorBook, you get great color at a great price while maintaining excellent portability.

Intel® 486 Processor

ColorBook notebooks are based on Intel 486 microprocessors, which makes them powerful enough to serve as your desktop PC with an external mouse, keyboard and monitor. Supports simultaneous video, up to 1024 x 768 resolution.

Dual-Scan STN Color Display

Dual-scan STN color is the latest technology in portable color displays, and it looks fabulous! You get 256 colors with the ColorBook running in VGA mode (640 x 480 resolution).

PCMCIA Type II Slots

Add a modem, network card or any of dozens of available PCMCIA-compatible peripherals. The ColorBook’s two Type II slots can also be used for one Type III PCMCIA card.

COLORBOOK 486SX-25

- Weight: 5.4 Lbs.
- Dimensions: 11.7” x 8.5” x 1.77”
- Intel 25MHz 486SX Processor
- 4MB RAM (expandable to 20MB)
- 3.5” 1.44MB Diskette Drive
- 80MB IDE Hard Drive
- 9.4” Backlit VGA Dual-Scan STN Color Display
- NiMH Battery & AC Pack
- Suspend/Resume Feature
- 2 PCMCIA Type II Slots
- Integrated Track Ball (2 Buttons)
- 85-Key Keyboard
- Parallel, Serial & PS/2 Mouse Ports
- External CRT Port
- MS-DOS® and Windows

$1995

COLORBOOK 486SX-33

- Weight: 5.4 Lbs.
- Dimensions: 11.7” x 8.5” x 1.77”
- Intel 33MHz 486SX Processor
- 4MB RAM (expandable to 20MB)
- 3.5” 1.44MB Diskette Drive
- 170MB IDE Hard Drive
- 9.4” Backlit VGA Dual-Scan STN Color Display
- NiMH Battery & AC Pack
- Suspend/Resume Feature
- 2 PCMCIA Type II Slots
- Integrated Track Ball (2 Buttons)
- 85-Key Keyboard
- Parallel, Serial & PS/2 Mouse Ports
- External CRT Port
- MS-DOS and Windows

$2395

TRAVELER’S PACK

- Carrying Case
- Extra NiMH Battery
- PCMCIA Fax/Modem

Call For Details

COMBO PACK

- 124-Key AnyKey Keyboard
- MS Mouse
- 15” Color CrystalScan 1572FS

$499

Options include: PCMCIA fax/modem cards, PCMCIA network cards, 4MB or 16MB RAM upgrades, carrying case and extra NiMH batteries. Call for details.

8 0 0 - 8 4 6 - 2 0 1 0

©1993 Gateway 2000, Inc. Black-and-white spot design, "G" logo and "You’ve got a friend in the business" slogans are registered trademarks, and Gateway 2000 is a trademark of Gateway 2000, Inc. The Intel Inside Logo and Intel are registered trademarks of Intel Corporation. All other brands and product names are trademarks or registered trademarks of their respective companies. Prices and configurations are subject to change without notice. Prices do not include shipping.
Sometimes, innovations in technology really do have a direct impact on day-to-day life. Personal systems like Apple's Newton remain on the horizon, but technologies like PCMCIA 2.0, 3.3-V processors, and 2½-inch disk drives are driving portable system design today—and the results are practical Windows machines that are genuinely portable.

The CompUSA 4SL/25 Subnote, Hewlett-Packard OmniBook 300, and Zenith Data Systems Z-Lite 320L represent this next generation of ultra portable, high-power subnotebooks. All three are smaller than a three-ring binder, less than 1.6 inches thick, and under 4 pounds. Yet each has at least the performance of a 20-MHz 386, as well as the high-resolution screens and pointing devices necessary to run GUI applications designed for the desktop.

In addition to running the usual complement of BYTE Lab tests, I took each of these machines on the road. All are capable travelers, but they have different strengths: The Subnote is the most powerful, the OmniBook is the most portable, and the Z-Lite has the best screen. But a week on the road also exposed some significant compromises, like the Subnote’s unworkable trackball, the Z-Lite’s frustratingly small keyboard, and the OmniBook’s reliance on PCMCIA and other technologies that are still developing.

The Cutting Edge

All three subnotebooks owe their combination of small size and high performance to a collection of state-of-the-art technologies. Among these, the most significant are PCMCIA 2.0, 3.3-V processor systems, and high-capacity 2½-inch hard drives. But with the exception of 2½-inch drives, where reliable 80-MB devices are no longer hard to find, these technologies have a few limitations.

Using PCMCIA devices with any of these machines is not a plug-and-play operation. I tested each with a Xircom CE-10BT CreditCard Ethernet adapter. I couldn’t get the OmniBook to recognize the Xircom card at all, and HP was unable to offer a solution. As of this writing, HP doesn’t officially support the CE-10BT, or any other network adapter. ZDS’s and CompUSA’s machines worked with the card, but both took some tweaking of drivers that wasn’t always obvious.

Drivers for PCMCIA I/O cards are supposed to hook in through an interface called PCMCIA Socket Services, which should make every driver work on every PCMCIA-capable machine. But Socket Services is a new specification, and not all machines support it, or support it properly. So I/O card drivers often support PCMCIA controller hardware directly; the most common controller is Intel’s 82365 PCIC.

Of these three, the Subnote and the OmniBook support Socket Services. The Z-Lite does not. The Z-Lite and the Subnote use the 82365 as a peripheral controller, but the OmniBook has an HP proprietary controller. So except for the Subnote, you have only one out of two chances at eventually getting third-party cards to work. But you’re still only completely safe with PCMCIA I/O peripherals supplied by the system manufacturer.

These subnotebooks provide 3.3-V processors; the Subnote includes an Intel 486SL, the Z-Lite runs on a 3.3-V Intel 386SL, and the OmniBook runs on AMD’s equivalent 386 part. Low-voltage parts mean a great deal in terms of power savings (and weight savings, if you consider battery size), since power varies with the square of the voltage. But full 3.3-V peripheral support is not completely in place.
yet. The OmniBook is almost entirely a 3.3-V machine; CPU, memory, video memory, and the main system controller all run at 3.3 V. However, the Subnote runs only CPU and RAM at 3.3 V, and the Z-Lite’s only 3.3-V component is the 386SL processor.

**CompUSA 4SL/25 Subnote**

The Subnote is a high-powered machine manufactured for CompUSA by Taiwan-based Twinhead. Of the three reviewed systems, the Subnote is the only one built around a 486-class processor, and the only one with an FPU. Although not as radical in innovation as the others, the Subnote is a solid performer, easily portable, and inexpensive—a 4-GB RAM, 80-GB hard drive model costs just $1999.

Not surprisingly, the 25-MHz Subnote was the fastest machine of the group. But although strict CPU tests like BYTE’s DOS CPU benchmark rated the Subnote as nearly twice as fast as the second-place Z-Lite, the overall system was not that much faster than the Z-Lite running real Windows applications.

The Subnote is reasonably miserly with power. Battery-life tests placed the Subnote’s running time at just under 5 hours on a full charge. Intel’s 3.3-V 486SL lets the machine support the usual complement of CPU power management functions, including standby mode.

I had a little trouble getting the contrast setting to “stick” where I wanted it for Windows—the “hard” power switch resets the contrast. Once the level was set properly, the display looked great. The screen is tiny—at 7 1/2 inches, it’s at least an inch smaller on the diagonal than the other machines’ LCDs—but it’s bright and easy to read at 640 by 480 pixels.

The keyboard, though not as pleasantly laid out as the OmniBook’s, makes touch typing easy. However, the trackball is horrible; either my fingers are too long or the buttons aren’t far enough away from the ball.

The Subnote is nice and portable. It’s thicker than the rest, but squarer, and it carries easily. You’ll need to carry both the external floppy drive and the AC adapter when traveling. Both are small: The charger measures 1.8 by 4.4 by 2.5 inches, and the external floppy drive is only slightly larger and heavier than a 3 1/2-inch floppy disk.

The Subnote has a single PCMCIA slot. I got the Xircom Ethernet adapter to work with little trouble.

I had only one negative experience. After a few weeks, the 80-GB internal drive (which is removable, although the process requires a screwdriver) developed a whine that sounded like a bearing problem. However, I had no problems actually using the drive.

**Hewlett-Packard OmniBook 300**

In contrast to the Subnote, the OmniBook is a real departure from traditional notebook designs. It’s incredibly small—at 1.4 by 11.1 by 6.4 inches, it’s more like a tall novel than a notebook. The odd form factor and its sub-3-pound weight make it so easy to carry that I chose the OmniBook whether I needed to take a machine on a plane or just down the hall.

HP left out a lot to get the size down. The OmniBook has no floppy drive support, but even as an option. It relies on Traveling Software’s LapLink Remote and a serial cable to mount drives on other systems. LapLink Remote can send itself over the wire, so you need never carry a floppy disk. Once I got it up on my desktop system, I just left the cable hooked up and treated it like a docking station.

LapLink Remote, like most of the functions in the OmniBook, includes a Windows Control Panel for configuration. The OmniBook is a Windows machine: If you don’t like Windows and Windows applications, you can scratch this one off your list. Power management settings and all OmniBook configurations are handled through Windows Control Panels, and there are no DOS equivalents.

More significant, the OmniBook is the first machine to include Windows 3.1 in ROM. ROM holds all the core software, including Windows itself, LapLink Remote, DOS, and some OmniBook-specific DLLs. The OmniBook also includes Microsoft Word, Microsoft Excel, and an HP calculator utility—all ROM-based.

Besides saving on hard disk power, this ROM Windows design provides some nice enhancements. The most noticeable is that Windows, Excel, Word, LapLink Remote, and many other utilities are all available at the touch of a function key. Also, the Windows start-up sequence is fast, given the machine’s relatively low-speed processor.

The OmniBook has four PCMCIA 2.0...
Some say the T4600 is better than life itself. Because in life, there is compromise.

Introducing the T4600 Series. Make no compromise.

Get the awesome power of a 33MHz i486™SL processor, and don't sacrifice battery life. Add a 9.5'' color active matrix TFT-LCD screen, and access all 185,193 eye-popping VGA colors. Pack a massive 320MB hard drive and never have to leave a file at home. Get your hands on the BallPoint™ mouse, snap it into its QuickPort™, and never waste a moment or a motion.

Carry two slots for industry-standard PCMCIA cards — including one large enough for the new generation of removable hard drives — and take the next big step in peripherals.

Glance at the QuickRead LCD status icon bar for an instant read of battery life, power management, keyboard settings, and more. This is no time for compromise. This is the time to get your hands on the T4600 Series.

For a dealer near you, call 1 (800) 457-7777.

In Touch with Tomorrow

TOSHIBA

© 1993 Toshiba America Information Systems, Inc. The Intel Inside logo is a trademark of Intel Corporation. All products indicated by trademark symbols are trademarked and/or registered by their respective companies.

Circle 151 on Inquiry Card.
Performance testing highlights: the trade-offs between performance and portability chosen by CompUSA, HP, and ZDS. CompUSA’s 4SL/25 Subnote has the most capable processor (its integrated FPU was responsible for the unbalanced results on the floating-point-intensive spreadsheet application test), but it was outperformed on disk-related tasks by the OmniBook and its fast but expensive flash storage system. Its 3.3-V operation, no rotating storage, and no display backlight also combined to give the OmniBook an unprecedented 12½-hour duration on BYTE’s battery-life tests.

slots. Two of these are “system slots”; one is occupied by the ROM card that holds the system software, and the other holds either a 10-MB flash memory card or a 40-MB Type III hard drive. My test machine was the flash version. Although it has less capacity, it’s slightly more expensive than rotating storage; however, the hard drive will use up two PCMCIA 2.0 slots. The OmniBook uses a modified version of DOS 5.0 that includes Microsoft’s DoubleSpace compression to effectively double the space on any storage medium (so the storage on the flash disk was 20 MB).

With the flash model, two sockets are available for more storage, memory card interchange, or I/O cards. You generally can’t use DoubleSpace on a card you intend to use in another machine. As mentioned above, I couldn’t get a Xircom I/O card to work in the OmniBook, which was
A floppy disk that's so advanced, it cleans while it protects your data. The proof? Sony's new Super Cleaning™ Mechanism.

A redesigned metal lifter, improved liners and molded cross-flow ribs sweep the disk surface. Removing dust and debris, before they threaten your data. Find out more. Call 201-476-8199. From the inventors at Sony.  

© 1995 Sony Corporation of America. All rights reserved. Sony, Super Cleaning, and Only on Sony are trademarks of Sony.

Circle 144 on Inquiry Card.
disappointing. HP's current list of supported PCMCIA I/O peripherals includes only four modems and fax modems.

The ROM DOS installation is not complete. It lacks utilities like MORE, EDIT, EDLIN, and MEM; I couldn't bear using Microsoft Word just to edit AUTOEXEC.BAT; so I downloaded a full DOS installation to the flash card. After that, the OmniBook handled DOS tasks well.

The OmniBook's screen is not backlit, but the contrast is outstanding, and the screen is larger than the other systems. The keyboard is full-size and virtually indistinguishable from a full desktop model. HP's pointing device is a real (but tiny) mouse that pops out of a socket on the side of the machine—instead of a wire, it uses a mechanical arm connected to an internal sensor. It's the best solution to be found in these three machines, but it doesn't compare to a desktop mouse for usability.

With no backlight, no rotating storage, and 3.3-V design, the OmniBook's battery life is incredible. Lab testing measured it at over 12 hours. But the single feature I liked best about the OmniBook was its instant resume from standby. You can let the machine go into standby at any time, and a key press brings the screen up just as you left it—instantaneously. I found myself sending the machine into standby as a habit, even for very short breaks.

The standard OmniBook's worst feature is its 2-MB configuration combined with emphasis on Windows. The OmniBook runs only in standard mode, and 2 MB is not enough for real applications.

BYTE's DOS application benchmarks (e.g., dBase IV, which can use a built-in disk cache) really suffered from the memory limit. All the benchmarks were handed by lack of memory, although the speed of reads from flash memory (versus mechanical memory) put the OmniBook ahead in some categories. You can upgrade the OmniBook to 4 MB for $179, and you probably should.

There are other features, such as an infrared link for 115.2-Kbps connection to other HP infrared devices (although few are installed), and the ability to run on AA batteries. Besides PCMCIA, the machine also has a proprietary card slot for internal modems. The $2375 OmniBook is the best choice if you run Windows applications. But some of the technology on which it depends—such as PCMCIA, the infrared link, and RAM cards instead of floppy drives—is a little too new and uncommon to be fully exploited.

Zenith Data Systems Z-Lite 320L

Although only a few months older than HP's and Compaq's portables, ZDS's well-built Z-Lite 320L is already a few steps behind the competition. The Z-Lite is a handsome machine, with an innovative external floppy drive design, the best of the screens in this collection, and a tolerable trackball as a mouse replacement. But the Z-Lite reaches neither the peak of performance set by the Subnote nor the level of portability established by the OmniBook. ZDS promises performance enhancements in the very near term, but the current Z-Lite takes only the middle ground between the other systems.

The Z-Lite is certainly a capable Windows portable. It comes with Windows installed and system documentation on-line. ZDS sells two models of the Z-Lite, the one I tested ($1799, which includes 4 MB of RAM, a LitePoint pointing device, and an external floppy drive) and a stripped-down model with a 2-MB base configuration and none of the external options.

The screen on the Z-Lite is the best provided by these systems; although somewhat smaller than that of the OmniBook, the Z-Lite's LCD is backlit. Unfortunately, the keyboard is just too small to use for touch typing, with key spacing a very noticeable 1.2 millimeters tighter than it is on the OmniBook.

Performance testing put the Z-Lite somewhere between the very fast Compaq USA Subnote and the OmniBook. Subjectively, the system runs Windows and Windows applications at a comfortable clip, at least with 4 MB installed. I ran Microsoft Excel and Lotus Ami Pro and never found it wanting for performance. ZDS plans both a Z-Lite based on the 486SL, which will compete squarely against the Subnote, and an 80-MB replacement for the 60-MB drive. The company claims that both the storage upgrade and the new 486SL model will be out by the time you read this.

The Z-Lite is indeed light, at just under 4 pounds. It's thinner, though a little deeper, than the Subnote. The LitePoint device is a plug-in bar that fits on the front of the machine, with a trackball and buttons slightly off center. The external floppy drive is designed to serve as both a drive and an AC connector. The floppy drive plugs into a jack at the side of the machine—if you connect a small AC adapter to the back of the floppy drive, the Z-Lite also draws its power through the cable. This lets you set the floppy drive on a desk, connected to a power outlet, where it can act as a home base for the notebook with just a single connection.

The floppy drive, built-in hard drive, and relatively simple PCMCIA support make the Z-Lite a suitable desktop replacement, if you can get past the keyboard. It's certainly easier to work with on that basis than the OmniBook. But despite the innovative floppy drive, the Z-Lite is perhaps the most difficult subnotebook to actually pack. It has as many pieces as the Subnote, and if you leave the LitePoint attached, there are a lot of irregular edges to handle.

Sub Culture

Choosing between these tiny, innovative machines means choosing between compromises. The choice is between the powerful Subnote, the innovative but sometimes inconvenient OmniBook, and the Z-Lite, somewhere between the other two. I'll take the OmniBook, with a 4-MB upgrade, please. Despite some gaps between technology and real-life requirements, this is the best machine if you run Windows applications on the road.

Steve Apiki is director of the BYTE Lab. He has worked as a programmer and engineer and has a B.S.E.E. from Rensselaer Polytechnic Institute. You can reach him on BIX as "apiki" or on the Internet at apiki@byteph.bytemail.com.
Discover how easy it is to break the 640K DOS barrier with Phar Lap's 286 DOS-Extender™.

Try out Extended-DOS programming — 286 DOS-Extender Lite.
Here's some great news for DOS developers: every copy of Microsoft®’s new Visual C++ Professional Edition includes a FREE trial-sized Phar Lap® DOS extender! Phar Lap’s 286 DOS-Extender Lite is a special version of Phar Lap’s award-winning 286 DOS-Extender. With 286 DOS-Extender Lite, you can write DOS programs that break the 640K barrier, access up to 2 MB of memory, and run under DOS, DESQview®, Windows® and OS/2®. It's the easiest introduction you'll find to Extended-DOS programming.

Build multi-megabyte, full-featured DOS programs — 286 DOS-Extender SDK.
Professional developers can purchase Phar Lap's full-featured 286 DOS-Extender SDK for $495. With the 286 DOS-Extender SDK, you can access up to 16 MB of memory — with the standard Microsoft or Borland tools you already use! The new Version 3.0 of 286 DOS-Extender now supports Visual C++ as well as Microsoft C/C++, Borland® C++ and Microsoft Fortran. You can even use Microsoft's CodeView™ or Borland's Turbo Debugger™ to debug your Extended-DOS programs. 286 DOS-Extender programs will run on any DOS-based 80286, 386, 486 or Pentium PC. There's no special programming required to use a Phar Lap DOS extender; your program can access extended memory just as if it were conventional (below 640K) memory.

286 DOS-Extender is one of the most widely used 16-bit DOS extenders available. If you'd like to know why, take a look at what our customers and other industry experts have to say about the 286 DOS-Extender SDK. Then find out for yourself by trying the free 286 DOS-Extender Lite — or get started right away on your multi-megabyte DOS applications with the professional 286 DOS-Extender SDK!

What the experts say about Phar Lap's 286 DOS-Extender SDK:

"Great tools for Visual C++ programmers who need more memory"  
-Denis Gilbert, Microsoft Corp.

"A no-compromise solution for Borland C++ developers"  
-Paul Gross, Borland International

"An excellent product technically"  
-Glenn Axworthy, Brøderbund Software

"Gives our customers the memory they need"  
-Bert Love, Galacticomm, Inc.

"A superb way of utilizing all available memory"  
-Dave Jewell, Program NOW, August 1991

New virtual memory support.
In addition to Visual C++ support, 286 DOS-Extender, Version 3.0 now includes Phar Lap's 286 VMM virtual memory manager. 286 VMM is completely integrated into 286 DOS-Extender (you invoke 286 VMM with a command-line switch) and enables you to transparently access more memory than is physically available in your computer. 286 VMM can improve the performance of applications that previously relied on loading and unloading dynamic link libraries (DLLs). And it's fully DPMI-compatible, so programs running under Windows automatically use the virtual memory provided by Windows.

386 DOS-Extender — Your 32-bit DOS development solution.
If you want 32-bit speed and power, as well as megabytes of memory for your DOS applications, Phar Lap's award-winning 386 DOS-Extender™ is your solution. With 386 DOS-Extender, your programs can access all available memory and run in a workstation-like, unsegmented 32-bit address space. 386 DOS-Extender programs will run on any DOS-based 80386, 486 or Pentium PC. 386 DOS-Extender supports a wide range of 32-bit compilers, including Microsoft's 32-bit Windows NT® C/C++ compiler. It runs the NT compiler under DOS (no NT system required) to build 32-bit Extended-DOS programs — the only 32-bit Microsoft DOS development solution available.
When it comes to computing ... we wrote the book.

Rely on Osborne to deliver computer books with the information and insights you need... on virtually every hot topic. With our books, you'll find the answers fast, so you can become more knowledgeable, productive, and confident.

Abundant screen displays are clear and crisp, and marked for easy identification.

Special icons call attention to unique shortcuts, great tips and professional advice.

Check out our two-color text that highlights important information: chapter titles, page numbers, special tips and illustrations.

Osborne
Get Answers—Get Osborne
For Accuracy, Quality and Value

AVAILABLE NOW AT THE FOLLOWING STORES:

Waldenbooks  Waldensoftware  Barnes & Noble


Novell NetWare 4: The Complete Reference by Tom Sheldon $29.95 ISBN: 0-07-881909-1

A Giant Leap to OS/2 2.1

From running Windows 3.1 applications to providing hardware support, version 2.1 is truly a better OS/2 than OS/2 2.0.

BARRY NANCE

IBM has been working on OS/2 for years, and the various problems and detours the company has experienced in its drive to establish this operating system are well known. With OS/2 2.1, IBM’s sixth incarnation of this operating system, IBM has delivered a 32-bit environment that seamlessly multitasks DOS, Windows 3.1, and OS/2 applications. Version 2.1 of the operating system offers a definite step up from the confines of DOS or Windows-on-DOS, as well as an improvement over OS/2 2.0.

To effectively run OS/2, you’ll need at least a 386 processor, a minimum of 6 MB of RAM, and 20 to 45 MB of hard disk space. What you’ll pay for OS/2 is not so much the price of the package itself but the training and potential hardware upgrades you’ll require.

OS/2 2.1 offers the same features present in 2.0: crash protection, virtual memory, preemptive multitasking, fast disk I/O, more DOS memory, the HPFS (High Performance File System), and the object-oriented Workplace Shell. Enhancements in version 2.1 include the ability to run Windows 2.1, 3.0, and 3.1 applications in both enhanced or standard modes, support for a range of Super VGA adapters in various resolutions, more printer drivers (over 260 printers are now supported), and compatibility with more SCSI cards and CD-ROM drives. Version 2.1 supports the APM (Advanced Power Management) and PCMCIA specifications, has extensions for pen-based computers, and includes IBM’s multimedia software, MPPM/2. You can install OS/2 2.1 from a CD-ROM drive, instead of from floppy disks. Other features include a limited fax send/receive applic (the size of a fax goes just to one page) and a mah-jongg game. The documentation, provided in book form, is well written.

For less than the cost of buying DOS ($129.95) and Windows ($149.95) each, OS/2 offers both DOS and Windows for $249. The number of native OS/2 applications continues to grow. Recent notable arrivals that support the Workplace Shell, multitreading, and HPFS include Lotus’s cc:Mail and WordPerfect 5.2. Through September, if you order through (800) 342-6672, you can buy OS/2 2.1 for $99 (CD-ROM) and $119 (floppy disks). With OS/2 2.1, you get the usual Windows 3.1 accessories, including Sound Recorder, Character Map, Media Player, Notepad, Paintbrush, and Write. If you prefer to manage your computer through Windows, you can use the Windows 3.1 File Manager and Print Manager included in OS/2.

IBM also offers the system-diagnostic tools MSD.EXE and DRWATSON.EXE with OS/2.

OS/2 2.1 Picks Up the Pace

I ran OS/2 2.1 on a 486 notebook, an NEC PC on a NetWare LAN, and an IBM PS/ValuePoint 486/25. All have 8 MB of RAM and either VGA or Super VGA monitors. OS/2 2.1 installed easily from floppy disks and from a CD-ROM using a Toshiba 3301 drive. However, due to a BIOS problem, OS/2 2.1 failed to install on a clone computer with a Phoenix BIOS labeled V1.10 M6. IBM has acknowledged that certain early versions of the Phoenix BIOS code might not work with OS/2 2.1. Interestingly, that same clone ran version 2.0 without a hitch.

The most noticeable change from earlier versions is speed. I found that version 2.1 runs Windows software 10 percent to 50 percent faster than Windows-on-DOS. An IBM spokesperson said that IBM’s developers tuned the Win-OS/2 environment considerably and used the Watcom C compiler rather than the Microsoft C compiler to produce the Windows portion of OS/2 2.1.

You can even launch DOS sessions from within Win-OS/2. OS/2 allows you to have several Windows sessions under way on your desktop, with each session running a unique copy of Windows separately in its own address space or sharing a single instance of Windows. You can select whether you want DDE and the Clipboard to operate in public mode or private mode. In public mode, OS/2 Presentation Manager software can share data with Windows software through DDE or a global Clipboard. The Win-OS/2 environment offers TrueType and Adobe Type Manager fonts.

Super VGA: The Magnificent Seven

Probably the biggest complaint about OS/2 2.0 was the lack of support for Super VGA. IBM answers the complaints with version 2.1 by offering 32-bit high-resolution video drivers for seven chip sets, in either 800- by 600-pixel or 1024- by 768-pixel resolutions in 256 colors. You can choose from VGA, XGA, 8514, and Super VGA adapter drivers as you install OS/2 2.1.

The seven Super VGA chip sets that OS/2 supports are ATI Technologies’ VGA Wonder XL, Headland Technology’s Video Seven, Trident Microsystems’ 8900, Tseng Labs’ ET4000, Western Digital’s Paradise,
Cirrus Logic’s CL-GD542X, and IBM’s 256c SuperVGA chip. Immediately after installing OS/2 2.1, and with a Tseng Labs ET4000-equipped video adapter in place, I ran the OS/2 utility DSpINSTL to switch from the default 640- by 480-pixel resolution VGA screen to 1024- by 768-pixel resolution Super VGA screen. The DSPINSTL utility automatically detected the ET4000. The 32-bit video driver provided fast screen updates, and OS/2 automatically updated the Win-OS/2 environment to also use the higher resolution I had chosen.

Better Peripheral Support
OS/2 2.1 offers more printer drivers than version 2.0, including support for the Hewlett-Packard LaserJet 4 and Desk Jet 500 series. In addition, version 2.1 supports Hitachi, IBM, NEC, Panasonic, Sony, Telix, and Toshiba CD-ROM drives connected through an Adaptec, DPT, Future Domain, or IBM SCSI controller.

OS/2 2.1 supports Microsoft’s MS-DOS CD-ROM extensions, or MSCDEX, in each DOS session via a VCDROM virtual device driver. VCDROM allows DOS and Windows multimedia applications that are MSCDEX-aware to process audio and other digital data concurrently under OS/2 2.1.

If your notebook’s BIOS supports APM, OS/2 will cooperate with the hardware to help you conserve battery power. You can double-click on an icon to determine how much battery life remains or to change your power management settings. Version 2.1 also supports PCMCIA 2.0, so you can insert or remove PCMCIA peripherals (perhaps a modem, hard drive, or network adapter) while the PC is still running.

Improving on DOS
IBM says that OS/2 2.1 improves on DOS in many ways, and I found the improvements worthwhile. In one situation at my office, OS/2’s illegal instruction message, complete with offending address, register dump, and button for clean termination, gave the programmer the information she needed to fix a stubborn bug. On plain DOS-based PCs, the program simply locked up the computer and required a hard reboot. In addition, OS/2 2.1 declared the following DOS batch file statement invalid: "IF ERROR-LEVEL 1000 GOTO BADRESULT." The statement is in error—DOS return codes must be in the range of 0–255—but DOS versions 3.3, 5.0, 6.0, and even OS/2 2.0 didn’t detect the error.

However, I found the NetWare Requester for OS/2 didn’t properly detect file sharing violations when one user (using the Copy command) tried to write to a file in use by another workstation. I realize that the Requester is a Novell product, not an IBM product, but Novell and IBM should have worked more closely to produce a more reliable LAN environment for OS/2 users. Novell says it is aware of the problem and is working on a fix.

To my delight, I discovered that OS/2’s HPFS option automatically remarps bad sectors on a disk to allow write operations to proceed normally. When you set up a partition, HPFS creates a pool of spare sectors that stand ready to replace bad disk sectors. When a program attempts to write a file to a damaged area on the disk, HPFS displays a message informing you that a spare sector was used to store the data and advises you to run CHKDSK against your OS/2 boot partition. And official on-line support remains limited to CompuServe.

Still Missing
There are still one or two gaps in OS/2 2.1. It doesn’t maintain a separate message queue for each application. Implementing this would reduce the time spent staring at an hourglass cursor. You still have to boot two installation disks if you need to run CHKDSK against your OS/2 boot partition. And official on-line support remains limited to CompuServe.

But OS/2 2.1, when installed on the proper hardware, is a definite step up from the confines of DOS or Windows-on-DOS. I find version 2.1 a productive environment when I want to run DOS, Windows, or OS/2 software. It is speedy, gives me about 630 KB of DOS memory (with network drivers loaded), and supports my ET4000 video adapter. Unless you need a prohibitively expensive hardware upgrade, you should think seriously about replacing DOS or Windows-on-DOS with OS/2 2.1. I’ve even grown attached to the object-oriented Workplace Shell.

Multiple Multimedia
OS/2 2.1 has built-in multimedia support in the form of MMPM/2 1.01. I found MMPM/2 a joy to use—once I obtained a driver for my MPU-401 adapter from the IBM National Support BBS. MMPM/2 will play standard MIDI (.MID) files, and I have configured OS/2 to generate attention-getting sound effects when OS/2’s alarm clock needs to tell me I have a meeting or some other appointment.

DOS-based multimedia programs run well in a DOS session as a result of IBM adding dual-thread DOS session support in version 2.1. As a multimedia-based program reads or writes to a disk file, the multimedia program needs to service sound card interrupts on a timely basis. Dual-thread support, in effect, allows DOS applications to multitask along two threads within a single DOS session. The second processing thread within a DOS session allows the program to handle sound card interrupts at the same time file read or write operations take place. The support is automatic; the DOS program does not have to do anything different to take advantage of the extra multitasking. Dual-thread support helps improve playback performance of a multimedia CD-ROM title that’s playing music through a sound card. A DOS session settings notebook entry, INT_DURING_IO, enables the dual-thread feature.
Our print systems have the extras built in.

The QMS® 420 and the QMS-PS® 410 Print Systems make options unnecessary! Both printers easily accommodate DOS/Windows®, Macintosh® and Unix® systems while supporting your Windows and other applications by automatically selecting the correct printer language from those available (ESP). They simultaneously receive data on serial, parallel and LocalTalk® ports for greater efficiency (SIO) and can print PostScript®, language, HP PCL® and HP-GL® documents.

The QMS 420 Print System. At $1,995, it's your best value in high resolution printing. It features 600x600 dpi printing and is compatible with PostScript Level 2 and Level 1, HP PCL and HP-GL print languages. With its 39 fonts for PostScript language printing, resident HP PCL compatible fonts, the efficiency of SIO and the convenience of ESP, it sets new standards of satisfaction for individual users and small workgroups.

The QMS-PS 410 Printer. At $1,595, it's the value leader in 300 dpi printing. It features Adobe's PostScript Level 1 and compatibility with HP PCL (HP-GL is optionally available). It has 45 standard fonts for PostScript language printing, HP PCL compatible fonts, and the efficiency and convenience of ESP and SIO.

Call 800 841-0760 or 205 633-4300 for more information about the QMS 420 and QMS-PS 410.

QMS, QMS-PS and the QMS logo are trademarks or registered trademarks of QMS, Inc. PostScript is a trademark of Adobe Systems Incorporated which may be registered in certain jurisdictions. All other products and company names mentioned are trademarks or registered trademarks of their respective companies.

The only Windows™ statistics package you'll ever need.

#1 for DOS and Windows
Rated "the best general-purpose statistics program" for the PC by Software Digest®, SYSTAT for DOS is now joined by SYSTAT for Windows. This addition to the SYSTAT family takes full advantage of Windows, with pull-down menus, dialog boxes, sizable windows, and the ease of use you expect in a Windows package.

SYSTAT for Windows runs in standard and 386 enhanced modes and can take advantage of Windows advanced memory management. No matter how large or complex your analysis is, you can use SYSTAT.

SYSTAT delivers a balance of power and simplicity. It lets you analyze and manipulate data with a comprehensive range of advanced statistical procedures, and present your results with stunning graphics.

Just point and click
SYSTAT is a full-fledged Windows application. Just point and click. SYSTAT's QuickStat™ buttons give you simple, single-click shortcuts to common statistical analyses.

More statistics, from the basic to the most sophisticated
A full range of univariate and multivariate statistics—from t tests to multidimensional scaling. With a few clicks you can turn most statistics into graphs and perform:
- multiway crosstabs with log linear modeling
- nonparametric statistics
- principal components and factor analysis
- cluster analysis
- time series
- nonlinear estimation
- correlation matrices
- means, effect, and dummy models
- post hoc tests

SYSTAT offers the most advanced multivariate general linear model available for Windows.

The most graphics
No other statistical or graphics package can produce all the scientific and technical graphs that SYSTAT can—nor surpass its ease of use. Graphics capabilities include:
- histograms
- single, multiple, stacked, and range bar graphs
- single and grouped box plots
- stem-and-leaf diagrams
- pie charts
- scatterplot matrices
- 3-D data and function plots
- contour plots
- control charts
- maps with geographic projections
- Chernoff faces
- complete color spectrum
- log and power scales
- confidence intervals and ellipses
- linear, quadratic, step, spline, polynomial, LOWESS, exponential, and log smoothing

A compatible family of products
Whichever you choose—SYSTAT for Windows, SYSTAT for DOS or both—you'll enjoy the most powerful statistics and scientific graphics software available for the PC.

For more information, special offers for current users, and demo disks, call:

708-864-5670
For Windows circle 146,
For IBM/DOS circle 147.
A FirstClass Experience

SoftArc's FirstClass E-mail and conferencing system goes multiplatform with Mac, Windows, and terminal support.

RAYMOND GA CÔTÉ

The longer I work with computers, the less I'm impressed with splashy graphics, thundering multimedia demonstrations, and benchmark figures that zoom off the chart. What impresses me more is ease of use, a near-zero learning effort, and immediate payback in productivity.

SoftArc's FirstClass E-mail and BBS product meets these requirements, and it's flashy, too. FirstClass is an integrated E-mail and conferencing system that works equally well over LAN and dial-up connections. Regardless of transport, users connect to the FirstClass server through a graphics-based (Windows or Macintosh) FirstClass client. Remote users with less-capable hardware can also log on through a menu-driven command-line interface using generic VTI100 terminal emulators.

With its latest release, SoftArc has broadened FirstClass's reach with the addition of a Windows client as strong as the original Mac implementation. FirstClass remains a Macintosh-centered system— the FirstClass server still runs under the Mac OS—but its new multiplatform focus pits it squarely against mail systems like QuickMail, Microsoft Mail, and cc:Mail.

FirstClass blends conferencing and mail together under a remarkably clean interface that goes far beyond the capabilities of most mail systems. It easily outperforms its new competitors on those fronts. What it lacks is solid support for large networks, including multi-hop mail (i.e., mail that must be routed through several servers), a full complement of gateways, and distributed directories.

Client Side
The graphics-oriented clients are where FirstClass shines most noticeably. From the first time you sit down in front of the Mac or Windows interface, you'll know how to drive FirstClass. Most communication and conferencing functions are right where you expect them to be. Finding the rest requires only minimal hunting or a quick check of the documentation.

FirstClass grants direct (though controlled) access to files stored in actual hard disk folders (or directories). This allows you to download and upload files directly to and from the server. The target folder need not reside on the FirstClass server—it can be any machine to which the server has access, such as other Macs sharing files on the network or any NetWare server. This feature, combined with careful use of System 7 file sharing and network permissions, can allow users who work on the network when locally attached to log in via dial-up and obtain direct access to their own private disks and directories.

The clients present a truly graphical interface, not just a windowing application using text. The configuration databases that define the "look" of a client screen are stored on the FirstClass server on a per-user basis; administrators can customize an interface, and user changes (e.g., changing the location of icons) are permanently stored.

The clients' built-in text editor provides full text manipulation—font, size, style, and color. Although I wouldn't call it full-featured, it exceeds anything available with
I've seen. Besides text, FirstClass also supports graphics display and sound on both the Mac and Windows platforms.

**Beyond the Obvious**

There's considerably more to the FirstClass client than the well-designed interface. Underneath the smooth presentation lies a remarkably efficient communication engine that lets you make the most of every second you spend on-line. With FirstClass, you rarely wait for operations to complete; you'll hardly glimpse a watch or an hourglass cursor during any session.

Historically, interactive conferencing systems have been inefficient. You read messages, compose replies, scan a few conferences—all low-bandwidth operations. If you use most of the bandwidth by, say, initiating a download, your keyboard is rendered inoperative for as long as the file transfer takes to complete.

FirstClass is a “multitasking” communication system. Multiple communication sessions, running in both directions, can be active at the same time. That means you can start a download and then move over to browse a conference while the download completes. Or you can start uploading mail replies, start downloading a few files, and then go on to read new messages as the transfers proceed in both directions.

Naturally, file-transfer speed degrades as you use up more sessions. However, the transfers never stop; they continue to run as quickly as they can over the shared communications line. If all you’re doing is browsing conferences, which consumes very little bandwidth, you’ll scarcely notice a degradation in transfer speed.

FirstClass’s multitasking ability also improves your overall performance when using slow modems. For example, when you open a busy conference, you will immediately see a list of messages being built as each title is downloaded. If you see a message you want to read, you don’t need to wait for FirstClass to build the entire list. You just immediately double-click on the item of interest. A window will open with that message, and the list update will continue in the background.

**Something to Start With**

Installation of both clients and server is straightforward. Each FirstClass server is delivered with the full complement of capabilities: Macintosh, Windows, and command-line interface services; NetWare IPX interface for Windows; and unlimited users. Each of these capabilities is activated using a license floppy disk. A simple Installer script loads the server files, and you’re ready to come on-line with a five-user AppleTalk network system.

The Mac and Windows client software is freely distributable. If you intend to use FirstClass for customer support, you can ship a client with each software package. In-house users can have clients loaded on their desktop machines, portable computers, and home machines without having to worry about license violations. Licenses apply only to the number of active users registered on the server and the types of clients supported.

Network administration for the Mac is trivial. Install clients and servers on all your machines, make sure AppleTalk works, name your server and select that server on each client machine, and you’re up and running.

Configuring for Windows operation is only slightly more difficult. First, you need the NetWare IPX option for your FirstClass server. Then NetWare client software must be installed on each Windows machine and the server name configured as above. Notice I didn’t say you needed a Novell server. The IPX option on the FirstClass server provides an IPX interface that allows direct communication between the server and networked Windows clients.

**Administering FirstClass**

All system administrative actions are performed using the standard client software (any client type) logged in with administrative privileges. Although the server is delivered with an administrator account, any account can be given administrative privileges. This removes the need to give out a single special password when you need someone else to perform administration. It also means that administration does not need to be done locally. Administrators can call in from remote locations or log in anywhere on the network.

FirstClass permission and privilege designations are complex and will take some getting used to. Privileges are assigned on a per-user (or, more commonly, per-group) basis; these define the type of services to which users are allowed access. Several privilege groups, such as All Users, Network Users, Telecomm Users, and Auto-registered Users (self-registered users on a public system), exist by default. Privilege groups may also be grouped hierarchically. For example, a single user can be a member of the All Users, Network Users, Management, and Secret Project groups, all of whose privilege settings combine to provide actual privileges.

Permissions operate on a much finer level. While privileges determine whether a user has access to the conferencing system at all, permissions define the level of access an individual (or group) has to specific conferences. Over 17 individual permission flags are available, from the relatively standard decisions as to whether to allow uploads and downloads, to the more specific abilities to create conferences or folders.

Privileges and permissions are complicated subjects and may require a bit of fine-tuning for best operation. However,
With MusicTime™
Your Sound Card Plays More Than Games.

Create Songs on Your Sound Card with MusicTime.
Whatever your musical ability, MusicTime will inspire you to create your own breathy love songs, foot-tapping jazz, or head-slammin' rock 'n' roll. With MusicTime and either a sound card or a MIDI instrument, you can compose, edit, play back and print sheet music on your PC.

Bring Your Music to Life.
Use your mouse to click musical notes and symbols onto a staff sheet. If you've got a Miracle® or MIDI keyboard, MusicTime will record and transcribe your live performance into music notation in real time—right before your eyes!

Easy to Play Back, Edit and Print.
Play back instantly through your sound card or MIDI gear. Editing is easy with MusicTime's cut, copy and paste commands. Automatically transpose notes into any key. Add guitar chords. Write beautiful lyrics. Print out publishing-quality sheet music.

MusicTime couldn't be easier to use.
Windows, Mac and MIDI Compatible.
MusicTime is available for PCs with Windows® or the Macintosh®, and is compatible with The Miracle Keyboard, Sound Blaster Pro®, Media Vision Pro Audio Spectrum® and Thunder Board™, AdLib Gold™ and most popular PC sound cards.

For your copy of MusicTime, call Passport or visit your nearest computer or music store. If you're tired of just playing games with your sound card, get MusicTime and turn your beeps and blasts into be-bop and hip-hop.

PASSPORT.
Passport Designs, Inc. • 100 Stone Pine Rd. • Half Moon Bay, CA 94019 USA • Phone: (415) 726-2280 • Fax: (415) 726-2254
Passport MusicTime is a trademark of Passport Designs, Inc. All other products and brands are trademarks or registered trademarks of their respective holders.
Circle 126 on Inquiry Card.
the default settings let you get a small- or medium-size network operational quickly.

The Outside World
FirstClass servers can communicate with each other to transfer mail and conference messages. Conference messages can be replicated across any number of servers, so all sites can see the same information.

E-mail currently operates only in a point-to-point mode. This is a serious deficiency because it requires the server at the sending site to call each destination server. SoftArc promises multi-hop mail for future releases, and I've seen a version in beta test that delivers this capability.

There is also no systemwide user directory, nor any way to receive a list of subscribers at a foreign server. You have to know the person's name and ensure that you spell it properly. Solutions to the directory problem are also promised.

Gateways are available from SoftArc and from third-party vendors for communicating with a number of other messaging systems. Microsoft Mail, QuickMail, fax, and FidoNet gateways are available. Third-party vendors provide Internet and UUCP connections that support E-mail and network news.

SoftArc claims that MHS (Message Handling Service), AppleLink, and CompuServe gateways are also in the works. But if you desperately need an interface to some system that is not currently supported, SoftArc provides a series of toolkits for building gateways and other interfaces to messaging systems.

FirstClass Upgrade
FirstClass is a mail and conferencing system fully deserving of its name. It is easy to set up and use and does not require a lot of computing power for a small or medium system. I ran a small network using a Mac Color Classic as the server. However, having a larger system will come in useful as the number of concurrent clients grows. SoftArc actually recommends old Mac II systems as servers since they have a large number of available expansion slots that can be filled with multiport modem cards.

FirstClass is fast, provides an intuitive interface for users, and is a regrettable rare example of a useful piece of software. Unfortunately, the current version won't scale up easily for very large WAN (wide-area network) systems. The next release should address some of the directory and multi-server issues. In any case, if you are setting up a mail system for your business, I can't stress how much a well-designed system like FirstClass, especially with its sophisticated conferencing features, can boost productivity over simple E-mail.

Raymond GA Côté is a consultant, freelance writer, and publisher of The Robot Explorer newsletter. He has extensive experience in Macintosh and Windows program development. You can reach Ray on BIX as "rgacote" and on the Internet at rgacote@byseph.byte.com.

Introducing the $139 investment no computer user can afford to be without...

"Don't take chances...Get the ultimate protection...Back-UPS from APC."

Blackouts, brownouts, sags... if you use computers, your bottom line is directly linked to your power line. The fact is, your data and hardware are vulnerable to problems that surge suppressors and power directors just aren't equipped to handle.

Now there's an Uninterruptible Power Supply (UPS) to suit any budget. Back-UPS® are perfect protection for LAN servers, personal computers, phone/fax systems, POS equipment, or any other device that can go down when the power does. If lightning is a concern, Back-UPS are even backed by a $25,000 insurance policy against surge damage to your equipment (see details).

So don't wait for the inevitable power problem to rob your business. Protect your productivity with Back-UPS, available where quality computer products are sold.

APC Back-UPS provide instantaneous battery power during power disturbances, so your data and hardware are safe!
In Life,
Only A Few Things
Inspire Passionate Loyalty.
Real Intel® 486 Power

People using the original HandBook asked for more power. They asked for a HandBook that would run Windows.™ We gave them both in the HandBook 486. It's the smallest Windows PC in the world — and when using a 486DX2 processor, the HandBook 486 is by far the most powerful PC of its size. New HandBook models include Intel's 3.3v 486 processors and come with 4MB RAM, expandable to 20MB, and large hard drives.

Backlit VGA, Built-In Pointer, PCMCIA

Users asked for VGA. The new HandBook's screen is a black-and-white VGA display, backlit for use in any lighting situation. No need to carry a mouse with your HandBook 486. The built-in pointing device is convenient and easy-to-use. The HandBook 486 also includes one PCMCIA Type II slot, and the card fits entirely within the footprint of the HandBook.

The Bottom Line

HandBook 486 models start at only $1,495, an extraordinary value even by Gateway's standards — and we wrote the book on value! We have a reputation for offering the best prices on high-quality products with exceptional service from friendly folks in the Midwest. Give us a call. Once you get your hands on a HandBook, you'll wonder how you ever lived without one!
"You'll have to pry my cold, dead fingers off to get it away from me." That's what an editor told us once about the Gateway 2000 HandBook we sent him for evaluation.

A journalist covering the conflict in Somalia called to tell us his HandBook was so popular among his colleagues that he could sell dozens of them for us.

Another user wrote, "The HandBook has changed my life in a way that only a few other products ever have. I take it everywhere with me — something I never did with other notebooks."

This is a tiny sampling of the response to the original HandBook. Clearly, the HandBook — the pioneer product in an entirely new category dubbed "subnotebook" computers — inspired the kind of loyalty usually reserved for Harley-Davidson motorcycles and man's best friend.

Introducing The HandBook 486

Now we are proud to introduce the next generation of the HandBook — the HandBook 486. Since we began marketing the original HandBook a little over a year ago, we've been asking customers to finish this statement: "I'd like my HandBook better if _____." The HandBook 486 includes most everything anybody asked for while retaining all the things people love.

The HandBook 486 still weighs under three pounds and is smaller than the day planners many people carry. The new HandBook still has a great keyboard, excellent battery life, a backlit screen, and that wonderful HandBook suspend/resume feature. But the new HandBook has some important features the original didn't have.
Introducing The HandBook®486!

The HandBook 486 has a handy, integrated pointing device.

Even though the HandBook is very small, it has an excellent, touch-type keyboard. You'll also appreciate the sturdy, heavy-duty plastics used in the case.

Options: PCMCIA fax/modem cards, PCMCIA VGA card, PCMCIA network cards, external floppy drive, 4MB or 16MB RAM upgrades, alkaline battery pack, carrying case and extra NiMH batteries. Call for details.

Features

Size

The difference between a 3-pound portable and a 4-pound portable doesn't sound like very much until you lug one around for hours. Then every ounce counts! HandBook users swear by the size of this product. It's big enough to be fully functional, but small enough to take anywhere effortlessly.

Intel® 486SX or DX2 Processor

Your HandBook 486 includes a genuine 32-bit Intel 486 processor — not some chip that's 'almost' a 486. Those who crunch numbers will love the high-performance numeric coprocessor in the DX2.

Backlit VGA Display

The HandBook's VGA display is easy on your eyes. The screen is backlit for use in all lighting situations so you won't ever be left in the dark.

PCMCIA Type II Slot

A PCMCIA slot is a great way to add a modem, network card or any of dozens of available PCMCIA-compatible peripherals.

HandBook 486SX-25

- Weight: 2.9 Lbs.
- Dimensions: 9.75" x 5.9" x 1.6"
- Intel® 25MHz 486SX Processor
- 4MB RAM (expandable to 20MB)
- 80MB IDE Hard Drive
- 7.9" Backlit VGA Display
- NiMH Battery & AC Pack
- Suspend/Resume Feature
- 1 PCMCIA Type II Slot
- Integrated Pointing Device
- 78-Key Keyboard
- Parallel, Serial & PS/2 Ports
- MS-DOS, Windows, Interlink and Serial Download Cable

$1495

HandBook 486DX2-40

- Weight: 2.9 Lbs.
- Dimensions: 9.75" x 5.9" x 1.6"
- Intel® 40MHz 486DX2 Processor
- 4MB RAM (expandable to 20MB)
- 130MB IDE Hard Drive
- 7.9" Backlit VGA Display
- NiMH Battery & AC Pack
- Suspend/Resume Feature
- 1 PCMCIA Type II Slot
- Integrated Pointing Device
- 78-Key Keyboard
- Parallel, Serial & PS/2 Ports
- MS-DOS, Windows, Interlink and Serial Download Cable

$1995

Traveler's Pack

- Carrying Case
- Extra NiMH Battery
- Alkaline Battery Pack
- PCMCIA Fax/Modem Call For Details

Presenter's Pack

- PCMCIA VGA Adapter
- Asymetric® Compel
- Carrying Case Call For Details

GATEWAY2000

"You've got a friend in the business."®

800-846-2039

GATEWAY2000

610 Gateway Drive • P.O.Box 2000 • North Sioux City, SD 57049-2000 • Phone 605-232-2000 • TDD 800-846-1778 • Fax 605-232-2023 • FaxBack 605-232-2561

Sales Hours: 7am-10pm Weekdays, 9am-4pm Saturdays (Central Time)

©1993 Gateway 2000, Inc. Black-and-white spot design, "G" logo and "You've got a friend in the business" slogan are registered trademarks, and Gateway 2000 is a trademark of Gateway 2000, Inc. The Intel Inside logo and Intel are registered trademarks of Intel Corporation. Harley-Davidson is a registered trademark of Harley-Davidson, Inc. All other brands and product names are trademarks or registered trademarks of their respective companies. Prices and configurations are subject to change without notice. Prices do not include shipping.
I'm not sure what the image represents.
more convenient as a desktop video system. But VM is not a slave to its internal sync. As the sync-in connector implies, VM can be synched to an external source.

With everything connected, you'll have quite a tangle of cables behind the PC. Fast Electronic plans to sell an optional Studio Control Box that will consolidate all connections into an outboard black box with balanced audio inputs. The Studio Control option will also support linear time code, a capability missing in the standard version of VM. Note, though, that out of the box, VM supports VITC (both SMPTE and EBU), RCTC, and Rapid Time Code. VM will write VITC code to the master recorder even if the recorder lacks time-code hardware. The optional control box will also provide two video preview outputs. The stock VM lacks any preview outputs, but you will probably want to use the preview outputs of your professional-level video players anyway.

VM is compatible with PAL, NTSC, and SECAM input. The board outputs NTSC and PAL signals to a full 5.5-MHz bandwidth, with screens of up to 625 lines at 576 pixels per line. I tested it only with NTSC. VM can also accept mixed video standards during editing or convert from one standard to another.

I verified that VM can edit to half-frame accuracy when attached to capable video equipment. Although VM does not support true digital video recording (other than single-frame capture), Fast Electronic says that it hopes to offer digital, non-linear editing capabilities as an option. That option will include a digital JPEG video-compression board.

Putting the Pieces Together
A presentation in VM begins with the Project Manager. In this window, you prepare and organize the raw resources for the project: video clips, still images, titles, audio, special effects, and so on. Each object has its own editor that lets you define the object and attach pertinent settings to it (e.g., tweaking color temperature in a video clip).

For instance, using the Clip Editor, you might define as a clip a 10-second segment on videotape starting at 04:23:28 and customize playback parameters including color saturation, brightness, and contrast. You then attach a name and explanatory notes. The newly defined clip is placed in a window assigned to the specified videotape segment. Thumbnails of the Mark-In image for the clip are displayed in the reel window for later visual identification. During assembly, if your clip length doesn't quite fit the presentation, you can alter the Mark-In/Mark-Out settings for that clip without changing the basic clip definition. If you need still video images, you can capture them directly from source material using the Graphic Editor. You choose the source and click on Capture. The Editor grabs individual frames and stores them in a wide variety of graphics formats, from PCX to BMP to JPEG, in color resolutions up to 32-bit. Like video clips, these screen captures are placed in a graphics group window and displayed as thumbnails.

When capturing images in less than true-color resolutions, VM optionally can calculate custom palettes and apply Floyd-Steinberg and Bayer dithering techniques to maximize image quality.

All objects can be organized into racks. For example, you might want to place all the objects for a single scene into a scene rack. By assigning audio/video settings to each rack, you can not only match clip appearance but also establish an overall video "look" for a particular scene.

Special Effects
With the pertinent objects for a scene ready, you're almost prepared to assemble the scene. However, you can also select the DVEs you'll frequently use for the scene and place them in a selection bar for easy access and editing. VM comes with dozens of prefabricated effects, from wipes to dissolve to elaborate zooms and picture-in-picture trailing effects. Even so, you'll quickly find some effect that wasn't included. Hopefully, Fast Electronic will make more DVEs available in the future.

Until then, you can design or edit DVEs in VM's DVE Editor (see the screen on page 153). The Graphical Effects Editor provides four adjustable screen-aspect ratios: two for the effect creation and two to represent the effect's appearance on-screen. Although the DVE Editor doesn't provide tools to design all the effects that VM can produce (most of the tools are based on squares and rectangles and therefore could not generate some of the effects bundled with VM), it does let you customize fades, tumbles, strobos, wipes, and so on. You can preview the results with a preview button in the Editor or with a Time Bar emulator in the Time Line. Note that VM does not support true 3-D digital effects (e.g., spinning cubes with video images), although some simulated 3-D effects are available.

Fast Electronic arrived at a unique solution for the Titler module (see the screen on page 153). It is attached to the Windows environment as a printer driver. You create titles by entering any Windows-based word processor or graphics editor and identifying the VM Fast system as the printer driver. You create your choice of graphic or text and then print the results.

The Fast Titler screen appears, with available settings for color, type of title (e.g., still, crawl, or roll), wipe, antialiasing, position, transparency, and so forth. A preview mode lets you see the title against a video background if the VM software is multitasking in Windows. When you have the correct results, the driver saves the object to disk.

The VM Titler provides real flexibility by making an object of almost anything. In addition to the normal titling functions, for instance, you can produce logos or other small graphics to superimpose on the screen. Flexible color-mapping controls let you assign different levels of transparency to color groups, opening the door to a wide variety of color/chroma-key-like effects. The drawback is that the Titler requires you to leave VM, load another
Oh, it's not a total downer. We stored our data on Verbatim, didn't we?

Verbatim® tapes, optical and floppy disks. Your best defense against data loss.

Circle 154 on Inquiry Card (RESELLERS: 155).
Video Machine: True Desktop Video

Assembling a Video Clip

1. Video editing starts by capturing an item with VM's Clip Editor (top). Thumbnails of the Mark-In image for the clip are displayed in the real window for visual identification (center). You can then select a clip from the real window and drop it onto the Time Line (bottom). Positioning the clip in a player track (V1) assigns the object in and out times based on its length. Next, you drop a second clip onto track V2. To create a transition between tracks, you simply drag the desired effect (in this case, a dissolve) from the project window and drop it onto the FX track of the Time Line. With a few simple mouse-clicks, you've assembled two video clips with a dissolve between them.

2. To place an item into a presentation, you use the mouse to click and drag objects from the Project Manager into tracks in the Time Line window (see "Assembling a Video Clip" above). The tracks represent the two video player sources, a DVE track, and the audio tracks, which can be linked to video tracks in stereo pairs. (You cannot access the audio mixer as eight discrete inputs, only as four stereo pairs.)

3. Positioning an object in a player track will assign the object in and out times based on its length. The process is aided by options in the toolbar, such as a "magnet" tool that automatically butts Mark-Out times of an object to the Mark-In time of the next object. To create transitions between objects, you drag a DVE into the track in which you want the effect to end.

4. For example, to dissolve between V1 (Video 1) and V2 (Video 2) at 10 seconds, you drag the dissolve DVE icon onto the V2 track at 00:00:10:00. The program places it in the DVE track with instructions to begin with V1 and dissolve to V2. You can lengthen the effect by dragging its right end further along the Time Line, or you can relocate the effect entirely.

5. With the Time Line complete, you can preview the work or commit it to tape. Click the record symbol, and the computer does the final edit.

Perfect Timing

With clips, racks, and DVEs prepared, creating a video production is almost as easy as drag-and-drop. While VM has the power to satisfy video professionals, its basic design puts the techniques of video editing well within the grasp of newcomers.

To place an item into a presentation, you use the mouse to click and drag objects from the Project Manager into tracks in the Time Line window (see "Assembling a Video Clip" above). The tracks represent the two video player sources, a DVE track, and the audio tracks, which can be linked to video tracks in stereo pairs. (You cannot access the audio mixer as eight discrete inputs, only as four stereo pairs.)

Positioning an object in a player track will assign the object in and out times based on its length. The process is aided by options in the toolbar, such as a "magnet" tool that automatically butts Mark-Out times of an object to the Mark-In time of the next object. To create transitions between objects, you drag a DVE into the track in which you want the effect to end.

For example, to dissolve between V1 (Video 1) and V2 (Video 2) at 10 seconds, you drag the dissolve DVE icon onto the V2 track at 00:00:10:00. The program places it in the DVE track with instructions to begin with V1 and dissolve to V2. You can lengthen the effect by dragging its right end further along the Time Line, or you can relocate the effect entirely.

With the Time Line complete, you can preview the work or commit it to tape. Click the record symbol, and the computer does the final edit.

Video Performance

To test VM, I put together an A/B roll system using professional hardware from JVC, including the BR-S52SU player and the BR-S82SU and BR-S62SU recorders. These are S-video units designed for studio use. VM supports a thorough cross section of video hardware from several manufacturers.

continued
Getting PCs to co-exist with diverse computing standards means keeping a lot of balls in the air.

As the pioneer in developing X Servers for Microsoft Windows™, VisionWare™ understands how to unite Windows, X™, NT™, networks, UNIX™ and VMS™ to bring all your computing standards together at the PC desktop.

XVision 5 sets a whole new standard for PC X Servers as a smart, environment-aware server. XVision 5 automatically detects underlying network transports, automatically optimizes graphics speed to any PC hardware configuration, automatically aliases fonts and automatically eases the installation process.

Not stopping there, XVision also features transport-independent file transfer, local terminal emulation and an object-oriented, drag & drop desktop integrating DOS/X/Wi ndows.

XVision 5 ties it all together. Instead of another ball to keep in the air, XVision provides a real solution that finally frees you from the whole juggling act.

XVision 5
The Smart PC X Server from VisionWare.
I connected the devices through the optional RS-422 ports. Inexpensive preview monitors were attached to the VCRs' composite video preview ports. The master monitor was the JVC TM-1400SU, an S-video studio monitor. I assembled a variety of source objects and developed a half-dozen test presentations.

The Project Manager editors worked smoothly. VM exhibited seamless VCR control as I browsed tapes, creating video clips with two mouse-clicks to set the in and out points. I rate the object-creation process as one of VM's best features.

Less satisfactory was the Time Line. The editing and assembly software exposes VM as a first-generation product. Automated assembly was inconsistent and unpredictable, particularly during DVEs. In one case, a dissolve previewed properly but only flickered the screen during final edit. Some special effects edited correctly to the S622U but not the S822U (the two models have different VM setups and so are controlled somewhat differently, but the effects should work the same on both). Some effects functioned during one assembly and not during another, even though I made no change in the Time Line. During one session, the toolbar disappeared entirely and returned only after I reloaded the program.

The VM manual could be improved by more thorough explanations of setup and operation, as well as by adding an introductory walk-through. My features wish list includes the ability to use VM as a video output card for laying animations to tape, support for playing back animations as objects, and the ability to use the VCR controller to record single-frame animation (currently listed as a future option).

The Final Cut
Video professionals who use VM at this point will be opting for a pioneer experience, with all the joy and frustration that implies. During my evaluation, however, as evidence that it is sincere about perfecting and improving the system, Fast Electronic released a major software update that added several new features, including the VITC striping.

Despite some flaws in this initial release, VM's overall execution is sound, well designed, and effective. The automated editing seems like magic and can produce stunning results.

VM is an outstanding achievement with tremendous potential. Its future success is linked to those necessary software upgrades; if they proceed efficiently, Fast Electronic's Video Machine looks like a sure bet to make the video-editing PC an essential part of professional and semi-professional video studios.

Bob Lindstrom (Eugene, OR) is a nationally syndicated columnist and composer. He is a former creative director for Dynaflow. You can reach him on BIX clo “editors.”

Your Choice of Keyboard Monitor Switches
Access multiple computers with a single keyboard and monitor to cut equipment costs, save valuable space, and end clutter

- Simple pushbutton operation for quick selection
- Four, eight, or twelve ports per unit
- Daisy-chaining connects unlimited number of CPUs
- Compatible with EGA, VGA, Macintosh, Sun, and others
- Optional keyboard booting for 286, 386, and 486
- Optional RS232 or PS/2 mouse interface
- PCB construction for high reliability and low crosstalk
- Rack mount, matrix, and customized units available

Switch by keystroke, from front panel, or RS232 port
Two or four ports per unit
Cascade units to support up to 255 CPUs
Supports monochrome, EGA, and VGA
Includes keyboard booting for 286, 386, and 486
Includes RS232 and PS/2 mouse interface
LEDs display selected CPU and CPU power-on
Scan function switches among CPUs automatically

Make the Rose Connection
10850 Wilcrest Drive • Houston, Texas 77099 • Phone (713)933-7673 • Fax (713)933-0044

Call toll-free now for your copy of our Switching and Sharing Solutions catalog.

Other Rose products: Print servers, printer sharing units, print buffers, keyboard monitor extenders, video splitters. All Rose products are U.S.-made and have a 1-year warranty.

About the Product
Video Machine for PC: $3995
Video Machine with Multi I/O Professional: $4995
Studio Control Box: $2500
Fast Electronic US, Inc.
5 Commonwealth Rd.
Natick, MA 01760
(508) 655-3278
fax: (508) 650-0447
Circle 1075 on Inquiry Card.

JVC Co. of America
41 Slater Dr.
Elmwood Park, NJ 07407
(800) 526-5308
(201) 794-3900
Circle 1076 on Inquiry Card.
SEARCHING FOR THE BEST TRUE COLOR SOLUTION IN THE UNIVERSE?

If you're trying to visualize the perfect true color card, look no further than Pro Graphics™. From Media Vision. The only true color solutions with enough speed, resolution and true color for any visualization need. At a price that's truly affordable. Both Pro Graphics 1024 and 1280 give you workstation quality visualization on your PC. With 24-bits/pixel as high as 1280x1024 and 1024x768 resolution modes. That's 16.7 million colors, full-time, in any mode. And over four times the true color performance of most other popular 24-bit, high resolution graphics cards. What's more, they support the VESA local bus interface to give you up to 133MB/second bandwidth. And since the 1024 costs about half what the competition does, any other claim is just a pie in the sky. So when you're looking for powerful, affordable true color, just look for Pro Graphics from Media Vision. We're creating true color everyone else will be looking up to.

© 1993 Media Vision, Inc., 3185 Laurelview Court, Fremont, CA 94538. 1-800-845-5870. Fax: (510) 770-9592. Media Vision is a trademark of Media Vision, Inc. All other trademarks and registered trademarks are the property of their respective companies.

Circle 168 on Inquiry Card.
Rendering. Visualization and flybroughs - at your fingertips! MicroStation offers photo-realistic rendering to every designer, right in the software. It's easy to make your image reflect your imagination.

Windows. It walks and talks Windows. Behind MicroStation lies the user-responsive programming you look for in good Windows software. Version 5 gives you the ultimate in integration of CAD, engineering, and business applications.

MORE POWER TO YOU.

Modeling. Model any surface you can imagine in MicroStation. NURBS surface modeling combined with 3D Boolean operations gives you astounding flexibility in creating and modifying freeform models.

Drafting. MicroStation gives you first-rate drafting power - without the limitations of old technology. Enjoy the advantages of contemporary features like associative patterning, batch plot preview, standard text editing and fonts, and context-sensitive Hypertext help.

Workspaces. Choose the design environment that matches your profession or your CAD expertise - even AutoCAD. Complete with custom interfaces, drafting styles, and design environment management. CAD has never been so streamlined!

Read & write AutoCAD .dwg

Intergraph® is a registered trademark of Intergraph Corporation. MicroStation® is a registered trademark of Bentley Systems Inc., an Intergraph affiliate. Other brands and product names are trademarks of their respective owners. Copyright 1993 Intergraph Corporation, Huntsville, AL 35804-0001. 10/93D12160
Usability. What does computer-aided drafting have to do with the way you think? Everything. MicroStation software works for you. It understands the drafting process so well that it infers what you’ll do next.

Graphical User Interface. MicroStation’s easy-to-use interface includes pull-down menus, dialog boxes, tear-off tool palettes, and tool settings window. Choose your interface — Windows or Motif — on any platform. Transparent Modelless Operation. The software supports the way you naturally work, maintaining command execution while you fine tune: change element attributes or command parameters, manipulate views, change the dimensioning system, and more. Powerful View Manipulation. MicroStation supports up to eight active views that can be moved, sized, and overlapped to fit your design. Zoom and area at any scale. Move around your design fast with built-in dynamic panning. Workspace Editor. Tailor pull-down menus, dialog boxes, and tool palettes — even disable commands — with a graphically oriented toolset for customizing your chosen interface. Text Capabilities. A convenient text editor lets you easily edit single-line or paragraph text. Choose from TrueType, Postscript, AutoCAD SHX, and MicroStation fonts. ASCII text files can be imported and exported. Multiple Undo/Redo Commands. Undo mistakes and perform “what-if” designs in a flash with unlimited undo and redo. Plotting. Plot raster and vector information by view or defined areas, at any scale. Visually preview the plot before plotting, saving time and materials. Online HELP. MicroStation’s HELP remains active, tracking the command you’re currently using, so there’s no searching through manuals for assistance. Associative Patterning and Hatching. Associate patterning with graphics. Change graphics and the patterning updates. Flood-fill hatching/patterning intelligently fills an area, detecting boundaries and holes with a single pick. Associative Dimensioning. Dimensions are associated with the geometry, not with a point in space, so that when you change the geometry, the dimensions automatically update. Custom Line Styles. Create space-saving custom line styles and place railroad tracks, trees, isobars — anything — just as you would place a line. Multi-lines. Define line string elements comprising up to 16 parallel lines of varying symbology and store them in a style library for all. Architects can use multi-lines for fast and easy placement and intersection cleanup of walls and partitions. 2D Boolean Operations. Quickly modify, measure, and hatch multiple 2D shapes with integrated Boolean operations. Mass Properties. Calculate area and properties of your model: surface area, volume, mass, centroid, moments and products of inertia, principal moments and directions, and radii of gyration. Define relationships among graphic entities with intuitive drawing modes such as tangent, parallel, perpendicular, midpoint, intersection, and end-driven Symbols. Based on established relationships, you can assign variables to dimensioned graphics and save the graphics as cells of your model: surface area, volume, mass, centroid, moments and products of inertia, principal moments and directions, and radii of gyration. Symbol Libraries. Designs and complex elements can be saved to a library to be recalled later via MicroStation’s convenient Cell Browser. Cells can be individually or as shared cells. Cell Library Browser. View a cell before you place it with the Cell Browser dialog box. Raster Viewing. You can view
**ÆGIS: The World's Best Anti-Piracy Protection in Minutes.**

The ÆGIS System protects both DOS and Windows applications.

<table>
<thead>
<tr>
<th>File</th>
<th>Edit</th>
<th>Format</th>
<th>Options</th>
<th>Window</th>
</tr>
</thead>
<tbody>
<tr>
<td>ÆGIS SYSTEM — DOS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INPUT FILENAME:</td>
<td>TEST. EXE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OUTPUT FILENAME:</td>
<td>ÆGISST. EXE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENCRYPTED FILES:</td>
<td>*OVL  *DTA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENCRYPTION KEY:</td>
<td>1234ABCD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MESSAGES:</td>
<td>ENGLISH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SELF TEST:</td>
<td>Y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERIODIC CHECK:</td>
<td>30 SEC.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXPERT MODE:</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PRESS ENTER TO START PROGRAM CONVERSION...

- ÆGIS automatically checks for code changes due to viruses or hackers.
- ÆGIS automatically monitors the hardware key's presence.
- Only ÆGIS protects programs plus data files and overlays.
- Selling in other countries? Specify English, Spanish, German or other languages.
- Your application is enclosed in a highly secure encrypted shell, fully protected — with no programmer coding — in less than 7 minutes!

**End of Story.**

800-841-1316

SOFTWARE SECURITY

1011 HIGH RIDGE ROAD STAMFORD, CT 06905 203-329-8870 Fax: 203-329-7428 BBS: 203-329-7253

Software Security International, Ltd.: +44-784-430-060 Fax: +44-784-430-050

Circle 143 on Inquiry Card.
LANtastic 5.0 vs. Invisible LAN 3.4

Upgraded peer-to-peer LANs with high performance and capable Windows clients reduce the strain of networking Windows workstations

BARRY NANCE

Windows for Workgroups has kindled a higher level of competition in the peer-to-peer LAN marketplace. Only a year ago, people talked about Windows and networks as if they were oil and water. Now, Windows and LANs seem inseparable.

But you have choices other than Windows for Workgroups. You can, of course, choose a server-based system for high performance and the highest level of reliability. For smaller LANs, however, especially where price is a primary consideration, a peer-to-peer solution makes more sense. In this review, I'll look at LANtastic 5.0 for Windows and Invisible LAN 3.4, two peer-LAN staples that have recently undergone major revisions for improved performance and better Windows integration.

Both Invisible LAN and LANtastic have features that make them good peer-to-peer network operating systems for DOS and DOS/Windows environments. They're reliable and more or less easy to install and use. Both are good at sharing disk space, files, and printers. Both come with capable E-mail systems. In the end, the choice comes down to the high performance of Invisible LAN 3.4 versus the easier configuration and use of LANtastic 5.0.

Distinguishing Features

Both Artisoft and Invisible Software offer starter kits (which include hardware) as well as software-only packages; I evaluate only the software in this review. Starter kits are convenient, but Ethernet cards and cables are cheap and plentiful. It's the software features that distinguish peer-LAN products.

On a server-based network, a separate, unattended computer acts as a file server. On smaller LANs, a workstation can be a file server and a workstation at the same time. This is a peer-to-peer LAN, or peer network. If you are on a tight budget, you can save the cost of a separate file server by using a peer LAN. Be aware, though, that performance may not be entirely satisfactory, because the file server is using DOS and is also acting as a workstation.

You put your data somewhat at risk with a peer LAN. If someone is using an application at a workstation that is also a file server and that application crashes, your network will crash. However, you can make a peer-LAN node a dedicated server just by not using it as a workstation.

A peer LAN has to support shared resources properly. The first thing I checked in both products was support for file sharing, record locking, and machine name identification, as well as proper functioning during the concurrent transfer of large files and files with odd sizes (e.g., copying a 65,536-byte file). LANtastic and Invisible LAN passed these tests with flying colors. You can share resources and run mulituser applications on these networks with confidence.

INVISIBLE LAN 3.4

Invisible LAN is a simple, fast, peer-LAN operating system. Although it lacks the frills of LANtastic 5.0, Invisible LAN offers better performance and a "server" option for speed-sensitive or larger peer environments.

Invisible LAN includes a Windows interface program called Network Manager. To install Network Manager, you run the DOS-mode Windows setup utility and then manually add the program and its icon to a Windows program group. Network Manager offers six categories of management tasks—Mappings, Local Station, Information, Print Spooler, Administration, and Electronic Mail. It allows you to share drive letters and parallel ports, manage print jobs, send and receive messages, and control security from within Windows. Invisible LAN doesn't install in a Windows environment as automatically as LANtastic does, but the process

Both Invisible LAN (top) and LANtastic for Windows integrate networking features into the Windows environment. Invisible LAN's Windows client, called Network Manager, allows you to assign drive letters and parallel ports to shared resources, manage print jobs, control security, send and receive messages, and perform other network tasks. LANtastic for Windows has better overall Windows integration. Two of its more sophisticated Windows features are a Windows Network Scrapbook, which allows users to share information between networked applications, and a strong graphical E-mail interface. Unlike the Clipbook Viewer in Windows for Workgroups, LANtastic's Windows Network Scrapbook lets you share only static data.
LANtastic 5.0 vs. Invisible LAN 3.4

**High Performance**

The $399 Ultra Server option for Invisible LAN helps the product make up for a lack of administrative niceties. Ultra Server is a 32-bit file management module that is licensed on a per-network basis. Theoretically, you can use Ultra Server on a non-dedicated machine, but in most cases you'll want to turn one PC into an unattended file-sharing engine. The performance will be worth the cost of the extra PC. Ultra Server boosts performance in a variety of ways, including 32-bit, protected-mode hard disk access and fast disk caching. As measured by benchmark tests, Ultra Server doubles Invisible LAN's performance. Invisible LAN uses a network protocol called TransBIOS, which is much like the IBM/Microsoft NetBEUI standard. TransBIOS negotiates a packet window between workstations and servers. The window is the number of file-read packets the server can send to a workstation, or the number of file-write packets the workstation can send to a file server, without requiring acknowledgment from the other party. This mechanism lets Invisible LAN transfer more information in a given amount of time, thus improving performance.

**User's View**

Invisible LAN offers a reasonable set of printing, mail, and conferencing features to each client. Network users can monitor, hold, and reprioritize print jobs sent to shared network printers. Invisible LAN can display print jobs by job title, time, or size, and you can use Windows Print Manager to manage print jobs from your own workstation (but not those jobs submitted by other workstations).

When you want to communicate with your coworkers over the LAN, you can send E-mail or use Invisible LAN's BBS-style conferencing. Invisible LAN's E-mail system offers a text editor for creating electronic interoffice memos. In addition to sending and receiving over-the-wire correspondence, you can print, save, and reply to incoming mail.

With conferencing, you leave messages in a message base that the other team members can read; other participants can also attach comments to messages. The message base maintains threads among

---

**Peer-LAN Benchmarks**

I tested these operating systems on a four-node peer LAN. The test configuration included four 25-MHz 486 machines (made by IBM and Compaq) running Windows 3.1 on DOS 5.0 or DOS 6.0, and four Novernet Ethernet adapters (made by Artisoft) hooked up through thin-wire Etherent. The benchmark results are shown as file I/O performance relative to a stand-alone machine; therefore, 1.0 represents a perfect score. I found Invisible LAN slightly faster than LANtastic (with both LANCache and Alone) when I didn't use Invisible Software's Ultra Server option. With Ultra Server, however, Invisible LAN was—amazingly—twice as fast as LANtastic.
WHY OUR INTELLIGENT MODEMS ARE A WISE INVESTMENT.

With the ZyXEL U-Series moderns, you're sure to save. Time. Effort. Money. The savings begin with the U-Series' ultra-high-speed—16.8Kbps data, 14.4Kbps fax (send and receive). And our new PLUS Series runs at 19.2Kbps.

But what keeps you saving are the U-Series' intelligent features—features that save you effort and ensure reliable communications.

Like Fast Retrain with Auto Fall-Forward Fall-Back. And multi-level security features Call-Back Security and Password Protection. You can even answer calls selectively with Caller ID.

Want to save by having one phone line do the work of three? Get the U-Series. It adds Digitized Voice Capability with Speech Compression to its fax and data capability. And, Distinctive Ring and Auto Data/Fax/Voice Detection* for intelligent access to all three.

And now there's a Cellular Option for our PLUS Series.

Everyone can save with the U-Series moderns. Because they're smart enough to work in all environments including DOS*, Windows*, OS/2®, Macintosh®, NeXT®, UNIX®, and Amiga™—and with async/sync systems. The U-Series moderns support V.32bis/V.32, as well as industry-standard data compression and error correction protocols.

But in case you believe all this intelligence is expensive...relax.

The U-Series are the lowest-priced, high-performance moderns around. And they come with Voice/FAX software and a 5-year warranty. Which means now is the perfect time for smart people to save—by getting the ZyXEL U-Series moderns.

To start your wise investment, just call today for the name of your nearest ZyXEL dealer.

(800) 255-4101

ZyXEL
The Intelligent Modem
4920 E. La Palma Avenue, Anaheim, CA 92807, (714) 693-0808
BBS: (714) 693-0762, FAX: (714) 693-8861

*Auto Dialer/Voice detection available on DOS® version. Windows® version available with Auto Dialer attachment. Specifications are subject to change without prior notice. All trademarks are the property of their respective owners.

Circle 172 on Inquiry Card (RESELLERS: 173).
LANtastic has been a market leader for a number of years, and with good reason. LANtastic isn’t the fastest network you can buy, but the software is easy to install, easy to use, and feature-rich. I review LANtastic for Windows here, but Artisoft sells a DOS-only version for a little less ($119 versus $139 for a single workstation).

Artisoft’s support for Microsoft Windows is complete, although not quite as highly integrated with Windows as Microsoft’s own Windows for Workgroups. LANtastic gives you an over-the-wire scrapbook for the Windows environment, called Windows Network Scrapbook, that works something like Microsoft’s Clipbook Viewer. You can share text, image, and sound files with other Windows clients.

The LANtastic scrapbook is static, not dynamic: Other workstations get a copy of the data you want to share, not a connection to the original data on your PC. In contrast, Windows for Workgroups’ NetDDE feature allows dynamic, real-time data connections between Windows applications running on different systems. To its credit, LANtastic’s Windows Network Scrapbook can send messages that include a DDE macro that launches a given application when the recipient opens his or her mail.

The Windows E-mail component of LANtastic provides automatic notification of incoming mail, drag-and-drop capabilities, and cut-and-paste functions in the text editor. You can attach only a single file to an E-mail message.

Under Windows, you connect to a shared printer by simply clicking on the printer’s icon and then clicking on the parallel port icon. You can monitor print jobs in the queue or those print jobs currently being serviced (i.e., printed). You can see printer status (on-line or off-line) and the estimated time to finish the printout. You can prioritize, hold, or delete print jobs, and even schedule print jobs for off-hours printing. With a feature called immediate despooling, a print server can begin printing a spool file even before the workstation completes the print operation.
Discover the basic principle of connectivity...

Look to SmarTerm® for visionary emulation and multi-platform connectivity.

*It's a basic principle worthy of Galileo:*
SmarTerm's stellar PC-to-host connectivity puts you at the center of your system. New SmarTerm emulation software for Windows will expand your vision with a galaxy of UNIX, VMS, and DG host applications. SmarTerm 420 for Windows and SmarTerm 340 for Windows have both been upgraded. We also offer SmarTerm 470 for Windows, the first full-featured Data General 470 emulation product for Windows. And coming soon—SmarTerm for Windows NT!

**New Windows Sockets TCP/IP and more!**
Assure your system a window on the future with great new features like SmarTerm TCP/IP as a Windows Sockets DLL, drag-and-drop FTP, a dialing directory, a script recorder, and *SmartMouse*™ enhanced mouse support!

**Test a proven theory for reducing support costs.**
It's a fact. You'll save money and time with SmarTerm's pioneering corporate support tools and utilities.

These corporate support tools include simplified keyboard remapping, pop-up keyboard, toolbox, customizable help system, and enhanced button palettes with icons or text.

**Discover SmarTerm.**
It's the only emulation software that includes LAT and SmarTerm TCP/IP as a Windows Sockets DLL (a $199 value) FREE in every package. Discover the basic principle of connectivity today.

Call 1-800 EMULATE (1-800-368-5283).

Persoft U.S.A. 465 Science Dr. • Box 44953 Madison WI 53744-4953 • Phone (608) 273-6000 • FAX (608) 273-8227
Persoft Europe World Trade Center • Beursplein 37 • Box 30237 • 3001 CA Rotterdam, The Netherlands • Phone +31 10 405.3660 • FAX +31 10 405.5073
©1993 Persoft, Inc. SmartMouse is a trademark and Persoft and SmarTerm are registered trademarks of Persoft, Inc. Other trademarks mentioned are properties of their respective companies.

Circle 129 on Inquiry Card.
**Significant Features**

Artisoft includes with LANtastic a disk-caching utility called LANCache. LANCache boosted LANtastic’s performance in my tests, but not nearly as much as Ultra Server did for Invisible LAN. Artisoft also bundles Alone, a module that allows you to dedicate a PC as a LANtastic server. Alone restricts users from running applications on dedicated machines.

Although Alone and LANCache together don’t add up to Invisible LAN with Ultra Server, LANtastic has connectivity features that more than make up for its lack of speed. For example, LANtastic’s NetBIOS packets are routable—through readily available IPX routers. According to Artisoft, LANtastic NetBIOS packets contain source and destination ID dataots at which the information would reside in an IPX packet. I didn’t test it, but the company claims that the packet structure makes LANtastic routable through any device that can route IPX.

LANtastic workstations can also share modems, using NetBIOS-aware communications software, through Artisoft’s optional Articom Modem Sharing product. Artisoft offers gateways to NetWare and to TCP/IP networks. Last but not least, a version of LANtastic runs on Macs, although connecting Mac and PC LANtastic nodes requires a dedicated PC.

However, the most notable feature of LANtastic is its sophisticated file-by-file security. You administer LANtastic security through ACL (access control list) groups. These groups let you assign and change access rights for a group of users at a time. If you wish, you can designate file-access permissions for a particular user. You can set access rights at the directory level (afflicting all files in the directory) or for a given file. The access rights you set include permissions to read, write, create, and modify files. By default, the rights are in effect 24 hours a day; however, you can also set up time-of-day and duration-specific rights. LANtastic’s security system can force users to change passwords periodically and can encrypt passwords over the wire.

LANtastic also includes some nice administrative touches. A LANtastic network administrator can operate a LANtastic file server through remote control. The administrator can set up log-on accounts on one server and have all workstations authenticate against that central directory. The administrator doesn’t have to add a new log-on account to every file server, as would be necessary under systems like NetWare 3.11.

**Between Peers**

How do LANtastic for Windows and Invisible LAN play against Windows for Workgroups? Windows for Workgroups has much better overall integration with Windows than either of these products, with a more capable NetDDE and seamless linking to File Manager and Print Manager. It also includes scheduling and other productivity applications. But Windows for Workgroups is much slower on all but the most trivial networks.

If your organization is new to LANs and you have users who aren’t comfortable with DOS, I recommend that you buy LANtastic 5.0 for Windows. You’ll also want to get LANtastic instead of Invisible LAN if you have Macs or if the peer LAN you create is part of a larger NetWare network.

If your group is already familiar with DOS and will forgo some of the niceties of point-and-click for pure speed and responsiveness, you’ll definitely want to buy Invisible LAN with the Ultra Server option. LANtastic is a Cadillac, but Invisible LAN is a hot rod (and Ultra Server is a fuel-injection and turbocharger option). Both peer LANs are reliable and handle the basics well, and pricing is similar; choosing between the two is mostly a matter of deciding between speed and comfort.
CorelDraw 4.0: The Word Is More

Path-based animation, multiple pages, an object database, and even OCR and forms generation: The latest CorelDraw packs in the features

G. ARMOUR VAN HORN

More. That's the central theme of CorelDraw 4.0, the market-leading illustration software for Windows—more fonts, more clip art, more modules, more common interface among modules, and more pages. The box includes two CD-ROM disks, but the video tour that introduced new users to the program for the last two versions had to be eliminated—there just wasn't room for it.

For many professionals, CorelDraw 4.0 ($595) will be the first choice for graphics creation and editing. Corel will continue to offer CorelDraw 3.0 at $199 for those who don't require quite so much "more."

The 12 1.44-MB floppy disks install about 36 MB of files on your hard drive, including Corel's seven modules, symbols, and a small number of fonts. If you are really voracious, you can install from the two CD-ROMs and get all 18,000 pieces of clip art and over 750 fonts. The font collection includes both TrueType and PostScript Type 1 formats. You can run CorelDraw 4.0 from a CD-ROM drive, reducing the hard disk space requirement to about 2 MB, but performance will suffer noticeably.

A Striking Resemblance

CorelDraw 4.0's interface has no immediately apparent differences from that of version 3.0: The status bar and menus appear across the top of the screen, nine tools run in a column down the left side, and the fill palette continues across the bottom of the screen. This should comfort experienced CorelDraw illustrators, because the new features and commands in version 4.0 require enough attention without a new interface to learn as well.

CorelDraw 4.0 maintains commands from earlier versions, which allow the creation of lines, shapes, and text, and still requires substantial mouse motion and keyboard exercise for the commonly used commands. Relatively few common commands are available as mnemonic keyboard shortcuts, so you'll either have to memorize Shift, Control, or Alt combinations with the F1 to F12 keys or make many trips to the toolbox or menus. Version 3.0's pick, shape, and alignment tools are also included in the new version.

With so many like features between the two versions, you could work in version 4.0 and not notice the differences at all—until you undo a change. Unlike in CorelDraw 3.0 where you only have one level of Undo, version 4.0 defaults to four levels of Undo, and it's configurable to up to 99 levels.

Another bonus feature in CorelDraw 4.0 is an Insert Pages command in the layout menu, which allows up to 999 pages in a single file. CorelDraw can work as a simple page-layout program for the occasional brochure, but the speed with which it manipulates text will not threaten QuarkXPress or PageMaker. Multiple pages are convenient for assembling a series of ads for a customer or for generating several variations of a single illustration, largely making up for the lack of an MDI (Multiple Document Interface).

Offering convenience and power with minimal screen clutter, CorelDraw 4.0's rollups now control more features. These floating palettes allow you to specify many attributes of an object; at the press of a button, the palettes roll up into a simple bar showing only the title and the control box.

Rollups control text, layers, styles, text envelopes, powerlines, contours, node editing, symbols, and data.

Powerlines are an outgrowth of the effects available with pressure-sensitive tablets (but you do not need a tablet to take advantage of powerlines). Woodcut shapes, teardrops, bullets, and trumpet are available at the stroke of the pen tool. Once you have created a shape with powerlines, control handles let you edit it.

SEPTEMBER 1993 BYTE 169
Fractal fills have also been added to the new version. You may find fractal fills a welcome and powerful addition to illustrations, or you may find yourself wasting more time than with any program since Windows Solitaire. There are 42 basic patterns (e.g., aerial photographs, minerals, paper, clouds, fibers, and flames), and each has a range of editable options for a total pattern count in the millions.

**Stylish Text**

Text creation and modification has always been powerful in earlier versions of CorelDraw, featuring editable text envelopes, spelling and thesaurus, extrusion, and the ability to convert text to curves. CorelDraw 4.0 dramatically expands text handling. It delves into the realm of desktop publishing with a staggering variety of automatic bullets and better control over tabs, indents, and character spacing. If you need to work with large bodies of text, version 4.0 lets you export blocks of text for editing in your favorite Windows word processor; you then can merge the text back into the illustration file, and most text attributes will remain intact.

The right mouse button exposes other new features. You can create styles for both text and graphics for specifying fills, outlines, fonts, tabs, indents, bullets, and spacing. Clicking on any object with the right mouse button adds its characteristics to your style sheet, or you can apply an existing style to the object. With an existing style selected in the style menu, clicking on an object with different characteristics presents the Update Style option, which then updates all objects in that style to match. Not only is it a powerful tool for editing complex files, but it's fun to watch. The Control + numeral combinations can rapidly apply your 10 most common styles.

An object-database feature has also been added, again only noticeable if you click on an item with the right button. You can associate part numbers, costs, dates, and text with drawing elements and display them in a spreadsheet. Alas, you can't export the spreadsheet to other applications.

CorelDraw 4.0 can import most common formats, including JPEG compressed images and Kodak's Photo CD format. Although the program can open only its own files, it can import Adobe Illustrator, Micrografx Draw, Windows metafile, and WordPerfect graphics files directly. CorelDraw can turn Mac EPS files that Adobe Illustrator creates into editable illustrations. You can place EPS files that other Mac applications create in a Corel document, but the files aren't editable. The distinction between importing and placing a file is not well documented.

CorelDraw 4.0 can export all the formats it can import, and it can export selected items only rather than the entire document if desired. It is both an OLE server and client.

**Enhanced Image Editing and Charting**

Corel introduced the Photo-Paint module, an image-editing package based on Photo-Finish from ZSoft, in CorelDraw 3.0. In that version, the ZSoft module was bundled with few changes. Now, in version 4.0, the toolbox is on the left, and many editing options appear as rollups. Photo-Paint has direct scanning controls for common scanners and acts as an OLE server.

Effects filters include emboss, motion blurs, psychedelic, solarize, sharpen, unsharp mask, rotation, color-balance controls, and Van Gogh or Seurat effects. Although the default file format is PCX, Photo-Paint can read and write BMP, GIF, Targa, and TIFF files, as well as save EPS files and read some JPEG compressed files. The image editor works only with RGB format files, but it supports color separation and prepress functions and can save CMYK files for process color printing.

CorelChart is a module that creates 18 different chart types (the same amount that's in version 3.0) and includes a minimal—although expanded—spreadsheet for arranging data. You can now apply fills, patterns, and textures to charts from any other module. CorelChart is an OLE server, allowing other applications to use the resulting charts; therefore, you can establish DDE links to any Windows spreadsheet to build charts quickly from existing data. You can export CorelChart's data sheets to Excel, Lotus, and several ASCII formats.

CorelShow, a presentation module, creates overhead transparencies, 35mm slides, and on-screen presentations. New features include branching to different slides depending on audience response and setting transitions for different elements on an object-by-object basis instead of slide-to-slide. The CorelShow module is an OLE client and ships with a run-time component, allowing you to provide
A chain is as strong as its weakest link.

Picture your Hardlock™ key as a bike lock, and the accompanying software routines used to implement the copy protection as the chain. You can own the best lock that money can buy, but that lock is useless if the chain is weak.

Introducing HL-Crypt, a major breakthrough in copy protection. HL-Crypt is not just a shell or simple conditional response checker. Using our proprietary Patcher Technology, HL-Crypt encrypts and binds the application to your Hardlock™ device. HL-Crypt features many protection modules that secure the application against piracy, reverse engineering, and debugging, to name a few.

Picture HL-Crypt as an ironclad chain. The only ironclad chain in the industry today. For more information, call 1-800-562-2543

HL-Crypt
The Fortified Protection Linker for Hardlock
Announcing the
BYTE EURODECK

The First Computer Postcard Deck Targeting the Exploding European Market!!!

By the end of 1992, the European Community will be a $14 trillion market. In fact, behind the US, it's the largest microcomputer market in the world!

If you are a BYTE subscriber in Europe, watch for the new EURODECK coming to you soon! The BYTE EURODECK contains a selection of state-of-the-art products important to you and your business.

Advertisers!
The BYTE EURODECK offers you a unique direct mail approach to increasing sales in this fast-paced computer market.

Circulation of the BYTE Eurodeck is targeted to 50,000 computer buyers in over 20 countries in Western Europe. Take full advantage of the benefits of the upcoming unification of Europe in 1992! For information on the next BYTE EURODECK, call Jim Bail today at 603-924-2533!

Companies outside of North America, please contact your local representative.

---

Reviews CorelDraw 4.0: The Word Is More

stand-alone presentations to Windows users without CorelDraw 4.0.

Trace, Mosaic, and Move

CorelTrace, the module for importing bit maps and generating vector images that CorelDraw can manipulate, has changed substantially for version 4.0. In addition to including the outline and centerline options of the previous version, CorelTrace generates silhouettes of bit-map images, an interesting woodcut effect that looks more like a coarse line screen, and supports two options for OCR.

The basic OCR process converts a scanned document to text, and CorelTrace does a reasonable job of it. A Form method goes even further: It first recognizes text, then scans lines, and finally traces other objects. This allows rapid development of replacement forms in CorelDraw, perhaps the most direct and efficient process I've seen.

CorelMosaic is a module that creates thumbnail images of any files you edit in the other modules and saves them in catalogs. You can attach text to catalog entries, and CorelMosaic can search across multiple catalogs. While preparing files for the catalog, CorelMosaic compresses any file that is not already in a compressed format. You manage files by simply dragging and dropping them.

The new version also adds a slick animation module called CorelMove. You can start with any "actor" or "prop" from a bundled library or create your own in CorelDraw or Photo-Paint. By using version 4.0's blend feature, you can automatically create a series of steps for your actor. A CorelMove checkbox lets you assign these steps to animation cells. The actors travel along a path you create. Nodes on the path can be added, deleted, or automatically smoothed for a less jerky motion. You can customize WAV sound files with the CorelMove Sound Editor and attach them to the animation, and you can export the final creation to .FLC or AVI (Audio Video Interleave) format or distribute it with a stand-alone player.

The Kitchen Sink

It is almost criminal to purchase version 4.0 without using a CD-ROM drive. Without either a CD-ROM player or lots of hard disk space, the 489-page catalog of color and black-and-white clip art is just a tease. There are 755 fonts on the CD-ROM disks; installing from floppy disk limits you to about 50 TrueType fonts.

Despite so many new features, CorelDraw 4.0 still does not support multiple-open documents, a significant deficiency. In a welcome accommodation to Windows 3.x, Corel has finally adopted the Windows conventions for common editing commands, although the old commands are still available.

Corel has always supported many operating platforms and was expected to support the Macintosh by this time. The program's designers decided to take advantage of features in Apple's promised QuickDraw GX but delays in the release of Apple's upgrade delayed development of the Mac version of CorelDraw. To make significant moves into the professional graphic-arts market, CorelDraw will need to operate on both Windows and the Mac, and Corel intends to take that direction. A good first step would be to allow the Windows version to export Mac EPS files (and vice versa when the time comes). Corel's previewless EPS files appear only as gray rectangles when placed in Mac layouts.

I ran into two significant problems when installing CorelDraw 4.0. Besides space for the Corel program files, the installer requires space on the drive with your Windows directory for TrueType fonts. I discovered that you can't install the program without having enough room on the Windows drive to place the 50 TrueType fonts; if you don't, you will never get to the selection dialog box to deselect enough fonts to make the program fit. Also, it turned out to be impossible to install from a floppy drive across Windows for Workgroups, a problem that Corel plans to address in a maintenance upgrade. Corel has an excellent record, however, for supporting early buyers with free maintenance upgrades.

For a number of professionals, CorelDraw 4.0 will be a valuable toolbox. No other program comes close to offering this range of function at Corel's price. CorelDraw 4.0 is an impressive piece of work.

---

About the Product

CorelDraw 4.0...$595
Corel Corp.
The Corel Building
1600 Carling Ave.
Ottawa, Ontario,
Canada K1Z 8R7
(613) 728-8200
fax: (613) 729-9790
Circle 976 on Inquiry Card.

G. Armour Van Horn is a writer and graphics consultant in Free­land, Washington. He can be contacted on BIX as "vanhorn."
Don't Jump to a Graphic Conclusion

If you're about to take the plunge on a new graphics accelerator, get one that won't limit your future. ATI's GRAPHICS ULTRA+ and GRAPHICS ULTRA PRO give you no-regrets performance with all of today's applications. And they're perfectly poised for the leap forward into 32-bit operating systems and multimedia applications.

Get the Jump on the Latest Technology

Don't let inadequate technology give you or your PC a nervous breakdown. Our mach32 Accelerator Chip and 2.0MB of standard memory accelerate graphics to heights that others can't match. And ATI's newest accelerators are multimedia-ready, with hardware-assisted scaling of motion video images under Windows for full screen playback.

Software Safety Net

Software driver support shouldn't have to be a giant leap of faith... but without it, an accelerator is just an expensive VGA card. ATI gives you the best driver selection with the full security of 8514/A-compatible acceleration, plus up-to-the-minute ATI drivers for all major applications, including 32-bit environments, like OS/2 2.1 and Windows NT.¹

Don't Fall Behind

ATI helps you stay on the leading edge, without going over the brink financially. Our new upgrade plan² lets you move up to the latest hardware... at a fraction of the regular price.

GRAPHICS ULTRA+

- True color at 800x600 and 65,000 colors at 1024x768
- Non-interlaced 1280x1024 in 256 colors
- Flicker-free Windows, up to 76Hz refresh rate
- 2.0MB memory
- Fast DOS and graphics performance
- Enhances and accelerates Video for Windows
- $299.00³

GRAPHICS ULTRA PRO adds

- VRAM for better performance at higher refresh and greater colors
- Non-interlaced 1280x1024 graphics at 74Hz refresh
- ISA, EISA and Micro Channel versions available⁴
- $499.00⁴

So look before you leap. Drop in to your local ATI dealer and let our counselors help you avoid a graphic mistake.
Powerful, Fast And Loaded With Features.

ZEOS LOCAL BUS UPGRADABLES.

Upgradable to Intel's Pentium® OverDrive® architecture
Intel tested and approved for compatibility and thermal compliance!

Local bus video—VESA standard!

Local bus IDE hard drives

"It's hard to imagine a brighter upgrade picture."—PC World

More power. More speed. More features than ever before—and more than you'll get anywhere else in a local bus upgradable system!

We start with a brand-new motherboard—one that's faster, more integrated, and gives you even more reliability. We've increased the size of our local bus hard drives (all the way to 528MB!) so your hard disk data throughput is faster than ever before. Even better, we've taken one of the two VESA local bus slots (which can also be used for standard 16-bit cards) and added a screaming local bus video card...for Windows performance that "blows all competitors away"(PC Magazine).

Flash BIOS

On-board Adaptec SCSI option

.28mm non-interlaced SVGA color monitor in every package!

So that you can easily upgrade your system as new technology is developed, we include such features as CPU upgradability to Intel's Pentium OverDrive; a Zero Insertion Force (ZIF) socket; Flash BIOS for easy BIOS upgradability, and room to expand as well—with eight expansion slots and plenty of drive bays. With ZEOS local bus upgradables, you're investing in a bright future!
STANDARD WITH EVERY ZEOS LOCAL BUS UPGRADABLE:
- RAM expandable to 64MB on the motherboard.
- Upgradable processors that let you upgrade to Intel's Pentium OverDrive architecture.
- Zero Insertion Force (ZIF) socket makes upgrading easy.
- 14" ZEOS color SVGA non-interlaced monitor, .28mm dot pitch.
- Two serial ports and one parallel port integrated on the motherboard.
- Flash BIOS for easy upgradability.
- Eight expansion slots: two VESA local bus, five 16-bit and one 8-bit.
- ZEOS six-bay desktop case.
- Two cooling fans for increased reliability and product life.
- High-capacity 200W power supply with built-in suppression; switchable between 115/230V.
- Socket for inexpensive optional on-board SCSI.
- Shadow RAM support.
- ZEOS 101-key Reduced Size (RS) keyboard.
- FCC Certified Class B; UL Listed.

### SYSTEM HIGHLIGHTS

**NOW:**
Hard drives up to 528MB and new lower prices!

### PACKAGE HIGHLIGHTS

<table>
<thead>
<tr>
<th>PACKAGE 1</th>
<th>PACKAGE 2</th>
<th>PACKAGE 3</th>
<th>PACKAGE 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>486SX-25</strong></td>
<td>$1395</td>
<td>$1695</td>
<td>$1995</td>
</tr>
<tr>
<td><strong>486SX-33</strong></td>
<td>$1495</td>
<td>$1795</td>
<td>$2095</td>
</tr>
<tr>
<td><strong>486DX-33</strong></td>
<td>$1695</td>
<td>$1995</td>
<td>$2295</td>
</tr>
<tr>
<td><strong>486DX2-50</strong></td>
<td>$1795</td>
<td>$2095</td>
<td>$2395</td>
</tr>
<tr>
<td><strong>486DX2-66</strong></td>
<td>$1895</td>
<td>$2195</td>
<td>$2495</td>
</tr>
</tbody>
</table>

### FAVORITE OPTIONS

**15-INCH MONITOR UPGRADE**
SVGA non-interlaced, 1024x768, flat screen $95

**VERTICAL CASE UPGRADE**
Includes ten bays $95

**DIAMOND VIPER VIDEO CARD**
Combine it with the ZEOS motherboard and you'll get speed that PC Magazine said "blew all competitors away!"
Includes 1MB VRAM $149
with 2MB VRAM $249

**INTERNAL CD-ROM DRIVE** $199

**ARCHIVE 51250A INTERNAL TAPE BACKUP**
80 to 250MB (with compression), includes EZTape for DOS $249

**ADAPTEC SCSI CONTROLLER CHIP** $49

**SPECIAL OFFER: WE’LL REPLACE YOUR 3½" DRIVE IN ANY PACKAGE WITH A CD-ROM PLAYER!** $99

Hundreds of other affordable upgrades and options available. Call for details!

### AWARD-WINNING SERVICE & SUPPORT.
We're the only company to win PC Magazine's Readers' Choice for Service & Reliability—
for both desktops and notebooks—twice!

### TOLL-FREE TECH SUPPORT AT ANY HOUR.
We're here for you 24 hours a day, 365 days a year, and always a toll-free phone call away.

### WARRANTIES & GUARANTEES.
All ZEOS systems come with a One Year Limited Warranty, Express Parts Replacement Policy and a 30-Day Money-Back Guarantee. You're going to be very satisfied. We guarantee it!

### CALL NOW TOLL FREE
**800-554-5226**

**24 HOURS A DAY**

Fast hard drives at affordable prices: From the diminutive 2½-inch Maxtor 7245AT to the screamingly fast Seagate ST12550N (also known as the Barracuda), the class of '93 has pushed the envelope on speed and capacity. We stress-tested 32 IDE and SCSI hard drives ranging in capacities from 250 MB to 2 GB to find the leading performers, whether you're expanding your current storage capacity or specifying a hard drive for a new PC, workstation, or Macintosh.

We rank the performance of each drive using a suite of custom benchmarks that identifies the fastest drives in three capacity classes. The benchmark suite consists of 24 tests that run the gamut from simple reads and writes to multithreaded tasks that challenge a drive's caching abilities.

The BYTE Lab Reports rate the best products based on application rather than product categories. But for hard drives, we decided there were no clear-cut ways to typify how hard drives are used, because even single-application computer users will need to read and write sequential and random data over the course of a day. Instead, we built a model based on DOS, Windows, Unix, and Macintosh applications and from that made the following assumptions: You run your hard drive with a disk cache, the ratio of reads to writes is 60 to 40, and your drive won't be so fragmented that your data is scattered randomly across the disk. Even if this

---

**How to use this guide**

To find the right hard drive, compare the drives ranked in the capacity categories that match your requirements. In each category, we select best overall, best low-cost, and best IDE and SCSI drives. In each category, we also list a number of close competitors. If you are not sure which interface to use, see "IDE and SCSI: Contrasting Styles" on page 190.

For IDE drives, the cost per megabyte consists of retail drive price plus $25 (for controller), divided by capacity; for SCSI drives, the cost equals retail drive price plus $200 (for controller), divided by capacity.

All performance measurements are in milliseconds. For response times, lower numbers indicate better performance. A 10 percent difference in performance between drives is almost indistinguishable, while a 30 percent or greater performance difference will be noticeable to most users in real-world conditions.

---

**BEST OVERALL**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Seagate Technology ST3390A</td>
<td>IBM</td>
<td></td>
<td>$389</td>
<td>$1.22</td>
<td>10.2GB</td>
<td>Ultra16</td>
<td>100MBps</td>
<td>5.3ms</td>
<td>7200rpm</td>
<td>$1.22</td>
<td>$1.22</td>
<td>$1.22</td>
<td>$1.22</td>
</tr>
<tr>
<td>Seagate Technology ST3390A</td>
<td>IBM</td>
<td></td>
<td>$430</td>
<td>$1.26</td>
<td>10.5GB</td>
<td>Ultra16</td>
<td>100MBps</td>
<td>5.3ms</td>
<td>7200rpm</td>
<td>$1.26</td>
<td>$1.26</td>
<td>$1.26</td>
<td>$1.26</td>
</tr>
<tr>
<td>Seagate Technology ST3390A</td>
<td>IBM</td>
<td></td>
<td>$450</td>
<td>$1.32</td>
<td>12.1GB</td>
<td>Ultra16</td>
<td>100MBps</td>
<td>5.3ms</td>
<td>7200rpm</td>
<td>$1.32</td>
<td>$1.32</td>
<td>$1.32</td>
<td>$1.32</td>
</tr>
<tr>
<td>Seagate Technology ST3390A</td>
<td>IBM</td>
<td></td>
<td>$460</td>
<td>$1.33</td>
<td>12.3GB</td>
<td>Ultra16</td>
<td>100MBps</td>
<td>5.3ms</td>
<td>7200rpm</td>
<td>$1.33</td>
<td>$1.33</td>
<td>$1.33</td>
<td>$1.33</td>
</tr>
<tr>
<td>Quantum MC99185A</td>
<td>IBM</td>
<td></td>
<td>$460</td>
<td>$1.34</td>
<td>12.3GB</td>
<td>Ultra16</td>
<td>100MBps</td>
<td>5.3ms</td>
<td>7200rpm</td>
<td>$1.34</td>
<td>$1.34</td>
<td>$1.34</td>
<td>$1.34</td>
</tr>
</tbody>
</table>

* Cost = retail price plus controller. **Cost Reduced through $250 controller. **Cost Reduced through $250 controller.
doesn’t fit you exactly, remember that a fast hard drive remains fast no matter how you use it.

Our tests showed that today’s drives are the best-performing hard drives ever. Over 80 percent of the drives we tested operate at spindle rates greater than the traditional 3600 rpm. Fast spin rates mean you spend less time waiting for the disk to position itself correctly to read or write data. Thanks to its 7200-rpm spin rate, the 2-GB Barracuda ran more than 15 percent faster than its closest competitor, the 6300-rpm Maxtor MXT-1240S, a 1.2-GB SCSI drive.

Today’s drives use write caching to improve performance (within our main sample, only Seagate’s 245-MB ST3283A IDE drive and Hitachi’s 418-MB DK314C SCSI drive did not support write caching). But 15 SCSI and four IDE drives arrived with write caching disabled, and enabling it usually required firmware updates.

The long-term durability of today’s faster spinning drives remains a question. The high spin speeds mean harder impact whenever a head hits a platter. Faster hard drives can run hot. It’s wise to choose a drive with a multiyear warranty (a third of our test sample offered five years).

Many IDE drives can run five times faster than what a standard ISA bus can handle. Local-bus interfaces promise an end to this bottleneck, but some drives in our sample showed only minor performance improvements with local-bus technology (see “Local-Bus IDE” on page 180).

We only tested drives from manufacturers, rather than from VARs that relabel OEM drives. We believe this gives you the best basis for comparing hard drive performance. Note that Quantum and Hewlett-Packard declined to participate in this evaluation because they couldn’t supply their new drives in time for testing.
THE BEST DRIVES IN CAPACITIES FROM 250 TO 350 MB

This capacity is the size of choice for entry-level and general-business PCs and Macs. Because of their mass-market appeal, these drives often favor low price at the expense of performance.

In each of the “Best” categories, we ranked winners based on their performance scores. Low-cost winners and runners-up are those with the lowest cost per megabyte.

On the PC side, IDE remains the standard interface for low-range and midrange systems, and not surprisingly, seven of the 10 drives we tested in this class were IDE-based. Cache sizes tend to be small to limit cost; many of the drives provide just 64 KB of cache. Contrast this with the usual 128- or 256-KB caches on higher-capacity drives.

The Seagate ST3390 IDE and SCSI drive series includes the fastest-spinning drives (4500 rpm) and provides the largest caches (256 KB); not coincidentally, these hard drives proved to be the best-performing drives throughout this category. Although the Seagate ST3283 drives have the same spin rates as that of their larger cousins, they are two of the slowest drives in this category. The ST3283A (IDE) performance is particularly bad due to its lack of write caching. Only the 251-MB Samsung 3122A is slower. The ST3283N’s performance is good, but its relatively small capacity for a SCSI drive puts it at a performance disadvantage compared to large SCSI drives, which can pack data more densely. Nevertheless, its performance was faster than all the IDE drives except that of the Seagate ST3390A.

Western Digital’s 340-MB Caviar 2340 is second in speed only to the two Micropolis drives among all IDE drives in reads using four threads. Excellent four-segment performance is important to database applications, as well as for multitasking multiple applications using OS/2 or Unix.

Conner’s CP-30254 is the fastest IDE drive under 300 MB, and it even outperformed the 345-MB Maxtor 7345AT. The Conner’s speed is partly due to its spin rate: 4542 rpm, the fastest in this capacity class. The Conner drive implements write caching, which boosts its performance significantly over noncaching drives like the Seagate ST3283A. The Conner was also one of the most improved drives when used with local bus; it was 30 percent faster on sustained reads using local-bus IDE.

GLASS-PLATTER DRIVES

We tested two 2½-inch IDE drives that use new glass-platter technology: the 180-MB Areal A180 and the 251-MB Maxtor 25252A. Areal has been a force in bringing glass-platter drives to market and makes only glass drives. The Maxtor 25252A hard drive marks Maxtor’s first glass product.

Glass platters are lighter and stiffer than aluminum platters. As low-fly heights of modern drives make head-to-platter impacts inevitable, the smoother and stiffer glass platter may be better suited to survive these impacts. Glass is particularly useful for notebooks and other portables, where head impacts are more likely to occur, and in fast-spinning drives, where the head impacts the platter with much more energy. Glass platters are also lightweight, so it takes less energy and time to spin them, which are advantages in notebooks and for “green” PCs.

Our tests showed the Areal drive to be optimized for cost, while the Maxtor drive focuses on performance. However, the Maxtor drive’s performance could easily be better: It currently doesn’t offer write caching. Maxtor says it plans to add this in the near future, which could put the performance of this little drive close to that of the top-ranked Conner CP-30254. In its present design, the Maxtor drive averaged 15.8 ms in our composite test scores, which places it in the performance midrange of 250-MB IDE drives. The Areal drive, which offers lower capacity for $90 less, achieved a composite score of 19 ms, which places it among the slower low-capacity drives we tested.
Fujitsu’s 329-MB M2622FA SCSI drive is the only other fast-spinning drive in this capacity class, but it could not sustain good write performance in our tests. Fujitsu is aware of the problem but could not deliver a fix in time for testing. On the plus side, this and the higher-capacity Fujitsu drives all have high drive-to-host data transfer rates for prefetched data. The Fujitsu M2622FA transferred data over 50 percent faster than the Seagate ST3390N. All the Fujitsu drives handle two- and four-threaded operations flawlessly; the only drives faster than the Fujitsu M2622FA at the four-threaded read tests were the bigger Fujitsu drives. Some Fujitsu drives also offer five-year warranties, which is tops in this category.

Clearly, Maxtor is seeking to optimize price and not performance in its 245- and 345-MB drives. The 64-KB cache is too small to efficiently handle segmented operations (e.g., file compiles). The relatively slow spin rate of 3551 rpm translates into slower performance on nonsequential operations typical of database operations, virus scanning, and defragmentation. The company claims the highest MTBF (mean time between failures) at 300,000 hours (over 34 years) but warrants this drive for only one of those years.

The Maxtor drives are not without strengths, however. They are notable for their unique jumper-selectable write cache (other IDE drives require special software to change write-cache settings). Maxtor also packs many modern IDE-drive features into its products, including block mode, write reallocation, power management, and automatic geometry translation.

As the slowest drive in this class, we can’t recommend the 251-MB Samsung 3122A IDE drive. While random access times were nearly equal to that of the 245-MB Maxtor drive, the sequential operations took nearly twice as long. This suggests that the drive controller is not doing a good job of managing the host-to-drive interface.
How to Choose a Hard Drive

1. Buy a hard drive with at least 250 MB for your primary system and at least 120 MB on a notebook. Beyond that, buy the largest capacity and fastest hard drive you can afford. It's safe to assume that you will always wish you had more storage space.

2. Don't assume that local-bus IDE will deliver better performance. Our tests show that drives designed to take advantage of local-bus technology ran 30 percent faster than with standard IDE connections, but not every drive was able to take advantage of local-bus technology.

3. Don't pay for performance you can't use. Match the speed of the controller and the drive; slow controllers can seriously degrade performance of fast drives, but 32-bit bus-master controllers can't make slow drives any faster. For fast SCSI drives, you will need an adapter that can support SCSI-2 fast speeds. The built-in SCSI support in many Macs can't support SCSI-2. Several companies make fast SCSI-2 adapters for PCs and Macs with NuBus slots. You will need a 32-bit PC bus (i.e., EISA, Micro Channel architecture, or VL-Bus) to take full advantage of the fastest drives.

4. Watch out for vendor throughput claims that are based on transferring data from the drive cache to the host memory or from the host memory to the drive cache. For example, the SCSI-1 bus bandwidth may be 5 MBps to up to 40 MBps, but few drives can sustain throughput at this level. Look for sustained throughput numbers to get a good picture of drive performance. Access-time calculations also vary from manufacturer to manufacturer, so you will want to know how the access time is calculated. The most accurate way is to measure command service times by performing actual reads and writes.

5. Choose a drive that can write cache as well as cache more than one segment. Write caching noticeably improves performance, especially in the DOS, Windows, and Mac environments. A segmented cache allows the drive to effectively prefetch when an application simultaneously accesses more than one file at a time. (Be sure to turn off write caching on database servers and be cautious on network servers, which may use logging and roll-back for network information.)

6. IDE drives that support a write cache typically come with the write cache enabled. If you do not want to use write caching, you may want to request that the dealer disable it. It is rarely as simple as moving a jumper and generally requires a special program from the manufacturer.

7. For digital audio and video applications, you need fast, large-capacity drives (e.g., the Micropolis 2217) that smoothly handle TCAL (thermal recalibration). Sustained throughput numbers will not necessarily tell you anything about the frequency of TCAL glitches, but your eyes will tell you when you play back jumpy video.

8. SCSI cabling and termination can be troublesome, and for the uninstructed, a task that the dealer may best handle.

9. IDE drives from different manufacturers can be troublesome to get to work together, although progress is being made on standards. If you need multiple drives, you may be better off with SCSI.

10. Consider using a small-capacity IDE drive to boot from, along with larger SCSI drives for storage. This takes maximum advantage of IDE compatibility and SCSI flexibility and performance. SCSI drives are also faster if you don't boot from them, because SCSI controllers have to emulate the standard PC drive interface for compatibility when the drive is configured as a boot drive. This slows performance.

---

**LOCAL-BUS IDE**

Modern drives can produce data faster than the ISA bus can transfer it. Local-bus technology promises to close this gap by accelerating data transfer rates from the 2- to 10-Mbps rate of ISA-based IDE drives faster than SCSI, but for now, standards in this area are lacking. Several of the drives we tested are capable of operating at speeds faster than standard ISA. We used an Appian local-bus interface in an Intergraph 486 system to test drives to determine maximum data transfer rates under local bus. Future versions of the IDE command set will include a protocol for querying an IDE's optimal speed. For now, the Appian device driver attempts to determine the optimum speed by trying several different speeds.
"So there I was, playing with my Nintendo® and Dad was all spazzed out. No one at his office thought they could handle one of those storage things. You know, the disk deals. Well, Dad said these guys at Conner told him it's so simple a kid could do it. So I did. Dad got a raise, I got a suit, and I'll be home late. O.K. Mom?"

85 MB, 120 MB, 140 MB, 250 MB Internal Disk Drives
Available in 3.5" x 1" form factors to fit the latest, most advanced PCs. All are up and running with a simple DOS command.

Call 1-800-755-0535 for the Conner dealer nearest you.

All trademarks or registered trademarks are of their respective owners. © 1989 Conner Peripherals, Inc.

Circle 114 on Inquiry Card (RESELLERS: 115).
How We Tested

Testing hard drives is complex: variable-zone recording contributes to dramatic performance changes over the surface of the same disk; thermal recalibration can kick in to cause a temporary but sharp increase in response time; the biggest drives have 512 KB of cache that can be tuned with more than a dozen parameters. Write and read performance varies dramatically depending on how or if write caching is enabled.

To account for this complexity, we designed a set of custom benchmarks called PLATT (Page Level Availability Time Test)—so named because it models hard disks as a linear array of "pages," which are the units of reads and writes. Most modern operating systems, including DOS and System 7, view the disk in this fashion (Berkeley Unix is a prominent exception; its file system uses a more complex disk model in terms of cylinders and tracks). We call PLATT an availability test, because it measures response time from when a command is issued until the time when data is available in system memory. PLATT closely models a 486 machine running DOS 5.0, Smartdrive 4.0, and a combination of DOS and Windows applications.

We tested every hard drive on a Compaq Deskpro/M 66-MHz 486. For IDE drives, we used the built-in interface; for SCSI drives, we used an Adaptec 1742 EISA bus-master adapter. The 1742 is capable of 10-Mbps drive transfer and 33 MBps across the EISA bus. We also tested using an Intergraph 66-MHz 486 system with an Appian local-bus IDE adapter. Our Mac Quadra 700 test system ran with a SCSI-2 FWB JackHammer NuBus adapter.

ADDITIONAL TESTS

In addition to PLATT, we ran BYTE's disk benchmarks, which evaluate drives at the DOS file level. We were able to configure these benchmarks to run an infinite variety of profiles; we ran a profile created to model typical DOS use and a second one to model typical Unix use. We also ran BYTE's file-level benchmark tests, which perform common operations such as creating, deleting, opening, closing, reading, and writing files. Our profile description specifies the number of times each operation is run, as well as the size of reads and writes. We tested using profiles developed to simulate typical DOS usage and Unix usage.

Finally, for the IDE drives, we ran QBench, a low-level test that accesses the drive through the ROM BIOS and measures time for reading and writing for a variety of block sizes spread across the disk. QBench is too low level for testing high-end SCSI drives; these drives are faster when used without BIOS support.

OTHER CONSIDERATIONS

Because this roundup includes only "bare" hard drives that are not necessarily intended for retail channels, features and ease-of-use considerations typical of our other BYTE Lab Reports could not be weighted here. By comparing bare drives, end users can specify their models of choice from system vendors and companies that package OEM drives as external subsystems or in upgrade kits.

Our Test Team

Helen Holzbaur, Project Manager/NSTL, became proficient with storage products as a network manager and systems administrator for Temple University.

Jim Hurd, Vice President of Research and Development/NSTL, has directed evaluations of storage and other hardware products, as well as operating systems and applications software, during the last 10 years at NSTL.

Alan Joch, Senior Editor/BYTE, coordinates the combined testing between the BYTE Lab and NSTL.

The Lab Report is an ongoing collaborative project between BYTE Magazine and National Software Testing Laboratories (NSTL). BYTE Magazine and NSTL are both operating units of McGraw-Hill, Inc.
Windows users are opening up a new world of possibilities.

The new Bernoulli® 150. Get increased performance with fast cache built in.

Ah, the things you can do with software these days. Amazing, isn’t it? That’s why we created the new Bernoulli 150 removable drive. So you can get more out of your storage than ever before—more freedom. More excitement. And frankly, more storage.

With the new Bernoulli, you’ll get a free 150MB disk included with your drive. So you can explore new ideas without running out of space. Then just add inexpensive disks as you need them—in 150, 105, 90, 65 or 35MB sizes. That’s what we call MultiDisk®, a feature you can only get with the Bernoulli 150.

What’s more, you can take your data where you need it, when you need it. Free from worry. And since no one has time to sit on their hands, we’ve included new 256KB fast cache firmware for even better performance.

As you might have guessed, only award-winning Bernoulli Drives give you this much potential. Call 1-800-777-6649.

Or visit your local dealer. And from now on, expect the world out of your storage.

©1993 Iomega Corp. The Iomega logo and Bernoulli are registered trademarks, and MultiDisk is a trademark of Iomega Corp. All other products are trademarks of their respective holders. For customer service in U.S.A. and Canada, call 1-800-456-5522. In Europe, call 49-761-45040. For worldwide customer service, call 1-801-778-3000. For accessory items, call IOMART at 1-800-723-3770.

Circle 103 on Inquiry Card.
D

rives in this class fall into two categories: 500-MB and higher drives, which offer fast spin rates, large caches, and awesome speed, versus 400- to 450-MB drives, which favor low cost per megabyte over absolute performance. (As further proof of cost-consciousness in the 400-MB hard drive market, our tests showed the 424-MB Western Digital Caviar to be marginally slower than its 340-MB sibling, the Caviar 2340.) For example, the slowest drive above 500 MB is faster than the fastest 400-MB drive. What's more, SCSI dominates in the drives above 500 MB (due to its fast data transfer rates), while most 400-MB hard drives were IDE-based.

Winners and runners-up in each category were those drives with the fastest response times. The low-cost winners were those with the lowest cost per megabyte.

We found that drive makers in the 400- to 600-MB range share implementations of voicecoil head-positioning technology and similar recording technology, so the performance winners differentiated themselves with the fastest spindle spin rates, which cuts drive latency times. The 6300-rpm Maxtor MXT-540SL SCSI drive was Best Overall.

Both of the Conner SCSI drives we tested contained a firmware bug that prevented write caching from being effective when the SCSI drive is not allowed to disconnect. Conner acknowledged the bug and will have a fix by the time you read this; however, it was not available at the time of testing. Mac users will want to upgrade to the fixed firmware since the Mac SCSI manager does not support disconnect.

The Adaptec 1742 adapter used for testing didn’t work with Conner’s firmware; the adapter's enhanced-mode BIOS does not allow the drive to disconnect even when configured to do so. To allow the Conner CP-30540 to disconnect, we configured the 1742 into its standard mode. Using standard mode and allowing disconnect would normally degrade performance, but the CP-30540's performance improved dramatically due to write caching: 300 percent in the case of sequential writes.

Among the IDE drives, the Maxtor MXT-540AL fails to equal the Conner drive’s ability to squeeze data through the IDE bus. Driving the Maxtor IDE drive through our local-bus IDE didn’t help much; presumably, the Maxtor engineers didn’t have local-bus speeds in mind when they created the MXT-540AL. The drive is clearly not configured to do multithreaded sequential operations.

The Micropolis 2105A was the slowest of the 5400-rpm IDE drives, but it was considerably faster than any of the slower-spinning IDE drives. The Micropolis drive’s data transfer rate was worse than that of the Conner’s but roughly equal to the Maxtor’s. This stayed consistent using local-bus IDE; each drive improved by approximately 20 percent. The Micropolis drive was the only one of the three configured with four cache segments: It was 65 percent faster than the Conner drive at four-segment activity, such as a four-file database join.

The Seagate ST3585A and ST3665A drives have similar performance. Each scored well considering their 4500-rpm spin rate, but their performance was noticeably slower than the faster-spinning drives. Both do well with two sequential threads (e.g., a file compare) but poorly with four-segment tasks (e.g., Unix multitasking).
The Fujitsu drives are looking long in the tooth. Fujitsu was one of the first vendors to ship faster-spinning drives to the marketplace, but its 4400-rpm speed is slow compared to the 5400- and 6300-rpm speeds of its competition. We also saw slow response times for sustained writes to the disk, although this problem goes away if delays are inserted after each write. This problem is consistent with the smaller-capacity Fujitsu drives we tested, but it is not evident in the Fujitsu I-GB M2694ESA. Fujitsu was aware of the problem but couldn’t provide a fix in time for this report.

The Western Digital Caviar 2420 is nearly identical in design and performance to the smaller-capacity Caviar 2340. They have similar spin rates, a 128-KB cache, and excellent firmware. Western Digital appears to have taken the Caviar 2420 drive and tweaked it to pack as much data as possible onto the same basic design; the Caviar 2420 uses the same number of heads (four) but nearly 500 more tracks.

The slightly slower spin rate of the Caviar 2420 (3314 versus 3322 rpm for the Caviar 2420) probably allows the 2420 to use more aggressive variable-zone recording; the Caviar 2420 packs 396 sectors on the first 324 cylinders where the Caviar 2340 puts 356 to 384 sectors on the same cylinders.

This aggressive packing of data pays off in the short-stroke scores; the Caviar 2340 is 1 to 2 ms faster on localized drive activity than its smaller sibling. The Caviar 2340 can’t compete with faster-spinning drives due to its conservative 3314-rpm spin rate; however, it produces well-balanced performance overall. The Caviar 2340 excelled in the four-segment tests due to its four-segment cache design. The Caviar drives were second only to the Micropolis drives among IDE drives in reads using four threads.

The Hitachi drive produces some of the worst response times of any drive we tested. It does not use write caching, so sustained write performance is abysmal.

---

**B Y T E B E S T**

**NEED HIGH PERFORMANCE FOR PC, MAC, OR UNIX?**

**BEST OVERALL** Maxtor MXT-540SL

The MXT-540SL is the fastest drive in this size range, and it ties for the third-fastest drive on the entire test sample. It is especially fast for random and sequential reads and writes and short stroking. It also excelled in multi-threaded operations (i.e., after we tweaked its cache table size up to four).

<table>
<thead>
<tr>
<th>Interface</th>
<th>Formatted Capacity (MB)</th>
<th>Price</th>
<th>Cost Per Megabyte</th>
<th>Overall Response Time (MS)</th>
<th>Warranty (YEARS)</th>
<th>Spin Rate (RPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEST</td>
<td>Maxtor MXT-540SL</td>
<td>SCS1</td>
<td>$546</td>
<td>$1077</td>
<td>2</td>
<td>6300</td>
</tr>
<tr>
<td>RUNNER-UP</td>
<td>Conner Peripherals CP-30544</td>
<td>IDE</td>
<td>$527</td>
<td>$816</td>
<td>2</td>
<td>5400</td>
</tr>
<tr>
<td>RUNNER-UP</td>
<td>Maxtor MXT-540AL</td>
<td>IDE</td>
<td>$527</td>
<td>$1077</td>
<td>2</td>
<td>6300</td>
</tr>
</tbody>
</table>

**WHEN ONLY SCSI WILL DO...**

**BEST SCSI** Maxtor MXT-540SL

This drive’s overall response time clearly distinguished it from its two closest competitors and was more than three times faster than the slowest drive in this class, Hitachi’s 418-MB DK314C. However, the Maxtor drive’s cost per megabyte ($2.34) is significantly higher than the second-place Conner’s ($1.86).

<table>
<thead>
<tr>
<th>Interface</th>
<th>Formatted Capacity (MB)</th>
<th>Price</th>
<th>Cost Per Megabyte</th>
<th>Overall Response Time (MS)</th>
<th>Warranty (YEARS)</th>
<th>Spin Rate (RPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEST</td>
<td>Maxtor MXT-540SL</td>
<td>SCS1</td>
<td>$546</td>
<td>$1077</td>
<td>2</td>
<td>6300</td>
</tr>
<tr>
<td>RUNNER-UP</td>
<td>Conner Peripherals CP-30540</td>
<td>SCS1</td>
<td>$545</td>
<td>$816</td>
<td>2</td>
<td>5400</td>
</tr>
<tr>
<td>RUNNER-UP</td>
<td>Seagate Technology 3600N</td>
<td>IDE</td>
<td>$524</td>
<td>$900</td>
<td>2</td>
<td>4500</td>
</tr>
</tbody>
</table>

**NO-COMpromise IDE...**

**BEST IDE** Conner Peripherals CP-30544

The Conner engineers are masters of squeezing performance out of the IDE Interface. Among Conner's IDE performance-improving techniques is interrupt staging: The time from data availability in the drive buffer to interrupting the PC is less than 40 nanosecond. The Conner CP-30544 provides the fastest sustained sequential throughput of any IDE; its throughput using a local-bus adapter rivals a fast SCSI drive.

<table>
<thead>
<tr>
<th>Interface</th>
<th>Formatted Capacity (MB)</th>
<th>Price</th>
<th>Cost Per Megabyte</th>
<th>Overall Response Time (MS)</th>
<th>Warranty (YEARS)</th>
<th>Spin Rate (RPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEST</td>
<td>Conner Peripherals CP-30544</td>
<td>IDE</td>
<td>$527</td>
<td>$816</td>
<td>2</td>
<td>6300</td>
</tr>
<tr>
<td>RUNNER-UP</td>
<td>Maxtor MXT-540SL</td>
<td>IDE</td>
<td>$527</td>
<td>$1077</td>
<td>2</td>
<td>6300</td>
</tr>
<tr>
<td>RUNNER-UP</td>
<td>Micropolis 2105A</td>
<td>IDE</td>
<td>$557</td>
<td>$1172</td>
<td>2</td>
<td>5400</td>
</tr>
</tbody>
</table>

**PRICE CONSCIOUS?**

**LOW COST** Seagate Technology ST3550A

The ST3550A was the fastest IDE drive under 500 MB we tested. With a cost per megabyte of $1.12, the ST3550A delivers exceptional price/performance for this range of drives. Besides low cost, the two Conner drives are among the fastest drives in this category for sequential operations, such as loading or saving files.

<table>
<thead>
<tr>
<th>Interface</th>
<th>Formatted Capacity (MB)</th>
<th>Price</th>
<th>Cost Per Megabyte</th>
<th>Overall Response Time (MS)</th>
<th>Warranty (YEARS)</th>
<th>Spin Rate (RPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEST</td>
<td>Seagate Technology ST3550A</td>
<td>IDE</td>
<td>$480</td>
<td>$1.12</td>
<td>2</td>
<td>5400</td>
</tr>
<tr>
<td>RUNNER-UP</td>
<td>Western Digital Caviar 2420</td>
<td>IDE</td>
<td>$550</td>
<td>$1.36</td>
<td>3</td>
<td>3314</td>
</tr>
<tr>
<td>RUNNER-UP</td>
<td>Seagate Technology ST3655A</td>
<td>IDE</td>
<td>$500</td>
<td>$1.57</td>
<td>3</td>
<td>4500</td>
</tr>
<tr>
<td>RUNNER-UP</td>
<td>Conner Peripherals CP-30544</td>
<td>IDE</td>
<td>$816</td>
<td>$1.86</td>
<td>3</td>
<td>5400</td>
</tr>
</tbody>
</table>

¹ Consists of drive price plus controller, divided by capacity.
Write Caching: Boon or Threat?

Caching writes on a hard drive has become a standard feature on most new hard drives. Write caching can double speeds in single-tasking systems like DOS and the Mac OS, and it even achieves better performance in more advanced multithreaded systems like NetWare, OS/2, Windows NT, and Unix.

A standard write operation begins with the computer signaling the drive that it has begun a write operation. Immediately, the drive begins to reposition the drive heads to the correct location. Concurrently, the system copies the data from memory to the memory on the drive. When the system completes this copy operation, it is free to do other things. The drive signals the system when it completes the actual write operation.

On a PC, disk operations are usually handled through the INT 13 ROM BIOS routine. All popular ROM BIOSes offer only simple implementations of INT 13—the routine simply does not return until the drive signals that the write is complete and the system has safely stored the data on the disk. After the computer copies the data to the drive, it waits for the operation to complete, which can mean that the computer spends a fair amount of time idly looping instead of getting real work done. A similar situation exists for those running a Mac.

Two approaches have been used to get around this delay. One is to attack the problem at its root: Have INT 13 return as soon as the system copies the data to the drive and not wait for write completion.

A higher-performance approach is to adapt the hard drive to the limitations of DOS by caching writes on the drive. The drive signals the completion of the write immediately after it receives the data and before the drive is actually written to the disk. The system then continues to process data while the hard disk is actually writing the data. Performance is significantly better, because subsequent write operations can overlap getting data from the system to actually storing the cached information on disk. This approach allows subsequent sequential writes to be recorded without unnecessary drive rotations.

For most applications, caching writes poses no danger of data loss. The data write is not delayed, so data is written to disk at least as quickly as noncached drives.

### Hard Drive Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ATA (AT Attachment) Interface</strong></td>
<td>The formal name for what is popularly called the IDE interface. ATA is the dominant form of interfacing hard drives to PCs.</td>
</tr>
<tr>
<td><strong>ARRE (Auto Read Reallocation)</strong></td>
<td>The ability of a drive to move data to a spare location when it detects a (correctable) read error (see sparing).</td>
</tr>
<tr>
<td><strong>AWRE (Auto Write Reallocation)</strong></td>
<td>A drive's ability to remap sectors to spare locations when it detects a write error (see sparing).</td>
</tr>
<tr>
<td><strong>command queuing</strong></td>
<td>A SCSI feature that allows the computer to send multiple commands to the SCSI peripheral and control the order in which they are processed. The computer can specify that a command be placed at the front of the queue, or it can allow the drive to do commands in any order.</td>
</tr>
<tr>
<td><strong>contingent allegiance</strong></td>
<td>A SCSI feature to allow the drive to report deferred errors (i.e., errors that occurred after the drive reported &quot;good,&quot; which is possible with write caching).</td>
</tr>
<tr>
<td><strong>differential SCSI</strong></td>
<td>A SCSI variant that allows cables up to 75 feet long by signaling with voltage differences between two wires.</td>
</tr>
<tr>
<td><strong>IDE</strong></td>
<td>Formally any drive that integrates the drive controller onto the drive itself. In popular usage, IDE refers to the ATA form.</td>
</tr>
<tr>
<td><strong>latency</strong></td>
<td>The time in which the drive must wait for the correct sector to spin under the drive head.</td>
</tr>
<tr>
<td><strong>SCSI</strong></td>
<td>An evolving international standard communication protocol between computers and peripherals.</td>
</tr>
<tr>
<td><strong>segmented cache</strong></td>
<td>A drive cache that can maintain prefetched data for several areas on the disk. An unsegmented cache will overwrite prefetched data whenever the disk head is repositioned. A typical operation that can benefit from a segmented cache is a database join that reads from two files simultaneously.</td>
</tr>
<tr>
<td><strong>single-ended SCSI</strong></td>
<td>The standard form of SCSI cabling.</td>
</tr>
<tr>
<td><strong>sparing</strong></td>
<td>A formatting scheme where spare sectors and tracks are allocated to replace sectors that go bad during use. When formatting the disk, spare sectors are allocated and hidden from the user.</td>
</tr>
<tr>
<td><strong>TCAL (thermal recalibration)</strong></td>
<td>A periodic procedure where the drive recalibrates for mechanical changes due to changes in the internal drive temperature.</td>
</tr>
<tr>
<td><strong>transaction processing</strong></td>
<td>Transaction-processing algorithms guarantee that a group of changes are always made in an all-or-nothing fashion: Either all changes are made or none of them are made. For example, a common banking transaction requires subtracting money from one account and adding it to another. A hardware failure (e.g., a power loss) can interrupt a transaction but will never leave it partially completed.</td>
</tr>
<tr>
<td><strong>variable-zone recording</strong></td>
<td>See ZBR (zoned-bit recording).</td>
</tr>
<tr>
<td><strong>zero latency read</strong></td>
<td>An interesting feature that could have a big impact on performance if widely adopted. When a drive is instructed to perform a zero latency read, it starts the read as soon as any block of the request passes under the head, rather than wait for a particular block to spin around. When the system is requesting an entire track as a cache might, it is guaranteed that read will start right away, hence, the name. (Note that the read is zero latency only if the system is requesting an entire track; the latency of accessing a particular block is a physical reality that cannot be changed.)</td>
</tr>
<tr>
<td><strong>ZBR (zoned-bit recording)</strong></td>
<td>A technique for storing more information on the longer outer tracks by pulsing the drive electronics faster. Since the outer tracks are &quot;longer&quot; than the inner tracks, using ZBR allows the disk electronics to place more information on the outer tracks.</td>
</tr>
</tbody>
</table>
SAVE $100 ON ONE LAN CONNECTION.
GET ANOTHER ONE ABSOLUTELY FREE.

The Versatile Yet Affordable Pocket Ethernet LAN Adapter.
The Kingston Pocket Ethernet Adapter features both popular Ethernet LAN interfaces and is priced $100 less than the competition’s single interface adapters. It connects to the parallel port of any laptop, notebook or desktop PC and is compatible with most popular network operating systems including Novell Network, Microsoft Windows for Workgroups and LAN Manager.

Individual Product Testing.
As a member of the EzelleX network products family, every Pocket Ethernet Adapter is bench tested before it’s shipped. Our exclusive loopback transmission/receive test suite evaluates each adapter 32 times to ensure data integrity. This unequaled quality control process leads to many years of reliable service.

Convenient Dual Interface Connectivity.
The new Kingston Pocket Ethernet Adapter supports both twisted pair and thin coaxial cabling for 10BASE-T and 10BASE2 networks. It’s like getting one adapter for the low price of $995 and another one absolutely free.

Kingston Reliability.
Pocket Ethernet Adapter users enjoy the same reliability customers have come to expect from Kingston memory and processor upgrades. Every product is supported by free comprehensive technical assistance and backed by a full five-year warranty.

Another Free Connection.
Contact your nearby Kingston dealer or call us at (800) 435-2620. We’ll be happy to answer your questions about our full line of EzelleX networking products or any of our other 625 upgrade products.

[800]
Seagate Technology has thrown down a gauntlet with the 2-GB ST12550N SCSI drive (also known as Barracuda). Based on our tests, this is the fastest drive on the market.

Although the Barracuda’s sequential performance is good, where the drive really distinguishes itself is in how quickly it accesses data from 64-MB “localized” regions throughout the disk. In our tests of reads to localized regions, the drive produces response times of 13.1 ms for a 16-KB read and 10.3 ms for a 16-KB write. To put this in perspective, the fastest 250-MB drive we tested produced response times of 12.6 and 14.7 ms for sequential reads and writes.

The 1.2-GB Maxtor MXT-1240S was the second-fastest-spinning drive at 6300 rpm and the second highest-performing drive in this category. It is essentially the 540-MB MXT-540SL with twice the platters for double the capacity. The MXT-1240S’s nonsequential performance is a little better than the MXT-540SL’s, because the extra platters allow the drive to access more data without moving the head. Other performance gains over the MXT-540SL reflect the fact that we tested 1-GB and greater drives with the SCSI BIOS disabled, which speeds up the drives because compatibility translation overhead is eliminated. The downside of disabling the BIOS is that you cannot boot from the drive. To get the most from these drives, we recommend you boot from a floppy drive or, better yet, from a small inexpensive IDE drive. This isn’t practical for applications that require small-capacity drives, but it’s cost-effective for gigabyte-class drives.

All other SCSI drives in this class spun at 5400 rpm and produced similar performance. The relatively small-capacity 1-GB Fujitsu M2694ESA was unsurpassed in multitreaded operations, which explains its popularity in Unix machines. The 1.4-GB Conner CP-31370 and the two Micropolis drives (the 1-GB 2112A and the 1.8-GB 2217) were the slowest of the group due to poor results in

The heat generated by drive activity can force the drive controller to adjust its operations periodically, a process called thermal recalibration, or TCAL. While a drive is doing TCAL, it is unavailable to process commands from the host. TCAL takes place periodically, usually at 2 to 10 minute intervals and can disrupt data transfer for up to half a second. While these brief interruptions are rarely noticed for most applications, they represent serious problems to digital-video applications like QuickTime. Drive firmware varies widely in its handling of TCAL.

Part of the problem stems from the single-threaded nature of DOS and the Macintosh SCSI Manager. In theory, a digital-video application such as QuickTime should be able to buffer data in memory to hold it through TCAL pauses in the data stream. But with just a single thread at work, the system ends up waiting for the drive to finish TCAL. TCAL pauses translate directly into lost video frames.

The easiest TCAL algorithm to implement is a straight timer approach. This approach causes the drive to simply recalibrate all its heads at regular time intervals. For example, the Seagate ST3390N typically takes 100 ms to recalibrate itself every 2 minutes. For a drive with many heads, this can result in significant gaps in the data stream. If you’re running full-motion video at 30 frames per second, this 100-ms recalibration time represents a loss of three frames.

Big drives with many heads tend to be more sophisticated about TCAL. The Seagate ST12400 family does TCAL on only one head at a time. In between head recalibrations, the host is serviced, limiting the worst-case pause to the time needed to recalibrate a single head. Recalibrations are also delayed if a command is currently being processed.

The Micropolis 2217 is a drive often specified for video applications because of its extremely polished approach to TCAL. The figure compares the response time during a seek “ramp” test of the 2217, the Seagate ST12550N, and the Maxtor MXT-1240S. The “wobble” in the scores is due to normal latency variations due to disk spinning, but the large spikes are due to TCAL. We did not note any spikes for the 2217 (ample time was given between operations for the 2217 to do its TCAL), but the spikes for the other two drives are obvious.
the multithreaded read tests. The Conner drive has a single-segment cache design, which makes it a poor choice for a multitasking or multithreaded operating system. The Micropolis drives were tested with two sets of firmware. The firmware that did great with multithreaded tests performed poorly in the more heavily weighted single-threaded tests. The results shown in the summary tables are for the firmware that performs better in single-threaded activities because the overall scores were better.

The Micropolis 2217’s performance is not as good as that of the faster-spinning Maxtor and Seagate drives, but it still offers response times within 20 percent of the performance-leading Seagate ST12550N. The Micropolis mechanism has been around longer and seen a lot of use in digital-video applications. The Micropolis hard drive is a favorite among video professionals because of its ability to maintain consistent response time even while undergoing TCAL (thermal recalibration).

In contrast, the Maxtor drives and the Seagate ST12550N drive exhibited periodic TCAL spikes in the performance. These short lapses in performance are meaningless in most applications, but for digital video any lapse can mean a missed frame and jerky motion.

In this capacity range, the Micropolis 2112A was the sole IDE drive we tested. As the summary tables show, the drive ran significantly slower than its SCSI counterparts. But Micropolis says it will offer a new version that could make the drive’s performance more competitive with SCSI. For now, the 2112A is attractive for cost reasons. A high-performance SCSI system requires a wide bus such as EISA and a high-performance adapter such as the Adaptec 1742. This can add $900 to the cost of the system over an ISA design with built-in IDE.

We ranked winners and runners-up based on response time. “Low-Cost” winners were those with the lowest cost per megabyte.

**Want the top in size and performance?**

### BEST OVERALL

**Seagate Technology ST12550N (Barracuda)**

This drive is really in a class by itself as far as random-access performance is concerned. The fastest spin rate on the market helps: 7200 rpm means only 4.2-ms average latency. This low latency combined with a superfast actuator lets the drive access random data faster than many drives can access sequential data. Sequential performance is also very good, about the same as that of the smaller-capacity Maxtor drives.

<table>
<thead>
<tr>
<th>INTERFACE</th>
<th>FORMATTED CAPACITY (MB)</th>
<th>PRICE</th>
<th>COST PER MEGABYTE</th>
<th>OVERALL RESPONSE TIME (MS)</th>
<th>WARRANTY (YEARS)</th>
<th>SPIN RATE (RPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEST</td>
<td>Seagate Technology ST12550N</td>
<td>2139</td>
<td>$2050</td>
<td>$1.05</td>
<td>5</td>
<td>7200</td>
</tr>
<tr>
<td>RUNNER UP</td>
<td>Maxtor MXT-1240S</td>
<td>1234</td>
<td>$1539</td>
<td>$1.41</td>
<td>6</td>
<td>6300</td>
</tr>
<tr>
<td>RUNNER UP</td>
<td>Seagate Technology ST12400N</td>
<td>2100</td>
<td>$1900</td>
<td>$1.00</td>
<td>6</td>
<td>5400</td>
</tr>
<tr>
<td>RUNNER UP</td>
<td>DEC DSP-3160S</td>
<td>1600</td>
<td>$1995</td>
<td>$1.37</td>
<td>6</td>
<td>5400</td>
</tr>
<tr>
<td>RUNNER UP</td>
<td>Fujitsu M2694ESA</td>
<td>1078</td>
<td>$2130</td>
<td>$2.16</td>
<td>6</td>
<td>5400</td>
</tr>
<tr>
<td>RUNNER UP</td>
<td>Micropolis 2217</td>
<td>1777</td>
<td>$2170</td>
<td>$1.70</td>
<td>7</td>
<td>5400</td>
</tr>
<tr>
<td>RUNNER UP</td>
<td>Conner Peripherals CP-31370</td>
<td>1370</td>
<td>$2000</td>
<td>$1.61</td>
<td>7</td>
<td>5400</td>
</tr>
</tbody>
</table>

### Need high capacity and IDE?

**BEST IDE**

**Micropolis 2112A**

The Micropolis drive was the only IDE drive we tested in excess of 1 GB. The drive is noticeably slower than the SCSI drives, even when used with a local-bus adapter. However, Micropolis is in the process of slashing interface timings to match the higher throughput of local-bus IDE. The next generation of this drive is expected to achieve double the data transfer rate, or 10 MBps, which is competitive with SCSI. The Micropolis five-year warranty is among the best available in this capacity range. The 2112A provided performance second only to that of the faster-spinning and smaller-capacity Maxtor MXT-540AL.

<table>
<thead>
<tr>
<th>INTERFACE</th>
<th>FORMATTED CAPACITY (MB)</th>
<th>PRICE</th>
<th>COST PER MEGABYTE</th>
<th>OVERALL RESPONSE TIME (MS)</th>
<th>WARRANTY (YEARS)</th>
<th>SPIN RATE (RPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEST</td>
<td>Micropolis 2112A</td>
<td>1048</td>
<td>$1775</td>
<td>$1.88</td>
<td>9.5</td>
<td>5400</td>
</tr>
</tbody>
</table>

### Does economy matter?

**LOW COST**

**Seagate Technology ST12550N**

This Seagate drive sets the standard for hard drive performance; what’s equally impressive is that this drive costs $1.05 per megabyte, which comes to a total cost of approximately $150 more than the most economical drive in this capacity range. Seagate’s $1.00 per-megabyte, 2.1-GB ST12400N. Although less expensive, the latter drive runs an average of a millisecond slower than the ST12550N, a performance difference that outweighs the cost advantage in our eyes.

<table>
<thead>
<tr>
<th>INTERFACE</th>
<th>FORMATTED CAPACITY (MB)</th>
<th>PRICE</th>
<th>COST PER MEGABYTE</th>
<th>OVERALL RESPONSE TIME (MS)</th>
<th>WARRANTY (YEARS)</th>
<th>SPIN RATE (RPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEST</td>
<td>Seagate Technology ST12550N</td>
<td>2139</td>
<td>$2050</td>
<td>$1.05</td>
<td>5</td>
<td>7200</td>
</tr>
<tr>
<td>RUNNER UP</td>
<td>Seagate Technology ST12400N</td>
<td>2100</td>
<td>$1900</td>
<td>$1.00</td>
<td>6</td>
<td>5400</td>
</tr>
<tr>
<td>RUNNER UP</td>
<td>DEC DSP-3160S</td>
<td>1600</td>
<td>$1995</td>
<td>$1.37</td>
<td>6</td>
<td>5400</td>
</tr>
<tr>
<td>RUNNER UP</td>
<td>Maxtor MXT-1240S</td>
<td>1234</td>
<td>$1538</td>
<td>$1.41</td>
<td>6</td>
<td>6300</td>
</tr>
<tr>
<td>RUNNER UP</td>
<td>Fujitsu M2694ESA</td>
<td>1078</td>
<td>$2130</td>
<td>$2.16</td>
<td>6</td>
<td>5400</td>
</tr>
<tr>
<td>RUNNER UP</td>
<td>Micropolis 2217</td>
<td>1777</td>
<td>$2170</td>
<td>$1.70</td>
<td>7</td>
<td>5400</td>
</tr>
<tr>
<td>RUNNER UP</td>
<td>Conner Peripherals CP-31370</td>
<td>1370</td>
<td>$2000</td>
<td>$1.61</td>
<td>7</td>
<td>5400</td>
</tr>
</tbody>
</table>

1 Consists of drive price plus controller, divided by capacity.
2 Up to five years, varies with individual dealers.
IDE and SCSI: Contrasting Styles

Faster data transfer rates while maintaining and improving interoperability.

IDE evolves with power management, drive synchronization, DMA, and block-mode support for higher data transfer rates.

Imprimis (now Seagate) produces the Wren drive, the first drive with the integrated ISA-bus controller.

Compaq and Western Digital begin developing an ST506 controller that can be integrated onto a disk drive circuit board.

SCSI-3
Greater standardization of connectors, fiber-based connections for long-distance serial communication, and support for up to 32 devices.

SCSI-2
Official ANSI ratification still pending, but peripherals manufacturers are implementing specification. Includes zero-latency reads, command queuing, and standardized disk-cache control. Microsoft supports SCSI in Windows NT; Apple extends its SCSI support with true asynchronous I/O.

ANSI ratifies the SCSI standard, which combines elements of Interface specifications from ANSI and Shugart Associates. SCSI is a universal peripheral-interface standard with support for up to seven devices. Supported in Mac and Unix environments.

HONORABLE MENTIONS

At 7200 rpm, the Seagate ST12550N, or Barracuda, is the fastest-spinning and fasteest-performing 3½-inch hard drive on the market. The drive is also notable for its flex-board circuitry that fits more controller electronics onto the board by wrapping the flexible printed circuit board around the drive mechanics. (This same technology is often found in notebook computers.)

Micropolis offers a five-year warranty on all its drives. Seagate offers a five-year warranty on its drives bigger than 1 GB. (Depending on individual dealers, some Fujitsu drives also carry a five-year warranty.) You are finally guaranteed a piece of equipment that will outlive its depreciation.

The tiny 2½-inch Maxtor 25252A is a dynamo.
It is markedly faster than any other notebook drive we have tested. This little overachiever could even find a place in your desktop— it was second only to the Conner CP-30254 among drives of any size with its 251-MB capacity.

The Micropolis 2217 drive offers excellent all-around performance but is truly outstanding for its consistency. It is impossible to catch this drive taking a thermal-recalibration nap. This makes this drive a natural candidate for multimedia and digital-video applications.
For Starters, Our Drives and Arrays Offer You 100MB to 490GB of Raw Computing Power

At Mega, we believe in high performance. Which is why we've built scorching fast, 20 MB/sec, Fast & Wide SCSI-2 in our drive systems and disk arrays.

But there's a lot more to computing than sheer horsepower. You need bulletproof reliability, freedom from O/S and hardware, and true affordability.

Mega Drive brings it all to you in a scalable, fits-it-all, open architecture. On your PC, Mac and Novell servers. Or Sun, DEC, HP, and RS/6000 workstations.

Better yet, our MR/RAID disk arrays come fully loaded with fault tolerant features like RAID 0, 1, 3 and 5 support; "hot swap" drives, power supplies and fans; remote paging. Even built-in tape backup and UPS.

As for our Mercury removable drives, they offer you rock solid data security and portability in internal and external formats. Which makes them ideal for mirroring and duplexing under Novell. In fact, Mercury uses the same fully sealed and shock-protected drives as our MR/RAID arrays. For zero cost upgradability to you.

At Mega Drive, we believe in high performance. Which is why we've built scorching fast, 20 MB/sec, Fast & Wide SCSI-2 in our drive systems and disk arrays.

But there's a lot more to computing than sheer horsepower. You need bulletproof reliability, freedom from O/S and hardware, and true affordability.

Mega Drive brings it all to you in a scalable, fits-it-all, open architecture. On your PC, Mac and Novell servers. Or Sun, DEC, HP, and RS/6000 workstations.

Better yet, our MR/RAID disk arrays come fully loaded with fault tolerant features like RAID 0, 1, 3 and 5 support; "hot swap" drives, power supplies and fans; remote paging. Even built-in tape backup and UPS.

As for our Mercury removable drives, they offer you rock solid data security and portability in internal and external formats. Which makes them ideal for mirroring and duplexing under Novell. In fact, Mercury uses the same fully sealed and shock-protected drives as our MR/RAID arrays. For zero cost upgradability to you.

For more information please call toll free: 800-322-4744 or contact us at: Mega Drive Systems, 489 S. Robertson, BH, CA 90211 • Tel. (310) 247-5000 • Fax (310) 247-8118
# Roll Call of Hard Drives

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
<th>Interface</th>
<th>Formatted Capacity (MB)</th>
<th>Price</th>
<th>Height (Inches)</th>
<th>Overall Response Time (MS)</th>
<th>Short Seek Read (MS)</th>
<th>Short Seek Write (MS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Areal Technology</td>
<td>A180</td>
<td>IDE</td>
<td>181</td>
<td>$350</td>
<td>0.7</td>
<td>19.0</td>
<td>34.5</td>
<td>36.1</td>
</tr>
<tr>
<td>Maxtor</td>
<td>25252A</td>
<td>IDE</td>
<td>251</td>
<td>$595</td>
<td>0.7</td>
<td>15.8</td>
<td>28.4</td>
<td>26.4</td>
</tr>
<tr>
<td>Conner Peripherals</td>
<td>CP-30254</td>
<td>IDE</td>
<td>251</td>
<td>$375</td>
<td>1.0</td>
<td>13.5</td>
<td>31.1</td>
<td>27.7</td>
</tr>
<tr>
<td>Fujitsu Computer Products of America</td>
<td>M2622FA</td>
<td>SCSI</td>
<td>329</td>
<td>$1525</td>
<td>1.6</td>
<td>12.7</td>
<td>27.3</td>
<td>25.2</td>
</tr>
<tr>
<td>Maxtor</td>
<td>7245AT</td>
<td>IDE</td>
<td>245</td>
<td>$343</td>
<td>1.0</td>
<td>15.7</td>
<td>34.7</td>
<td>31.4</td>
</tr>
<tr>
<td>Maxtor</td>
<td>7345AT</td>
<td>IDE</td>
<td>345</td>
<td>$445</td>
<td>1.0</td>
<td>14.4</td>
<td>31.7</td>
<td>27.4</td>
</tr>
<tr>
<td>Samsung Electronics America, Inc.</td>
<td>3122A</td>
<td>IDE</td>
<td>251</td>
<td>$250</td>
<td>1.0</td>
<td>22.1</td>
<td>33.9</td>
<td>33.6</td>
</tr>
<tr>
<td>Seagate Technology, Inc.</td>
<td>ST3283A</td>
<td>IDE</td>
<td>245</td>
<td>$300</td>
<td>1.0</td>
<td>16.0</td>
<td>27.9</td>
<td>36.8</td>
</tr>
<tr>
<td>Seagate Technology, Inc.</td>
<td>ST3283N</td>
<td>SCSI</td>
<td>249</td>
<td>$320</td>
<td>1.0</td>
<td>13.6</td>
<td>30.7</td>
<td>26.9</td>
</tr>
<tr>
<td>Western Digital Corp.</td>
<td>Caviar 2340</td>
<td>IDE</td>
<td>340</td>
<td>$400</td>
<td>1.0</td>
<td>12.1</td>
<td>28.1</td>
<td>28.4</td>
</tr>
<tr>
<td>Conner Peripherals</td>
<td>CP-30540</td>
<td>SCSI</td>
<td>545</td>
<td>$816</td>
<td>1.0</td>
<td>9.0</td>
<td>20.8</td>
<td>18.6</td>
</tr>
<tr>
<td>Conner Peripherals</td>
<td>CP-30544</td>
<td>IDE</td>
<td>527</td>
<td>$816</td>
<td>1.0</td>
<td>8.6</td>
<td>20.3</td>
<td>22.2</td>
</tr>
<tr>
<td>Fujitsu Computer Products of America</td>
<td>M2623FA</td>
<td>SCSI</td>
<td>425</td>
<td>$1615</td>
<td>1.6</td>
<td>11.8</td>
<td>25.2</td>
<td>23.4</td>
</tr>
<tr>
<td>Fujitsu Computer Products of America</td>
<td>M2624FA</td>
<td>SCSI</td>
<td>520</td>
<td>$1700</td>
<td>1.6</td>
<td>11.8</td>
<td>25.3</td>
<td>23.9</td>
</tr>
<tr>
<td>Hitachi America</td>
<td>DK314C</td>
<td>SCSI</td>
<td>418</td>
<td>$995</td>
<td>1.6</td>
<td>21.6</td>
<td>40.5</td>
<td>43.5</td>
</tr>
<tr>
<td>Maxtor</td>
<td>MXT-540AL</td>
<td>IDE</td>
<td>527</td>
<td>$1077</td>
<td>1.0</td>
<td>8.4</td>
<td>17.9</td>
<td>13.6</td>
</tr>
<tr>
<td>Micropolis</td>
<td>2105A</td>
<td>IDE</td>
<td>557</td>
<td>$1172</td>
<td>1.6</td>
<td>9.6</td>
<td>21.1</td>
<td>21.1</td>
</tr>
<tr>
<td>Seagate Technology, Inc.</td>
<td>3600N</td>
<td>SCSI</td>
<td>524</td>
<td>$900</td>
<td>1.0</td>
<td>9.1</td>
<td>22.0</td>
<td>18.8</td>
</tr>
<tr>
<td>Seagate Technology, Inc.</td>
<td>ST3550A</td>
<td>IDE</td>
<td>451</td>
<td>$480</td>
<td>1.0</td>
<td>10.5</td>
<td>23.8</td>
<td>23.7</td>
</tr>
<tr>
<td>Seagate Technology, Inc.</td>
<td>ST3655A</td>
<td>IDE</td>
<td>527</td>
<td>$900</td>
<td>1.0</td>
<td>10.2</td>
<td>22.6</td>
<td>23.7</td>
</tr>
<tr>
<td>Western Digital Corp.</td>
<td>Caviar 2420</td>
<td>IDE</td>
<td>424</td>
<td>$550</td>
<td>1.0</td>
<td>12.6</td>
<td>26.7</td>
<td>26.4</td>
</tr>
</tbody>
</table>

- Conner Peripherals
- Fujitsu Computer Products of America
- Micropolis
- Seagate Technology, Inc.
- Western Digital Corp.

**250 to 350 MB**

**400 to 600 MB**

**1 to 2 GB**

---

* = BYTE Best.

- Up to five years, varies with individual dealers.
<table>
<thead>
<tr>
<th>RANDOM READ TIME (MS)</th>
<th>RANDOM WRITE TIME (MS)</th>
<th>SEQUENTIAL READ TIME (MS)</th>
<th>SEQUENTIAL WRITE TIME (MS)</th>
<th>WARRANTY (YEARS)</th>
<th>SPIN RATE (RPM)</th>
<th>PHONE NO.</th>
<th>TOLL-FREE NO.</th>
<th>INQUIRY NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>38.1</td>
<td>40.8</td>
<td>12.8</td>
<td>32.3</td>
<td>2</td>
<td>2981</td>
<td>(408) 836-6800</td>
<td>None</td>
<td>1105</td>
</tr>
<tr>
<td>33.0</td>
<td>30.5</td>
<td>13.5</td>
<td>24.1</td>
<td>1</td>
<td>4247</td>
<td>(408) 432-1700</td>
<td>(800) 262-9867</td>
<td>1106</td>
</tr>
<tr>
<td>35.1</td>
<td>31.1</td>
<td>12.6</td>
<td>14.7</td>
<td>2</td>
<td>4542</td>
<td>(408) 456-4500</td>
<td>(800) 426-6637</td>
<td>1107</td>
</tr>
<tr>
<td>30.8</td>
<td>28.3</td>
<td>7.8</td>
<td>21.0</td>
<td>—</td>
<td>4400</td>
<td>(408) 432-6333</td>
<td>(800) 626-4866</td>
<td>1108</td>
</tr>
<tr>
<td>39.5</td>
<td>36.0</td>
<td>15.9</td>
<td>13.9</td>
<td>1</td>
<td>3551</td>
<td>(408) 432-1700</td>
<td>(800) 262-9867</td>
<td>1109</td>
</tr>
<tr>
<td>37.5</td>
<td>32.3</td>
<td>14.9</td>
<td>11.8</td>
<td>2</td>
<td>3551</td>
<td>(408) 432-1700</td>
<td>(800) 262-9867</td>
<td>1110</td>
</tr>
<tr>
<td>37.6</td>
<td>37.1</td>
<td>26.1</td>
<td>27.1</td>
<td>2</td>
<td>3600</td>
<td>(201) 367-8004</td>
<td>(800) 446-0282</td>
<td>1111</td>
</tr>
<tr>
<td>32.0</td>
<td>40.0</td>
<td>11.7</td>
<td>28.5</td>
<td>1</td>
<td>4500</td>
<td>(408) 438-6550</td>
<td>None</td>
<td>1112</td>
</tr>
<tr>
<td>35.0</td>
<td>29.7</td>
<td>11.2</td>
<td>14.5</td>
<td>1</td>
<td>4500</td>
<td>(408) 438-6550</td>
<td>None</td>
<td>1113</td>
</tr>
<tr>
<td><strong>28.6</strong></td>
<td><strong>28.0</strong></td>
<td><strong>8.8</strong></td>
<td><strong>9.2</strong></td>
<td><strong>2</strong></td>
<td><strong>4500</strong></td>
<td><strong>(408) 438-6550</strong></td>
<td>None</td>
<td><strong>1114</strong></td>
</tr>
<tr>
<td>31.5</td>
<td>27.8</td>
<td>6.9</td>
<td>6.4</td>
<td>2</td>
<td>4500</td>
<td>(408) 438-6550</td>
<td>None</td>
<td>1115</td>
</tr>
<tr>
<td>33.4</td>
<td>34.0</td>
<td>10.6</td>
<td>12.1</td>
<td>3</td>
<td>3322</td>
<td>(714) 932-5000</td>
<td>(800) 832-4778</td>
<td>1116</td>
</tr>
<tr>
<td>24.5</td>
<td>21.0</td>
<td>6.0</td>
<td>5.8</td>
<td>2</td>
<td>5400</td>
<td>(408) 456-4500</td>
<td>(800) 426-6637</td>
<td>1117</td>
</tr>
<tr>
<td>23.0</td>
<td>25.6</td>
<td>6.8</td>
<td>8.0</td>
<td>2</td>
<td>5400</td>
<td>(408) 456-4500</td>
<td>(800) 426-6637</td>
<td>1118</td>
</tr>
<tr>
<td>28.9</td>
<td>26.7</td>
<td>7.6</td>
<td>21.0</td>
<td>—</td>
<td>4400</td>
<td>(408) 432-6333</td>
<td>(800) 626-4866</td>
<td>1119</td>
</tr>
<tr>
<td>29.0</td>
<td>27.7</td>
<td>7.6</td>
<td>21.0</td>
<td>—</td>
<td>4400</td>
<td>(408) 432-6333</td>
<td>(800) 626-4866</td>
<td>1120</td>
</tr>
<tr>
<td>45.6</td>
<td>47.9</td>
<td>17.5</td>
<td>30.2</td>
<td>5</td>
<td>3600</td>
<td>(415) 589-8300</td>
<td>(800) 448-2244</td>
<td>1121</td>
</tr>
<tr>
<td>22.6</td>
<td>18.0</td>
<td>9.0</td>
<td>8.9</td>
<td>2</td>
<td>6300</td>
<td>(408) 432-1700</td>
<td>(800) 262-9867</td>
<td>1122</td>
</tr>
<tr>
<td><strong>21.2</strong></td>
<td><strong>18.1</strong></td>
<td><strong>5.4</strong></td>
<td><strong>5.9</strong></td>
<td><strong>2</strong></td>
<td><strong>6300</strong></td>
<td><strong>(408) 432-1700</strong></td>
<td><strong>(800) 262-9867</strong></td>
<td><strong>1123</strong></td>
</tr>
<tr>
<td>26.0</td>
<td>26.2</td>
<td>9.6</td>
<td>9.8</td>
<td>5</td>
<td>5400</td>
<td>(818) 709-3300</td>
<td>(800) 395-3748</td>
<td>1124</td>
</tr>
<tr>
<td>25.7</td>
<td>23.9</td>
<td>6.3</td>
<td>7.1</td>
<td>2</td>
<td>4500</td>
<td>(408) 438-6550</td>
<td>None</td>
<td>1125</td>
</tr>
<tr>
<td>28.6</td>
<td>27.8</td>
<td>8.7</td>
<td>8.9</td>
<td>2</td>
<td>4500</td>
<td>(408) 438-6550</td>
<td>None</td>
<td>1126</td>
</tr>
<tr>
<td>29.6</td>
<td>29.1</td>
<td>8.7</td>
<td>8.9</td>
<td>2</td>
<td>4500</td>
<td>(408) 438-6550</td>
<td>None</td>
<td>1127</td>
</tr>
<tr>
<td>33.3</td>
<td>33.0</td>
<td>12.1</td>
<td>12.8</td>
<td>3</td>
<td>3314</td>
<td>(714) 932-5000</td>
<td>(800) 832-4778</td>
<td>1128</td>
</tr>
<tr>
<td>22.1</td>
<td>21.6</td>
<td>5.1</td>
<td>4.8</td>
<td>2</td>
<td>5400</td>
<td>(408) 456-4501</td>
<td>(800) 426-6637</td>
<td>1129</td>
</tr>
<tr>
<td>22.0</td>
<td>19.5</td>
<td>5.3</td>
<td>4.8</td>
<td>5</td>
<td>5400</td>
<td>(508) 641-6330</td>
<td>None</td>
<td>1130</td>
</tr>
<tr>
<td>22.5</td>
<td>21.1</td>
<td>5.0</td>
<td>4.8</td>
<td>—</td>
<td>5400</td>
<td>(408) 432-6333</td>
<td>(800) 626-4866</td>
<td>1346</td>
</tr>
<tr>
<td>19.7</td>
<td>18.0</td>
<td>4.8</td>
<td>5.5</td>
<td>3</td>
<td>6300</td>
<td>(408) 432-1700</td>
<td>(800) 262-9867</td>
<td>1347</td>
</tr>
<tr>
<td>25.7</td>
<td>26.4</td>
<td>9.6</td>
<td>9.7</td>
<td>5</td>
<td>5400</td>
<td>(818) 709-3300</td>
<td>(800) 395-3748</td>
<td>1348</td>
</tr>
<tr>
<td>21.1</td>
<td>20.4</td>
<td>4.7</td>
<td>4.9</td>
<td>5</td>
<td>5400</td>
<td>(818) 709-3300</td>
<td>(800) 395-3748</td>
<td>1349</td>
</tr>
<tr>
<td><strong>17.5</strong></td>
<td><strong>16.8</strong></td>
<td><strong>3.8</strong></td>
<td><strong>4.8</strong></td>
<td><strong>5</strong></td>
<td><strong>7200</strong></td>
<td><strong>(408) 438-6550</strong></td>
<td>None</td>
<td><strong>1350</strong></td>
</tr>
<tr>
<td>21.6</td>
<td>20.4</td>
<td>4.6</td>
<td>5.2</td>
<td>5</td>
<td>5400</td>
<td>(408) 438-6550</td>
<td>None</td>
<td>1351</td>
</tr>
</tbody>
</table>
From parallel 860s, to coprocessors and workstations-

**NDP™ Fortran Drives Them All!**

Microway's industry-leading 32-bit Fortran produces the highest quality numeric code and supports all x86 operating systems, processors and numeric devices. NDP Fortran was used to port industry standards like SRAC’s COSMOS/M to the 486 and is required to use AspenTech’s ASPEN PLUS, IBM’s OSL, and Fluid Dynamics’ FIDAP. The compiler uses advanced numeric optimizations and instruction scheduling which favor fast numerics and RISC devices.

**NDP Fortran, C/C++, Pascal**

and our new **Fortran 90**

for the 386, 486, Pentium, and 860 run under either Extended DOS, OS/2, NT, UNIX V.3/4, SOLARIS, or COHERENT.

The extended DOS compilers feature GREX, Microway's proprietary device-independent graphics library. To run large applications on DOS, our VCPI-based, demand paged virtual memory is superior to all alternatives. We also offer DPMI support for the OS/2 and the Windows DOS Prompt Box. The OS/2 compilers include support for OS/2's 32-bit graphics engine.

Microway's NDP Fortran 90 is a full implementation of the ANSI Fortran 90, which includes the entire array syntax notation, dynamic memory allocation, module definitions, and a complete library of intrinsics. Call for your free demo disk and white paper.

If you plan to use a 386, 486, 860 or Pentium and require portability across operating systems, numeric speed, precision and superior technical support, then NDP Fortran, C/C++ or Pascal is the only solution.

**QuadPuter®-860 ... 200 Megaflops**

The 200 megaflops of Microway's QuadPuter-860 are optimally harnessed using NDP Fortran-860, libraries from IMLS, NAG and KUCK, and the PSR Vectorizer.

**GIGACUBE™**

Microway can build you a customized one gigaflop NFS computational server using five QuadPuters® running in one of our industrial grade Towers for under $50K. We also configure less expensive 486 workstations. All feature industrial grade American power supplies based on Todd cores and flow-through filtered cooling.

To learn why more government research labs, universities and engineers worldwide specify "Microway" call our Technical Support Department at 508-746-7341. To sign up for our free October Seminars in London, Portugal, Italy, Germany Greece or France, please call the appropriate number below.

**Technology You Can Count On**

Corporate Headquarters, Research Park, Box 79, Kingston, MA 02364 USA • TEL 508-746-7341 • FAX 508-746-4678

U.K. 081-541-5466 • Germany 081-541-5466 • Greece 01-291-5672 • India 11 681 0645 • Israel 3-751-2929

Italy 2-749-0749 • Japan 079 822 5855 • Poland 22-414115 • Portugal/Spain 1-60 4049 • Russia 095 155 030
Pentium: More RISC Than CISC

The Pentium moves Intel closer to true RISC, but 80x86 compatibility has forced some compromises

DICK POUNTAIN

Since the launch of the 486 in 1989, all of Intel's high-end competitors have been won over to the RISC computing philosophy. Each has designed its own RISC processor from scratch, and each has reaped substantial performance gains, as demonstrated by DEC's 200-MHz, 40-MFLOPS Alpha AXP architecture.

When Intel's engineers sat down to design the Pentium, they had their work cut out for them. And they might have felt a bit boxed in by the success of the 80x86. In a world where workstations and multimedia PCs have converged, Intel's Pentium had to offer a performance boost that could compete with RISC. But Intel didn't have the luxury of starting from scratch: Any new chip had to be binary-compatible with Intel's CISC 80x86 predecessors.

This is more than a matter of ethics for Intel, because the ability to run the hundreds of thousands of already-existing PC applications is also a powerful marketing weapon. RISC processors such as the Alpha, the PowerPC, and the SuperSparc have so far been locked out of the lucrative desktop PC market because they're not 80x86 compatible.

The design that Intel's Pentium team finally arrived at is a canny compromise that adopts as much RISC technology as possible without sacrificing 80x86 compatibility. And it yields a worthwhile, though not spectacular, performance boost of around 100 percent over that of a 486DX2 (at the same internal 66-MHz clock rate).

The 486 borrowed a few RISC ideas, such as on-chip caches and highly pipelined execution, so you might say that it's a CISC processor with RISC-like aspects. The Pentium tips the scales even further; its RISC-like aspects have shoved the CISC aspects (literally) into a corner, nearly all the silicon real estate on the Pentium die is devoted to caches and pipelined execution units. Only 3 percent of it is devoted to complex instruction support for microcoded instructions.

The most important RISC technique that the Pentium adopts is superscalar execution, the ability to execute more than one instruction at once. Only RISC-like simple instructions (discussed later) can be issued in parallel, so while the Pentium remains fully 80x86 compatible, it separates the 80x86 instruction set into fast-executing and slower-executing instructions.

New optimizing compilers that make proper use of simple instructions are crucial to extracting the full potential speed increase. Borland has already updated its C++ compiler to support Pentium optimizations, and Microsoft will soon follow suit. A speed increase of roughly 30 percent can be attained by merely recompiling existing applications to exploit the Pentium's superscalar execution.

The one area where the Pentium does not follow RISC practice is in its register-file architecture. Where RISC processors always incorporate large register files—which typically consist of 32 integer and 32 floating-point registers—the Pentium has to maintain the AX/BX/CX/DX register structure that is common to the entire 80x86 family of microprocessors.

BYTE presented an overview of the Pentium in the May issue (see "Intel Launches Rocket in a Socket"). In this article I will discuss the RISC-like elements of the Pentium's architecture in more detail: its superscalar execution units, caches, and branch-prediction logic. I will also compare these elements with those of the 486 and RISC competitors such as the IBM/Motorola PowerPC 601, the DEC Alpha AXP, and the Sun Microsystems/Texas Instruments SuperSparc.

continued
The Pentium Architecture

The bus structures in the Pentium's integer pipeline region—between the control unit and the data cache—have been greatly simplified in this diagram to more clearly show the branch-prediction circuits. These circuits predict the outcome of conditional branch instructions before they enter the pipeline and so reduce delays caused by bubbles. The predictions are based on the previous execution history.

Superscalar Execution

The Pentium contains three pipelined execution units—two integer and one floating-point—and can issue either two integer operations or one floating-point operation in a single clock cycle. Intel calls the twin integer-instruction pipelines the U-pipe and the V-pipe.

The five stages of each integer pipeline perform the same functions on the Pentium as they do on the 486: prefetch (PF), decode1 (D1), decode2 (D2), execute (EX), and write back (WB). On the Pentium, however, these stages have more complex implementations. For example, each pipeline has its own ALU and address-generation logic and is therefore capable of executing an instruction independently of the other pipeline (see the figure "The Pentium Architecture").

A pipelined execution unit works just like a Detroit production line; it doesn't reduce the total time needed to perform an individual operation, but it overlaps several operations simultaneously to increase overall throughput. Once filled, a five-stage pipeline can issue a new instruction and produce a finished result every cycle, even though each instruction takes five cycles to complete. The Pentium's twin pipelines can produce two results per cycle (see the figure "The Pentium's Instruction Flow"). The downside to this, however, is that anything that interrupts the flow of instructions into the pipeline causes a delay of several cycles.

The decision to issue two instructions simultaneously in the U- and V-pipes occurs at the D1 decoding stage, where two parallel decoders determine whether the two current instructions meet the Pentium's pairing rules. Several conditions must be met for the instructions to execute in parallel: Both instructions in the pair must be simple (as defined below); there must be no data dependencies (via either memory or registers) between the instructions; neither instruction may contain both a displacement and an immediate value; and instructions with prefixes can be issued only in the U-pipe.

Simple instructions are those that are hard-wired, require no microcode support, and execute in one clock cycle. These instructions include register-to-register ALU operations; moves, inc, dec, push, pop, lea, and nop; and the near jmps, calls, and jccs. In addition, all the ALU memory-to-register and register-to-memory instructions (e.g., add [BX], CX) are considered simple, even though they require two or three clock cycles.

Special sequencing logic in the control unit stalls any single-cycle instructions that pair with multiple-cycle simple instructions; this keeps everything in step. Conditional and unconditional branches can only be the second of a pair—that is, they must
Availability and Low Prices
A Powerful Combination

 Fujitsu Keyboards
01-key enhanced keyboard
Part no.: 9B17128
Product no.: FK84700
$79.95

Toshiba Floppy Disk Drives
1.44MB 3.5" Internal Floppy Disk Drive
Part no.: 9B45774
Product no.: 336KU
$99.95

futuxi Adapters
DE9 female to DB25 male serial adapter
Part no.: 9B10265
Product no.: AD925
$4.95

Memory
Part no.: 9B41769
Product no.: 421000A/B-80
SIMM Module
Function: "MB 80ns
$40.95

Jameco Adapters
DE9 female to DB25 male serial adapter
Part no.: 9B10265
Product no.: AD925
$4.95

Jameco Power Supplies
150 watt 8088
Part no.: 9B19465
Product no.: JE1030
$69.95

20 Years of Full-Service
Product selections & customer service based on solid business experience.

Toshiba Floppy Disk Drives
1.44MB 3.5" Internal Floppy Disk Drive
Part no.: 9B45774
Product no.: 336KU
$99.95

Intel Math Coprocessor
Part no.: 9B21361
Product no.: PPC6
$59.95

Toshiba Floppy Disk Drives
1.44MB 3.5" Internal Floppy Disk Drive
Part no.: 9B45774
Product no.: 336KU
$99.95

Intel Math Coprocessor
Part no.: 9B21361
Product no.: PPC6
$59.95

Jameco 80386DX
33MHz Motherboard
Part no.: 9B31664
$199.95

Jameco Cables
6-foot parallel DB25-pin male to Centronics male printer cable
Part no.: 9B28716
Product no.: PPC6
$7.95

12" VGA Monochrome Paper White Monitor
Part no.: 9B67401
Product no.: MVGA
$89.95

Call for your free Jameco Catalog
1•800•637•8471

Guaranteed Top Quality
Products tested & backed by 30-day money-back guarantee.

Over 5000 Products in Stock

20 Years of Full-Service
Product selections & customer service based on solid business experience.

Computer & Printer Repair
ServiceLine quick-turn repairs, parts installation & tech assistance. Jameco ServiceLine™
1-800-831-8020

Same-Day Shipping
Priority orders before 2:00PM PST are shipped the same day.

Always Prompt Courteous Service
Jameco phone staff quickly connect you with the products and services you seek.
Technical Support: 1-800-831-0084

Circle 104 on Inquiry Card.
execute in the V-pipe. The instruction-issue algorithm looks like the following in pseudocode:

```
IF I1 is simple
   AND I2 is simple
   AND I1 is not a JUMP
   AND Destination of I1 is not Source of I2
   AND Destination of I1 is not Destination of I2
THEN Issue I1 to U-pipe
   Issue I2 to V-pipe
ELSE Issue I1 to U-pipe

The "no data dependencies" rule is relaxed for push/pop pairs (which implicitly depend on the shared stack pointer) and for some commonly used compare/branch pairs.

If pairing fails and only the first instruction is issued to the U-pipe, the second instruction remains in D1 and gets tested against the next instruction to see if they are pairable. If not, the second instruction gets issued alone into the U-pipe (Pentium instructions can never be executed out of order).

The Pentium's EX stage, like its equivalent in the 486 pipeline, performs ALU operations and data fetches so that those instructions that require both will have to spend more than one clock cycle in EX. The pipelines are interlocked, so paired instructions always leave the decode stage and enter the execution stage in step. If one instruction stalls in any stage, for whatever reason, its partner gets held back by the logic so that both stay in step. Much of the Pentium compiler writer's art revolves around ordering instructions to avoid such stalls.

The Pentium's on-chip FPU is also deeply pipelined. It has eight stages, five of which are shared by both integer pipelines. The integer write-back (WB) stage doubles as the first floating-point execution stage X1, which converts floating-point numbers from external memory format and writes them to FPU registers. This is followed by a second execution stage, X2, then by rounding and write-back in WF, and finally by ER, where error reporting and status updating occur.

Both the integer ALUs work together to fetch a 64-bit double floating-point operand in a single cycle. Consequently, the Pentium cannot pair floating-point instructions with integer operations. Floating-point instructions cannot be paired together and must always execute in the U-pipe, with one exception: the FXCH instruction, which swaps the top of the floating-point stack with a lower item and can be paired with all the simple arithmetic operations (e.g., FADD, FSUB, FMUL, and FDIV) to speed up complex expression evaluations. A paired FXCH comes absolutely free—that is, it takes zero clock cycles.

So how does the Pentium's superscalar execution scheme stack it up against its RISC rivals? Unlike the Pentium, both the Alpha and the PowerPC can pair integer operations with floating-point operations, but neither can issue two integer instructions per cycle. Both the Alpha and the PowerPC support a limited degree of out-of-order execution and hence allow some parallel operations that the Pentium forbids. The SuperSparc can issue three instructions per cycle—two integer and one floating-point. It also features radical "cascaded" ALUs, which can execute two instructions in parallel, even when those instructions have a direct data dependency.

All three of these RISC processors make heavy use of register bypass, or feed-forwarding, to reduce the delays caused by data dependencies. Finished results get forwarded directly to waiting instructions earlier in the pipeline, bypassing the register file. This saves an extra cycle stall that reading the destination register would incur. The Pentium implements bypassing for the WF and X1 stages of its FPU, but not for its integer pipelines. The PowerPC does just the reverse, forwarding integer but not floating-point instructions.

Feeding the Pipeline

Benchmark results from both the BYTE Lab and Intel show that the Pentium performs almost exactly twice as fast as an equivalent 486 on integer code—just the improvement that you would expect from issuing two instructions at once. These numbers emphasize that the Pentium's twin superscalar pipelines are the processor's crucial architectural innovation. But there's absolutely no point in executing more instructions at once if you can't supply the instructions quickly enough to keep both units busy. Therefore, most of the other innovations in the Pentium exist to support the pipelines by increasing the available bandwidth into memory.

The Pentium doubles the width of the 486's data bus to 64 bits and replaces the 486's unified cache with separate instruction and data caches (a so-called Harvard architecture) so that the instruction fetch can proceed in parallel with data access. (On the 486, a cache data access would stall any instruction fetch attempted in the same cycle.) The Pentium's 8-KB instruction and data caches are organized into 32-byte lines—twice the size of the 486's lines—and the bus interface can fill these lines with a single burst-mode read of four 64-bit chunks from external memory. An ultrawide, 256-bit bus out of the instruction cache allows the 32-byte prefetch buffers to fill in a single cycle. Only the address bus and the

After a four-cycle latency to fill the twin integer pipelines, two instructions are completed per cycle—so long as no instruction stalls.
Break the Found Barrier

Find Anything, Anywhere with ZyIMAGE™ Document Imaging or ZyINDEX™ Text Retrieval Software

ZyIMAGE and ZyINDEX provide a quick, precise, easy way of accessing information in letters, memos, email, manuals, or legal documents regardless of location or format. Turn paper, fax or electronic files into dynamic information systems. Unlock the hidden potential in your file cabinets, CD Roms, or hard disk drives with the click of a button.

Call for more information on ZyIMAGE, for a free ZyINDEX demo disk, or about our Authorized Reseller program.

ZyLAB • 100 Lexington Drive • Buffalo Grove, Illinois 60089
800•544•6339 708•459•8000 FAX 708•459•8054

©1993 ZyLAB

Circle 162 on Inquiry Card.
integer-register file remain 32 bits wide.

The Pentium's instruction cache and data cache are two-way
set-associative; they are subdivided into 128 two-line sets. Con­
trast that with the 486's single, four-way associative cache. Us­
ing larger sets (i.e., four-way rather than two-way) can improve
the hit rate for a given cache size, because lines that are still use­
ful need not be overwritten so often. But you need more search
logic, and lookup is slower. The Pentium's caches are twice as
large as the 486's, so they can maintain a similar hit rate with half
the associativity.

In an attempt to justify the above explanation, I checked on the
cache associativity of some of the Pentium's RISC rivals. I found
little comfort. Sun's SuperSparc uses a 20-KB, five-way in­
struction cache and a 16-KB, four-way data cache; DEC's Alpha
21064 uses 8-KB direct-mapped (i.e., not associative) instruc­
tion and data caches; and Motorola's PowerPC 601 uses a unified
32-KB, eight-way cache. From this I concluded that cache design
is still one part mathematics and two parts magic (like audio
speaker or racing-engine design), although, presumably, engi­
eers prove all designs empirically by studying the results of
many simulations.

The Pentium's caches use a write-back design to reduce ex­
ternal bus traffic, and since the chip is destined for use in shared-
memory multiprocessors, the data cache supports the MESI (mod­
ified/exclusive/shared/invalid) cache-coherency protocol in
hardware. MESI is a scheme for ensuring the consistency of a
shared memory when several processors are holding cached
copies of it; for more details, see "The Multiprocessor Solution,"
June BYTE. The data cache can also be configured to be write-
through, on a line-by-line basis, by way of external hardware or
software.

The MESI protocol maintains coherence between caches by bus
snooping: The cache-control logic watches the external memory
bus, looking for reads and writes from other processors (i.e., it
"snoops" on bus transactions). When such a transaction is de­
tected, the cache logic initiates an inquire cycle to find out whether
there's a copy of the target address in its own cache. If there is, a
write-back or an invalidation might be needed to maintain co­
herency. This means that up to three different agents may all be
trying to access the Pentium's data cache in the same clock cycle
because a pair of integer instructions might both want to fetch an
operand during an inquire cycle.

To prevent such contention from stalling the Pentium's pipe­
lines, the designers provided the data cache's tag memory with
three ports. One port is devoted to snooping; the other two are used
to look up data addresses for the pipelines. Everything happens
in a single cycle. The cache's actual data memory is not dual-port­
ed but interleaved in eight banks, on 4-byte boundaries. This en­
able two simultaneous data accesses to be made to the same
cache line, so long as they fall in different banks. It also allows a
bank-conflict detect gate to trap and resolve address dependencies
between parallel instructions.

The Pentium's instruction cache is read-only to prevent code
corruption, but this raises a potential problem for self-modifying
As a member of The Computer Book Club...

...you'll enjoy receiving Club bulletins every 3-4 weeks containing exciting offers on the latest books in the field at savings of up to 50% off of regular publishers' prices. If you want the Main Selection do nothing and it will be shipped automatically. If you want another book, or no book at all, simply return the reply form to us by the date specified. You'll have at least 10 days to decide. If you ever receive a book you don't want, due to late mail delivery of the Bulletin, you can return it at our expense. And you'll be eligible for FREE BOOKS through the Bonus Book Program. Your only obligation is to purchase 3 more books during the next 2 years, after which you may cancel your membership at any time.

All books are hardcover unless otherwise noted. Publishers' price shown. If you select a book that counts as 2 choices, write the book number in one box and XX in the next. A shipping charge of $1.50 per order will be added to all orders. ©1983 CBC
programs. Code that’s modified by a write to the data cache may also exist in the instruction cache in its unmodified form. To maintain consistency, the instruction cache snoops on the data cache using a subset of the MESI protocol (it uses just the shared and invalid states), and a write to any instruction invalidates it in the instruction cache. The Pentium also checks to see if the modified instruction has already been prefetched for execution. If this is the case, it flushes the prefetch queue. The instruction cache also sports triple-ported cache tags. One port is for snooping; the other two enable split line accesses.

The Pentium’s architecture displays at least as much data parallelism as it does parallel execution. For example, during a single clock cycle, the processor can prefetch 32 bytes of instruction code, provide operands to two executing instructions, and snoop into both caches.

### Branch Prediction

Flow-control changes are the enemy of efficient pipelining. When a branch instruction is taken, it renders all the following instructions—which may have already been prefetched and decoded—irrelevant. Flushing the pipeline to discard these instructions creates a “bubble” in the pipeline until valid instructions can be fetched from the branch target address. The deeper the pipeline, the more cycles are wasted.

Always prefetching the branch target as well as the next sequential instruction is only a partial cure, because one must still be discarded. The 486, for example, speculatively prefetches from conditional branch target addresses. But because there are two pipeline stages between prefetch and execution, the processor still incurs a two-cycle delay whenever the branch gets taken.

A better solution is to calculate the result of conditional branches earlier, before any unusable instructions have been prefetched. First-generation RISC processors achieved this by using delayed branches. With this method, the CPU always executes the single instruction that immediately follows a branch. This keeps the pipeline full while the CPU fetches a new instruction stream. Unfortunately, the introduction of superscalar execution and two-cycle instruction caches made delayed branching unworkable. The reason: So many instructions need to execute in the “delay slot” that more problems are raised than solved.

Today the preferred method is branch prediction—guessing which way a branch will go and then acting as if it has already happened. The prize for guessing right is zero branch overhead; the penalty for a wrong guess is a complete pipeline flush.

Static branch prediction is the simplest solution to implement. The most commonly used algorithm predicts that backward branches are always taken and forward branches are not. This makes sense because most backward branches represent conditional loops, which are taken for every iteration but the last. Forward branches are less obvious and require compiler technology.

Optimizing compilers try to arrange things such that, for an IF...THEN...ELSE structure, for example, the most frequent outcome is the one generated as in-line “fall-through” code. The less frequent outcome is placed at the branch target address.

---

**Links you anywhere, anytime!**

**New! PCMCIA KeepInTouch™ modem**

Send/receive data and faxes at 14,400 bps from your PCMCIA portable computer via the cellular or standard telephone networks. Why tie yourself to a desk!

With AT&T’s exclusive Enhanced Throughput Cellular (ETC™) protocol* and Optical Line Interface* (OLI™), you get:

- Fastest speeds possible
- Increased connectivity and productivity
- Reduced cellular and line charges

Plus, the KeepInTouch Card lets you easily download modem enhancements to protect your investment. It uses a software-defined architecture similar to that of our COMSPHERE® 3800 Modems that won these awards:

![Modem Awards](image)

**Competitively priced!** Visit Computer City, Elek-Tek, and Fry’s. Or for the name of the dealer nearest you, or to order direct, call us at 1 800 554-4996 ext. 9699.
Choose The Right Performance.

Getting the best performance often means choosing the next generation of technology. If you're looking for leading edge performance from a personal computer, take a look at DIGICOM's new P5 system. Based on Intel's Pentium™ Processor 60/66MHz, this system delivers the power needed for demanding networking, multimedia and graphical workstation applications.

<table>
<thead>
<tr>
<th>PRODUCT NAME</th>
<th>ITEM</th>
<th>CPU</th>
<th>I/O BUS</th>
<th>MEMORY</th>
<th>CASE DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG-P5-60/66</td>
<td>DIGIS-P5</td>
<td>Intel Pentium™ Processor 60/66MHz</td>
<td>ISA+VESA BUS</td>
<td>1-64MB</td>
<td>TOWER CASE 432mmx190mmx620mm</td>
</tr>
</tbody>
</table>

The Intel Inside® Logo is a trademark of Intel Corporation.
PowerPC 601 and DEC Alpha use this type of static prediction.

A second level of compiler-assisted static-branch prediction uses spare bits in the branch instruction's op code to convey hints as to what the most likely branch target will be. The DEC Alpha makes 14 such bits available. That's not enough for a full target address, but it is sufficient to identify an offset within a page so that a read can be started several cycles before the exact target is known. One of the PowerPC 601's three superscalar execution units is a dedicated BPU (branch processing unit) that contains special registers so that conditional branches no longer depend on the main register file. Compilers can use a single hint bit to predict branches taken or not taken.

The Pentium eschews both these forms of static branch prediction in favor of a more radical dynamic prediction scheme. A dedicated BTB (branch target buffer) remembers the target address and the outcome of each branch and predicts their future direction on the basis of their execution history. The Pentium's U- and V-pipes actually have two 32-byte prefetch buffers each, only one of which is active at any time.

Normally the active buffer fetches sequential instructions, but when a branch instruction appears in the buffer, the BTB predicts which way it will go. If the prediction is "branch taken," then the second prefetch buffer becomes active and starts fetching instructions from the branch target address. If the BTB's guess is correct, then the pipeline carries on executing instructions; a wrong guess incurs a three- or four-clock delay, during which both pipelines are flushed and the correct target instruction is fetched.

The Pentium's BTB is actually another 1-KB, four-way set-associative cache with 256 lines, each holding a branch target address and 2 "history bits" and tagged by the address of the branch instruction. Whenever a new branch is taken, the Pentium puts its target address into the BTB, replacing an existing entry at random. Each history bit can have one of two values: 1, for taken, or 0, for not taken (see the figure "The Branch Target Buffer"). The four possible states of these 2 bits record what happened on the last two executions of that branch. A new entry's history gets set to 11, and each subsequent execution of the branch updates the history. The BTB predicts that a branch will be taken unless its history is 00 or it misses the BTB (i.e., it's not recorded there).

The Pentium's dynamic prediction scheme needs less compiler support than does static branch prediction, where an optimizing compiler may have to execute and profile the program code to get sensible hint information. The Pentium in effect profiles code on-the-fly in hardware and in its real-life environment.

**Diminishing Returns**

Intel quotes an amusing example to show off superscalar execution with branch prediction at its best. The inner loop of the Sieve of Eratosthenes, which BYTE used for many years as a benchmark, looks like this in C:

```c
for(k = i + prime; k <= SIZE; k += prime)
    flags[k] = FALSE;
```

A popular C compiler generates the following assembly code from this fragment:

```assembly
inner_loop:
    mov byte ptr flags[edx], al
    add edx, ecx
    cmp edx, FALSE
    jle inner_loop
```

On a 486 system, this code consumes six clock cycles (of which two are due to the branch), but on the Pentium it runs in just two cycles. The `mov` and `add` instructions get paired and executed in parallel for one cycle, the `cmp` instruction pairs with `jle` for another cycle, and the BTB correctly predicts the branch taken, so it requires no cycles at all.

This threefold speedup represents only the most favorable possible case for the Pentium, however. On average it achieves twice the 486's speed on integer code, rising to around three times its speed for floating-point operations. Welcome though it is, this boost is the smallest performance step yet at the launch of a new generation of Intel products.

Future Pentiums will get faster as clock speeds rise above 100 MHz and feature sizes fall to the 0.65-micron level, but this was equally true with the 486 through its life cycle. With the Pentium, Intel may have reached a level of diminishing returns with the 80x86 architecture. Adding a third integer unit or a second FPU will probably not produce cost-effective improvements. Intel's next generation after the Pentium must be full-blooded RISC, with an 80x86-compatible subunit.

Dick Pountain is a BYTE consulting editor. He specializes in programming languages and system architectures. You can reach him on BIX as "dickp," or on the Internet at dickp@bix.com.
Choose The Right Solution.

Looking for a fully equipped PC that doesn’t hog precious desktop real estate? DIGICOM’s Digilight system is the perfect answer. It offers all the flexibility and power of a desktop plus the convenience of a notebook. You can use it in the office and in the evening carry it home with you on your bicycle. Just plug in your favorite monitor and keyboard and get down to work.

<table>
<thead>
<tr>
<th>PRODUCT NAME</th>
<th>ITEM</th>
<th>CPU</th>
<th>I/O BUS</th>
<th>MEMORY</th>
<th>CASE DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>DL-486SX/DX</td>
<td>DIGIS-486DL</td>
<td>Intel i 486SX-33</td>
<td>ISA BUS</td>
<td>1-16MB</td>
<td>BOOK SIZE CASE 331mmx225mmx70mm</td>
</tr>
</tbody>
</table>

The Intel Inside Logo is a trademark of Intel Corporation
Master the art of multi-platform GUIs.

XVT Software is the leading choice of world-class developers for one reason: It is the simplest, quickest path to building quality applications that port to every GUI without compromises in look-and-feel or performance. Plus, it's easier to learn and use than native toolkits, so your time and effort goes into your application, not your GUIs.

XVT gives you simultaneous original GUIs.

Because XVT uses native GUI objects, your application is indistinguishable from one written directly to the native toolkit. Through our layered architecture, you achieve equivalent cross-platform functionality appropriate to each GUI, without the overhead and inflexibility of proprietary emulation-based systems.

XVT puts complete C/C++ solutions at your fingertips.

The XVT Solutions for C and C++ each include an Interactive Design Tool and the XVT Portability Toolkit. Our Design tools let you use your mouse to design and lay out your GUI, using native and custom controls, then test it on all your target platforms before generating and compiling your code.

When combined with in-depth consulting, training and support, plus a wide range of Partners products, XVT forms the most comprehensive and advanced solution for developing completely portable GUI applications.

Developers judge XVT to be a masterpiece.


Call now for a free XVT Technical Overview and Demo.

Ask about XVT training in FL, NY, WA, TX, NJ, and more.

The portable GUI development solution.

1-800-678-7988

XVT Software Inc. 4900 Pearl East Cir, Boulder, CO 80301
(303) 443-3223 FAX (303) 443-0699
For European inquiries, contact: Precision Software GmbH
Phone: 49 0 01 0307 94 0 Fax: 49 0 01 0306 95 3

Circle 159 on Inquiry Card (RESELLERS: 160).
Debugger Support in Windows 3.1

Good debugging support at the OS level is essential to writing good tools and applications. Here's how Windows 3.1 stacks up.

MATT PIETREK

Three years into the 1990s, DOS is finally starting to make its exit. A multitude of contenders stand ready to take its place as the new king of the operating-systems hill. These days, the primary contenders are Windows 3.1, Windows NT, and OS/2 2.1.

With each new operating system comes a new set of APIs to master. For the most part, an API call in one operating system has a counterpart in the others. However, when you get down to the level of the operating-system kernel, this rough equivalence starts to fall apart. This is particularly true in the case of operating-system support for debuggers.

I focus here on the system support for debuggers that is provided by Windows 3.1 (I'll cover OS/2 2.0 and Windows NT next month), but it's important to note that this information is relevant to more than just the small group of people who write debuggers. Having a good knowledge of debugging support is crucial for writing certain classes of tools and applications.

For example, under Windows 3.1 many programmers need a way to start another application and wait for it to finish before continuing the original program. The typical way of accomplishing this is to hook into the notification stream used by the debugger to know when a process exits, when a DLL loads, and so on.

The Basics

There are certain basic services that a debugger requires from any operating system. These services are relatively few in number, but they are absolutely essential for a usable debugger. For the purposes of this article, the basic operating-system support for debuggers includes the following services:

- loading a new process for debugging (known as the child process)
- execution control (the ability to make the child process step through instructions or run)
- reading and writing memory in the child process's address space
- reading and writing the register set of the child process
- notification of significant events (including DLL loads and unloads, the creation and destruction of child-process threads, and the termination of the child process)
- address mapping (the ability to convert a logical address in the debugging information to a real physical address as used by the child process)
- isolating the child process from external events when the process is stopped (primarily a concern for event-driven programs that process messages)
- miscellaneous support (hardware breakpoints, access to system data structures, and so on)

Much of what makes a truly outstanding debugger includes things that the debugger doesn't need the operating system for. Examples of such elements are the data inspectors and browsers that are becoming commonplace these days. The magic of these features is performed by sophisticated lookup mechanisms and manipulation of debugging information. No operating-system support is needed for these portions of the debugger.

Another example is statement stepping. The CPU and the operating system know nothing about the C or C++ statements in your program. Instead, it's up to the debugger to interpret the debugging information. From this information, the debugger synthesizes a statement step out...
Some Assembly Required

Debugging a Child Process in Windows 3.1

Flow control during a breakpoint or single-step interrupt.

of a series of instruction steps and lets the child process run until it hits a breakpoint.

The Windows 3.1 View

In some respects, writing a debugger under Windows 3.1 is not that different from writing a debugger under MS-DOS. In other words, there's not much operating-system support. The debugger is responsible for intercepting INT 1 for single-step and hardware breakpoints, and INT 3 for code breakpoints. As under DOS, all Windows 3.1 tasks share the same address space because they use a common LDT (local descriptor table). And because Windows and DOS are both 16-bit operating systems, debugger code that manipulates addresses can often be ported easily from DOS to Windows.

On the other hand, there are significant differences between a DOS debugger and a Windows debugger. A Windows debugger has to be acutely aware of protected mode. If the user of a debugger inspects a garbage pointer, the debugger can't blindly try to dereference the pointer, possibly generating a general-protection fault in the process. Instead, it has to put on the surgical gloves and treat everything about the child process as potentially dangerous.

The addition of DLLs makes the life of a Windows debugger even more difficult than that of a DOS debugger. A DOS debugger can assume that the symbol table for the child process is the only symbol table. A Windows debugger needs to juggle around the symbol tables of any DLLs it's debugging in addition to the symbol table of the main program. The correct symbol table to use often depends on the context in which the child process is executing.

In Windows 3.1, most of the operating-system support for debuggers and debugging utilities comes in the form of TOOLHELP.DLL. Although TOOLHELP was introduced with Windows 3.1, it's backward compatible with Windows 3.0. It exports upwards of 30 functions, but only a small subset is truly essential for debugging support. The two most important APIs in TOOLHELP are InterruptRegister() and NotifyRegister(). The former lets you see all CPU interrupts and exceptions of interest to a debugger, and the latter is how the debugger finds out about DLL loads, task termination, and so on.

The interrupts, exceptions, and notifications your TOOLHELP-installed handlers receive are from all tasks in the system, not just the task you're debugging. In addition, TOOLHELP multiplexes the interrupts and notifications among all programs that register handlers with it. Because of these two points, it's important that your handler routines inspect each interrupt, exception, and notification to see if it's of interest to the debugger, and chain it on if not.

Loading a New Process

Windows 3.1 offers no explicit support for loading a program for debugging. Instead, a debugger uses the standard Windows APIs LoadModule() or WinExec() to execute a child process. The difference in loading a child process for debugging is that the debugger needs to force the process to stop at the first instruction, rather than executing until it yields. The trick in stopping the child process at its first instruction is finding out where the new process will begin executing. By setting a temporary breakpoint at that location, a debugger can gain control before any child-process code is executed.

There are two approaches to finding the starting address of the child process. The first method is to read the NE (new executable) file of the program to be debugged and extract the starting CS:IP (code segment:instruction pointer) as a logical address. The debugger can then watch the segment-load notifications (i.e., the NFY_LOADSEG notification from NotifyRegister()). When it sees that the appropriate segment has been loaded into memory, the debugger inserts a temporary breakpoint into the segment. The second approach is a more elegant variation on the first method. It requires the debugger to look for the NFY_STARTTASK notification. The dwData argument for this notification is the starting CS:IP of the child task.

Execution Control

While being debugged, a Windows process is either executing its code normally or executing inside an interrupt handler in the debugger's code. A child process halts execution when it finishes stepping an instruction or when it encounters a breakpoint op code. Either of these events causes an interrupt, which transfers control to the debugger's interrupt-handler code. However, just because an exception has occurred does not mean that Windows switches tasks. As a result, you can have a strange state where the child process is still the active process but is running in code owned by the debugger process. The child process remains "suspended" in this interrupt handler until the user instructs the debugger to step through or run the program again. The figure above shows the situation graphically.

A Windows debugger controls whether the "debuggee" will step or run when it resumes by selectively modifying the trap flag in the copy of the child process's FLAGS register. This register is saved on the stack when the child process encounters INT 1 or INT 3. To make the child process single-step the next instruction, the debugger sets the trap flag in the image of the process's FLAGS register. The debugger then switches task
Circle 145 on Inquiry Card.

StatSoft, StatSoftW, and Quick STATISTICAW are trademarks of StatSoft, Inc.

STATISTICA™ (for Windows) Complete Statistical System with thousands of on-screen customizable, presentation-quality graphs fully integrated with all procedures: Complete Windows 3.1 support, DDE, OLE, TT-fonts, multiple toolbars, right mouse button support, Unlimited numbers of data-, results-, and graph-windows: Inter-window integration: data, results, and graphs can be treated as objects and converted into one another in a number of ways: The largest selection of statistics and graphs in a single system; comprehensive implementations of: Exploratory techniques; multi­

TISilCA/oos statistics and graphics • Price

The largest selection of statistics and graphs in a single system; graphs fully integrated with

tem with thou­sands of on-screen customizable, presentation-quality tables with toolbars, pop-up windows, and instant

2D, 3D and multiple graphs: Extremely large analysis designs (e.g., correlation matrices up to 32,000x32,000, unlimited ANOVA designs) • Megafone Manager with up to 32,000 variables (8 Mb) per record • Unlimited size of files; extended (“quadruple”) precision; unmatched speed • Exchanges data and graphs with other applications via DDE or an extensive selection of file import/export facilities: Hundreds of types of graphs, including categorized multiple 2D and 3D graphs, matrix plots, icons, and unique multivariate (e.g., 4D) graphs • Facilities to custom design new graphs and add them permanently to menu: On-screen graph customization with advanced drawing tools, interactive stretching and resizing of complex objects, interactive embedding of graphs and artwork, special effects, icons, maps, multi­graphics management, page layout control for slides and printouts; unmatched speed of graph redraw • Interactive rotation, perspective and cross-sections of all 3D and 4D graphs • Extensive selection of tools for graphical exploration of data: fitting, smoothing, overlaying, spectral planes, projections, layered compressions, marked subsets • Price $995.

Quick STATISTICA™ (for Windows) A comprehen­
vive selection of basic statistics and the full graphics capabilities of

STATISTICA/w • Price $495.

STATISTICA/‑dos™ (for DOS) A STATISTICA/w-compatible data analysis system • Price $795.

Quick STATISTICA/‑dos™ (for DOS) A subset of STA­

tistica/‑dos statistics and graphics • Price $295.

Domestic sh/h $10 per product; 14-day money back guarantee.

Circle 143 on Inquiry Card.

StatSoft™

2325 E. 13th St. · Tulsa, OK 74104 · (918) 583-4149
Fax: (918) 583-4376


StatSoft, Quick STATISTICAW, STATISTICA/Mac, Quick STATISTICA/Mac, STATISTICA/‑dos, Quick STATISTICA/‑dos, and Scrollsheets are trademarks of StatSoft, Inc.
context to the debuggee's context with `DirectedYield()` and drops out of the suspended-state loop. The child process eventually uses an `IRET` (return from interrupt service routine) to return to its own code, causing the modified copy of the FLGS register to be restored to the FLGS register. If the trap flag is set when the FLGS register is reloaded from the IRET, the CPU executes one instruction before generating an INT 1, forcing execution to return to the debugger's interrupt handler.

To make the child process run (as opposed to stepping), the debugger simply does the opposite, clearing the bit in the trap-flag image. This ensures that the trap flag won't be set when the child process does the `IRET` back to its code.

Windows presents an interesting situation with regard to breakpoints. Since Windows can demand load and discard segments as necessary, a debugger needs to watch the segment-load notifications (NFY_LOADSEG, discussed below) to see if a segment with a breakpoint in it has been discarded and then reloaded. If so, the debugger needs to reinsert the breakpoint before letting the child process resume.

**Memory and Register Access**

Because Windows has a single address shared by all applications, it's possible for a debugger to directly read any memory belonging to the child process. However, a debugger that does this has to be extremely careful and perform segment limit and access checking for any address it attempts to read or write. Additionally, if the debugger wants to write to a code segment (e.g., to set a breakpoint), it needs to create an alias data selector. (An alias selector is a data selector that has the same address and limit as a code selector, or vice versa.)

Since doing access checking and creating aliases is "surgical glove" work, Microsoft mercifully provided the `MemoryRead()` and `MemoryWrite()` APIs in TOOLHELP. If you use these APIs, you can eliminate all the hassle of doing your own address validation. Instead, you call these APIs and just check the return value to see if they were successful.

A properly designed interrupt/exception handler in Windows will save the complete register set when the debuggee generates an exception and will restore all the registers before the child process does the `IRET` to resume execution. Typically the registers are saved by `PUSHing` them on the stack. If the user wants to change a register value while the child process is stopped, the debugger just changes the saved copy of the register value. When the child process resumes, the saved copy will be restored instead of the original register value.

The issue of 32-bit registers in Windows is interesting. The kernel scheduler in Windows saves only the 16-bit set of registers, ignoring the high halves of the extended registers. However, the child process may be using 32-bit registers, so it's important that the debuggee interrupt handler save and restore the full 32-bit register set.

**Event Notification**

Event notifications such as DLL loads come through the handler routine installed by `NotifyRegister()`. Of particular interest to debuggers are the following notifications:

- **NFY_STARTTASK** gives the debugger the ability to regain control before the child process executes the first instruction.
- **NFY_EXITTASK** tells the debugger that the child process has terminated. A debugger typically indicates this event to the user and cleans up internal tables as necessary.

**NFY_STARTDLL** tells the debugger about DLLs that are loaded while the child process is executing. A debugger might use this notification to update its internal tables. Note that this notification will not be generated for DLLs that are already in memory when the child task loads.

**NFY_DELMODULE** tells the debugger that a DLL has been unloaded from the system. The debugger might clean up tables at this time as well. Finally, **NFY_LOADSEG** tells the debugger that a particular segment has been brought into memory. If the debugger supports virtual breakpoints in code that's not yet loaded, it inserts breakpoint op codes at this time.

**Address Mapping**

Segments in a Windows .EXE or .DLL file are ordered, starting with segment 1, then segment 2, and so on. If you look at a .MAP file produced by a Windows linker, you can see this segment ordering. Like the addresses in .MAP files, the addresses of functions and variables in the debugging information are stored in terms of these logical segments. The actual selector values that will be used to access these segments when loaded into memory simply aren't known at link time. Therefore, a Windows debugger needs support from the operating system to map a logical segment number to the actual selector value that the loader allocated for the segment. It's also necessary to be able to work in the opposite direction—that is, to convert a selector value to an hModule and a logical segment number.

There are two ways to perform this address mapping. The supported method is to use the TOOLHELP `GlobalEntryHandle()` and `GlobalEntryModule()` APIs. `GlobalEntryHandle()` takes a selector as an input and, if possible, returns a `GLOBALENTRY` structure containing an hModule and a logical segment within the module. `GlobalEntryModule()` performs the inverse mapping, taking an hModule and a logical segment number and returning the corresponding selector as part of the `GLOBALENTRY` structure.

If you don't want to rely on the TOOLHELP functions (which can be somewhat slow), your other alternative for address-mapping services is to directly read the segment table in the module tables. A module table is simply the segment for which an hModule is the selector. If you know the format of the data in the module table, you can quickly look up just the information you need. My book Windows Internals (Addison-Wesley, 1993) and Andrew Schulman's Undocumented Windows (Addison-Wesley, 1992) contain the layout of a module table.

**Isolating the Child Process**

A fundamental tenet of debugger writing is that when the child process stops for some reason, no child-process code should be executed. However, when the process is stopped because it's suspended in the debugger's interrupt handler, it can't be processing messages. A Windows program that doesn't call `GetMessage()` or `PeekMessage()` regularly will freeze the input system. Buried inside the `GetMessage()` and `PeekMessage()` code is where Windows tasks yield to other tasks.

If you don't call these functions, other tasks will never get the opportunity to be switched to the foreground or to execute. This has serious ramifications. If you put a 20-second delay in the message handler of your Windows application, your keyboard and mouse are useless until the delay finishes. No other application can be switched to the foreground or run until the current task starts processing messages again.

continued
If you think Dell's Performance 333s/L is the best value going, Northgate has a real eye-opener for you.

Presenting the Northgate Superb 486SX/25...a gutsy, power-packed system that gives you genuine 486SX performance, a generous 120MB hard drive and 486™ upgradability...for the same price as Dell's Performance 333s/L.

And there's even more! You get a VGA color monitor, DOS 6.0, Windows 3.1, a mouse and more. To top it off you get our award-winning service featuring our legendary 24-hour toll-free technical support.

When you add it all up, the choice is clear. For you it's the Northgate Superb 486SX/25. For Dell, it's back to the drawing board.

Compare...Northgate Beats Dell Cold!

<table>
<thead>
<tr>
<th>Feature</th>
<th>Northgate Superb 486SX/25</th>
<th>Dell Performance 333s/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
<td>486SX/25</td>
<td>386SX/33</td>
</tr>
<tr>
<td>486™ Upgradability</td>
<td>Yes; full range</td>
<td>No</td>
</tr>
<tr>
<td>Hard Drive</td>
<td>120MB</td>
<td>80MB</td>
</tr>
<tr>
<td>RAM</td>
<td>2MB</td>
<td>2MB</td>
</tr>
<tr>
<td>Video</td>
<td>14&quot; VGA; 640x480</td>
<td>14&quot; VGA; 640x480</td>
</tr>
<tr>
<td>Floppy</td>
<td>One</td>
<td>One</td>
</tr>
<tr>
<td>MS-DOS, Windows 3.1</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Price</td>
<td>$999</td>
<td>$999</td>
</tr>
</tbody>
</table>

Offer available for a limited time, so...

Call To Place Your Order Now!
800-545-6059

GSA #GS00K91AGS193 PS01
Major credit cards, money orders, direct wire and approved company purchase orders accepted.
Now consider the case of a Windows-hosted debugger. Imagine that the child process is executing along and then hits a breakpoint. At this point, the process is suspended inside the debugger's interrupt handler and isn't processing messages. The mouse and the keyboard aren't responding; they're useless until the child process starts pumping messages again. The only way to make the child task process its messages again is to make it resume execution. But to do this, you need to communicate some sort of "go" command to the debugger. And alas, you can't communicate with the debugger because the mouse and keyboard aren't responding.

Initially, Windows debuggers dealt with this problem by ignoring it. However, a debugger that does this cannot use Windows to display its screens. Examples of this kind of debugger are Borland's Turbo Debugger for Windows, Microsoft CodeView for Windows, and the text-mode version of Symantec's MultiScope. Debuggers like these essentially freeze all of Windows while the child process is stopped. Instead of using Windows to show their screen, they switch the screen to text mode, use a secondary monochrome monitor, or communicate to a remote debugger over a serial line or network connection.

When using these debuggers, your system is always in one of two modes. The first mode is when Windows and your program are running normally. The other mode is when the debugger is active and you can't access any part of Windows. Although there is no official name for this debugging mode, I've dubbed it super hard mode, for reasons I'll explain shortly.

As more and more developers came into the Windows fold, a clamor began to arise for a true GUI debugger. In light of the rather gloomy prognosis described above, it might seem that a GUI debugger is simply not possible. However, the presence of the graphical version of MultiScope, Microsoft Visual C++, and Bounds-Checker for Windows shows that all is not lost. These are definitely GUI programs, yet they don't freeze up when the child process hits a breakpoint. Something else is going on here under the hood. As it turns out, there are two ways to deal with the problem.

The first way to prevent the Windows input system from freezing is termed soft mode. As part of the entry sequence of the debugger's interrupt handler, the code subclasses each of the child process's windows, directing the messages to go to a dummy window procedure in the debugger's code. The debugger's job is to provide default message processing for the debugger while it's not processing messages itself. After subclassing the child process's window, and while still in the interrupt handler, the code goes into a GetMessage()/DispatchMessage() loop. The child process spins in this loop until the debugger gives it the order to resume execution. Because all the child process's windows have been subclassed, there's no need to worry about code in the child process being called. Instead, messages destined for the process's windows are handled by the dummy window procedure in the debugger.

continued
The best sound is not in the cards.

PORTABLE
sound PLUS™

Perk up your presentations. Make training more effective. And, put some guts into your gaming pastimes. Anytime. Anywhere. In fact, if you are not a card carrying member of the computer set, you have to hear PORTABLE Sound Plus from DSP Solutions. You know, those real smart people who make simple sound solutions.

PORTABLE Sound Plus is the first portable external sound peripheral to deliver 16 Bit CD quality music with stereo audio capabilities. And, since you just plug into your IBM PC or compatible, desktop or laptop parallel port, you do not need an engineering degree or even a screwdriver.

When you compare PORTABLE Sound Plus to any other external sound peripherals, you will see why anything else is just noise. PORTABLE Sound Plus is based on advanced Digital Signal Processing technology, so you will enjoy the greatest compression capability with the highest quality sounds. Here is something else that will be music to your ears. PORTABLE Sound Plus comes complete with everything you need including a high fidelity speaker and built-in microphone. There is an "Audio-in" for a CD or tape player and a "Line-out" for external powered stereo speakers. Even a built-in smart parallel port pass through so you can keep printing.

Whether you take your work across the hall or across the country, with PORTABLE Sound Plus, you have all the cards you need to play right in your hip pocket. The hinged design lets you flip up the unit if you are short on desk space or lap space. And, the power will always be with you whether you use rechargeable or non-rechargeable AA batteries. PORTABLE Sound Plus also comes equipped with an AC/DC power converter.

As a bonus, you will get all the software you need to communicate. Like Lotus Sound™ an OLE server for Windows 3.1, WinReader for Windows 3.1, a handy text-to-speech utility, DSP Solution’s DOSTalk and DOSReader text-to-speech applications. Show & Tell For Kids™ for Windows – an easy to use MultiMedia Authoring program. It is also Sound Blaster and AdLib compatible.

Why compromise on quality, portability, compatibility or affordability? When all the cards are on the table, PORTABLE Sound Plus from DSP Solutions is your ace in the hole. Suggested retail is only $198.95.

To order or obtain more information about PORTABLE Sound Plus, write or call DSP Solutions, or, contact your local dealer.

Sales Office: 550 Main Street, Suite J, Placerville, California 95667. Telephone: (916) 621-1787. Fax (916) 621-2093.

PORTABLE Sound Plus is a trademark of DSP Solutions, Inc. All other product names are trademarks or registered trademarks of their respective owners.

Circle 179 on Inquiry Card (RESELLERS: 180).
To seal off the child process even more, a soft-mode debugger should also somehow prevent hook procedures in the child process from getting called. In Windows 3.1, the WH_DEBUG hook is supposed to help with this. A WH_DEBUG hook is supposed to be called before any other hooks are called. However, in stepping through the hook code in USER.DLL, it appears that there may be problems with this particular hook.

The default message processing that the dummy window procedure provides appears to be highly subjective. The messages that the MultiScope debugger handles are different from what the Visual C++ debuggers handle, which are different from what Bounds-Checker for Windows handles. For the most part, the dummy window procedure can simply pass the message on to DefWindowProc(). In all cases, however, there are some messages that the dummy window procedure should handle specially. For instance, it will not want to allow certain WM_SYSCOMMAND messages (e.g., SC_CLOSE) to go to the default handler.

The advantage of soft mode is that all tasks in the system (except the child process) continue to operate normally. The windows of the child process remain on the screen but aren't responding to normal input commands. The disadvantage of soft mode is that important messages for the child process will be lost. For example, if the child process was in the middle of a DDE transaction when it stopped, the default processing provided by the debugger's dummy window procedure won't know what to do with the message. Put another way, while the child process is stopped, it won't see any of the messages it ordinarily would have received. Thus, soft-mode debugging isn't ideal for all situations.

**Hard-Mode Debuggers**

The second method of preventing the input system from locking up is to go into hard mode, a special mode of the windowing system that's new in Windows 3.1. In this mode, only one window (and its children) can receive messages; all other windows are frozen and receive no messages. To enter hard mode, a debugger calls LockInput(), specifying the window handle of its main window. Only the debugger responds to mouse and keyboard input, until the debugger calls LockInput() again. The child program, as well as all other programs, is frozen. If you've ever seen the old Bewitched TV series where Samantha temporally suspends people, you probably have an idea of what hard mode is like.

The advantage of hard mode is that the debugger doesn't have to deal with messages intended for the child process. And since all other tasks are frozen, there's no chance that the child process will receive an important message until the debugger exits hard mode. This mode's disadvantage is that, while you're in it, you're confined to whatever facilities the debugger provides. There's no way to start up an external editor or browser, for instance.

Recently, some people have begun referring to text-mode debuggers as hard-mode debuggers. However, a true hard-mode...
Introducing new Micrografx Designer 4.0.

With symbol creation and placement to one micron, new Designer 4.0 from Micrografx is a measurable improvement in technical illustration. In fact, hair-splitting accuracy is only the start of what will seem like an endless list of new features. And before you furrow a brow, you'll be glad to know that Designer 4.0 is first, last and always easy to use.

You get advanced features including 3-D drawing with rotation, smooth shading, and light source control. Make adjustments quickly with object snap, wireframe view of images, custom dimension units, direct entry of coordinates and dimensions, and auto dimensioning. And 32,767 layers keep everything organized. The bottom line: you're always in control while creating, editing and manipulating symbols.

Now, while Designer 4.0 is cool bar, and more keep you close to the tools you use the most. There's even invaluable extras like image editing, advanced text and layout capabilities, color separation and slide show utilities, plus 1,200 clip art images and 25 photo images on floppy disk, with 13,740 clip art symbols and 200 photo images on CD-ROM, and more. See for yourself how it measures up.

Order your copy today by calling 1-800-697-3540 or see your local dealer.
debugger uses Windows for its user interaction, while text-mode debuggers don’t. For this reason, I refer to text-mode debuggers as super hard-mode debuggers.

If it’s possible to have a GUI debugger, why would you want to use a text-mode debugger? By not using the windowing system to display information, these super hard-mode debuggers are the best way to minimize side effects caused by the debugger. Ideally, the system you’re debugging shouldn’t be influenced by the tool you’re debugging with. Super hard-mode debuggers are as close as you can get to this ideal (at least without using a kernel debugger, which I’ll describe next month). One of the few disadvantages of super hard-mode debuggers is that it is extremely difficult for a debugger to know about all the various Super VGA boards and how to switch between text and graphics modes with them.

Miscellaneous Support
In this category I lump such things as hardware breakpoints and access to system-level information (e.g., heap walking). In Windows, there is no direct support for hardware breakpoints, so an application must manipulate the debug registers itself. However, an application cannot read or write the registers directly, as only ring level 0 code is allowed to do this. Although the DPMI (DOS Protected Mode Interface) specification provides for setting the debug registers, bugs in the Win386 implementation of the DPMI specification rendered the provision useless. Therefore, the traditional route to manipulating the debug registers is to write a virtual device driver, since its code runs at ring 0.

For accessing system-level information such as the task list, the module list, and the local and global heaps, a Windows debugger can use the various TOOLHELP APIs. Although you can obtain this information from undocumented methods, TOOLHELP shields you from the differences found in different versions of Windows.

WINDEBUG
Before the TOOLHELP DLL, the only debugger support in Windows 3.0 came from WINDEBUG.DLL. Microsoft never publicly documented WINDEBUG.DLL, except to a few tool vendors such as Borland and Symantec.

WINDEBUG was an attempt to put a synchronous layer on top of the notification and interrupt streams that TOOLHELP lets you access. The WINDEBUG API consisted of one function to which you passed commands and from which you received notifications. Thus, it was similar to the DosDebug() API in OS/2, which I’ll discuss next month.

The problem with WINDEBUG was that it assumed that it was the only code that needed to see interrupts and notifications. It didn’t chain these events on, which led to problems when running with TOOLHELP under Windows 3.0. WINDEBUG has fallen into disfavor with the major compiler vendors, although you may occasionally sight some of its descendants, CVWIN.DLL and TDWIN.DLL.

Next month I’ll conclude with a discussion of debugger support under OS/2 2.x and Windows NT.

Editor’s note: Some Assembly Required has rw listings this month. Matt Pietrek specializes in debugging tools at Nu-Mega Technologies (Nashua, NH). He is the author of Windows Internals (Addison-Wesley, 1993). You can reach him on CompuServe at 71774.362, or on BIX c/o “editors.”
Virtual Device Drivers for DOS

Build virtual-device-driver support into your DOS applications and exploit the power of the Windows API

BILL HAWKINS AND ED PUCKETT

OS programmers used to work in a relatively simple operating environment that offered near-total freedom. Now, writing a successful high-performance DOS application requires understanding the Windows VMM (virtual machine manager) and VxDs (virtual device drivers). Once you master the art of writing a VxD, however, Windows offers untold new freedom in DOS programming.

VxDs enable DOS applications to interact with almost any part of the Windows API. For example, you can use a VxD to communicate with the ODBC (Open Database Connectivity) interface, gaining access to data sources residing on both Windows and Mac platforms. You can use a VxD to access the mail-enabling functionality of MAPI (Messaging API). You can even use VxDs to fix or enhance features in your application that Windows has compromised.

The VMM Architecture
Enhanced-mode Windows is based on the VMM, which is a 32-bit, single-threaded, preemptive multitasking operating-system kernel that supersedes DOS. It creates a VM for Windows and for each DOS application. (Windows and Windows applications run in the system VM.) The VMM provides each VM with its own address space, interrupt vector tables, and I/O port space. The VMM shares CPU time among VMs to give each the illusion that it is in complete control of the computer.

VxDs virtualize hardware devices, enabling enhanced-mode Windows to multitask non-Windows applications alongside Windows applications. (Cooperative multitasking is performed only in the system VM. DOS applications, each in their own VM, enjoy superior scheduling performance when compared to their Windows counterparts.)

VxDs are 32-bit, protected-mode DLLs that run at ring 0 and span VMs. This special status lets VxDs control the behavior of almost any application running in the Windows environment. To write a VxD, you need the Windows Device Driver Kit.

Preparations
We were forced to learn about VxDs because we had to tightly integrate our 32-bit DOS-extended graphical application into the Windows 3.1 environment while waiting for a release of Windows NT that supported the NT file system (we needed this to port our application to Win32s). However, application-specific VxDs are essential for any DOS application that isn’t going to be ported to the native Windows environment.

To begin integrating our application into the Windows 3.1 environment, we needed to fix two bugs. Our high-resolution video drivers were unable to coordinate with the Windows video drivers across hot-key events, and our print spooler and the Windows print spooler often collided.

We experienced three problems when running our DOS-extended graphical application in high-resolution video modes. Hot-keying from Windows back into our program often trashed the display, as did hot-keying back into Windows from our application. And if a user hot-keyed from our application back into Windows when our application was running in background mode, Windows would suspend our application.

Solving the first two problems was not difficult. When our VxD detects that our application is about to gain screen focus, we simply restore a copy of our display state, which was saved the last time we detected that we were about to lose screen focus. However, restoring a stashed copy of the Windows screen just before returning...
to Windows would miss any intervening screen events. Luckily, most VDDs (virtual display drivers) and screen grabber drivers correctly refresh their screen when they are regaining execution focus.

The third problem is trickier. Windows’ VDDs typically suspend any high-resolution DOS application when that application loses the execution focus. The VDD does this as a conservative measure; responsibility for virtualizing the display lies with the VDD.

When a DOS application is running full-screen, the display is not virtualized and the application deals with the video hardware directly. When a DOS application is windowed or in the background, however, the VDD virtualizes that application’s display and translates its display modifications to corresponding modifications in the application’s window. The VDD also translates a background DOS application’s display modifications to corresponding modifications in a special video state buffer maintained while the application is in background mode.

The VDD suspends a background DOS application that is running in a high-resolution mode because it must perform the aforementioned translations and cannot do so for the video modes it does not understand. We found this particularly frustrating because we had been careful to ensure that we were running in the same video mode as Windows, and our application was prepared to defer modification of the display until it was again the foreground application.

**The Solution**

We soon discovered that a VDD will not suspend a DOS application that is running in a standard VGA mode and changed our application accordingly. Our VxD would receive notification just prior to losing the display (i.e., Focus Out) and just after regaining the display (i.e., Focus In). We planned to get the information regarding the loss and gain of the display by monitoring the system controls, which are called in each VxD as the system state changes. Unfortunately, system controls corresponding to Focus Out and Focus In didn’t exist.

We discovered that the Windows SHELL VxD maintains a service for hooking the underlying events of the Windows operating system, which is actually built on top of the preemptive operating system controlled by the VMM. By experimenting, we found a combination of system controls and SHELL events that would herald the display changes we sought for each of the possible ways of switching to and from Windows. It’s unfortunate that these events are not officially documented.

We next focused on the print-spooler contention issues. Whenever device contention occurred, a frightening dialog box popped up. Because we already had a VxD, we used it to access the Windows print spooler.

This raises a crucial point: VxDs provide an API-complete pathway between Windows 3.1 and other VMs. By API-complete, we mean that anything that can be performed in the Windows VM using the Windows API can also be performed in another VM through the VxD pathway. This opens up a vast realm of possibilities for all those DOS boxes that enjoy the advantage of true preemptive multitasking.

API completeness depends on the ways in which data and control can be communicated across an interface. The most common one is a data interface, in which raw data is communicated. Shared memory buffers, message packets, and even function parameters are examples. Windows includes a data interface between itself and the other VMs: The INT 2Fh Clipboard interface transfers data between a Windows application and a program running in a different VM.

A control interface communicates process-execution information. An RPC (remote procedure call) is one example. Microsoft implements a simple control interface in the WX and WXServer programs it distributes with Microsoft C 7.0. With the help of a VxD, these programs implement a control interface consisting of a single command that executes a Windows application.

**The Client/Server Approach**

Because all computer interfaces are fundamentally data interfaces, control must be communicated in an encoded form and decoded so the receiver can act on it. In “Making Windows and DOS Programs Talk” (Windows/DOS Developer’s Journal, May 1992), Thomas W. Olsen demonstrated how to pass data and control (encoded as data) between a DOS client and a Windows server process using an intermediary VxD. Olsen’s code serves as a template for various client/server pairs you might want to implement.

We generalized this technique into a general-purpose client/server architecture between DOS clients and Windows servers. Each client/server pair is defined via C++ class derivation from standard base classes. Furthermore, a single VxD manages communication for all client/server pairs.

Using one VxD is attractive because each one reduces the amount of physical memory available to other applications. In fact, the current implementation of Windows locks all VxD memory, even memory that is flagged as not requiring such treatment. VxDs also require unique IDs, which Microsoft doles out on a case-by-case basis. Unfortunately, the ID is a 16-bit quantity, so there are only 65,536 approved VxD IDs.

Our single VxD maintains a list of service tags provided by the various servers on the Windows side. A client submits a request, and, if a service tag for the requested type exists, the VxD returns the tag and request to the server. The server is passed the linear address of the request and forms a memory selector for it. During the remainder of the request’s processing, the request exists as a block of shared memory between the client and the server. The server decodes the request, acts upon it, and posts the results back into the request. You should note that, except for a small generic header indicating the server type, the request’s structure is known only to the client and the server; it appears to the VxD as uninterpreted data.

This architecture makes providing Windows API services to DOS programs a straightforward affair. For the desired API subset, you simply define a suitable request structure and IDs for the various service requests. The server acts on each service request accordingly.

If you are still writing DOS applications and you feel encumbered by the Windows environment, take the time to learn how to write a VxD. You’ll quickly find that you can do much more than you ever could in DOS. In fact, you might even end up requiring that your users run your application on top of the Windows 3.1 VMM.
"Disk compression is inherently more fragile... users of compression should have a copy of Norton Utilities 7.0."

PC Week - May 10, 1993

The new compression technology can put you in a squeeze. You wanted the efficiency, but now you're worried about losing data.

Here's some news that might help you relax. No other single product gives you the complete compressed data protection of Norton Utilities® 7.0.

It's the only utility specifically designed to recover data from DOS 6.0 DoubleSpace, Stacker and SuperStor compressed drives. Only with our Speed Disk® feature can you truly defragment the drives, making your recovery a fast, painless process.

You also get the Norton Disk Doctor, with its nine automated repair functions specific to compressed drives. Plus the new Norton Diagnostics, which analyzes and tests all vital system components, including memory, video, CPU, system boards, communication ports, keyboard, mouse and more.

You can't put a price on peace of mind. But we'll try. So call FAST FAX today and discover the ultimate security of Norton Utilities 7.0. It just might get you out of a tight spot.

For complete information about Norton Utilities 7.0, dial FAST FAX 1-800-554-4403, select option 1, document 447.

For more information in Europe, call 31-71-353111. In Australia, call 61-3-879-6877. In Canada, call 1-800-667-9661. Everywhere else outside U.S., call 408-353-3570. The Norton Utilities, Norton Disk Doctor and Speed Disk are registered trademarks of Symantec Corporation. Other names are trademarks of their respective holders. Compatible with Windows 3.0 and 3.1, DOS 3.3 and higher.©1993 Symantec Corporation. All rights reserved.

Circle 161 on Inquiry Card.
ANAON, the technical leader in monitors has done it again. In addition to being the top choice of today’s graphics professionals and Windows users, Nanao’s award-winning FlexScan F-Series monitors now have a remarkable energy-saving system — Power Save.

Built into Nanao’s new 17-inch FlexScan F550iW and 21-inch F760iW, Power Save has been designed to work with all screen saver software, including Windows 3.1 and After Dark. Power Save activates when the blank screen of the screen saver appears, cutting operating power to less than 8% of total consumption. It can also automatically power the monitor down to a stand-by mode when the computer is turned off. These innovations add up to energy savings and longer monitor life, and have placed Nanao at the forefront of the Environmental Protection Agency’s EnergyStar Program.

Both the F550iW and F760iW exhibit their superiority in many other ways, as well. Each Invar Shadow Mask CRT has a new anti-reflective coating that eliminates reflection of ambient illumination, without sacrificing the focus level and brightness. Ultra-high resolutions with large screens plus other features make them ideal for CAD/CAM, DTP and Windows applications. On top of that, they can power down. So when you’re not working, neither are they.

Nanao FlexScan monitors. Intelligently designed. Incredibly useful. And now, built to help protect our environment by reducing energy consumption.

© 1993 ANAON USA CORPORATION. All product names are trademarks of their respective companies.
always think of September as the beginning of the year. Many of us old academics still do, no matter how long we’ve been away from the college scene. That’s actually a bit odd, since traditionally the fall academic term begins around Michaelmas on September 29. No matter, for me September is the first month of a new year. It’s also time for my annual outfitting-for-college recommendations, which I’ll get to in a moment.

Since my last column, I spent a week in Washington, D.C. I was there mostly to promote new ways to get access to space for all of us, not just NASA employees. I was also doing some research on a new novel. It was a good trip, capped off by a Saturday midnight expedition to the Capitol, where we visited George Washington’s tomb—empty, of course, since he’s buried at Mount Vernon, but the tomb’s still there in case he ever needs it.

I also got to visit the floor of the House, look at the cloakrooms, walk in the Speaker’s veranda, and even sit in the Speaker’s chair. It’s a rather awe-inspiring experience. So is coming out of the House entrance at the top of the Capitol steps; when we did, my member friend said, if this ever stops getting to you, it’s time to quit. I wish they all thought that.

I went from Washington to Atlanta for Spring Comdex, which was hectic. A couple of years ago, BYTE’s editors got a new duty: we, in conjunction with the Interface Group, give out awards for the best products shown for the first time at a Comdex. The Interface Group puts on Comdex, and there are two big ones, Spring and Fall, each year. For two days, between 15 and 20 BYTE editors race about the show floor, visiting every booth and looking for new products worth nominating. Then we all get together for a marathon editorial meeting—this year’s lasted from 3 to 11 p.m. nonstop—at which we choose nominees and winners in each of about 10 categories. We also pick the Best of Show from among the winners.

I think I learn more at those meetings than I do the rest of the year. This shouldn’t come as a surprise, since it would be hard to assemble a group with more collective knowledge about this industry than BYTE’s editors, all of who have a passionate interest in this industry, as indicated by the heated discussions. The awards are given on the basis of both technical merit and potential impact on the industry; and we’re well aware that winning—or even being a finalist for—one of the BYTE Best of Comdex Awards can itself give a product more impact than it would otherwise have.

Samuel Johnson said that when a man knows he is to be hanged in a fortnight, it concentrates his mind wonderfully. The Best of Comdex Awards do much the same: they make us concentrate on what’s both new and important at Comdex. This year, three things stood out.

First, OS/2 had a large presence. Not as large as Windows, of course. Spring Comdex was officially divided into Comdex and Windows World. The split was about two-thirds to one-third, which is pretty astounding when you think
how long Comdex has been around compared to how long Windows has existed as a practical product. Still, OS/2 had a real presence, and IBM announced that OS/2 2.1 is shipping; Microsoft Windows NT remained in beta testing.

Second, Windows NT had no small presence itself. There were perhaps 50 minibooths inhabited by NT users and applications developers. Considering that no one is quite sure just who NT is for, that’s quite a showing.

Finally, the IBM/Motorola/Apple consortium’s PowerPC chip was on display, and a few systems were running early copies of the chip. It was quite impressive, sufficiently so to win BYTE’s Best Technology Award, which is notable since both Apple and IBM have bet a reasonable part of their future on the success of this chip.

There were other notable products, particularly a whole raft of PCMCIA products. Along with modems and network connections, these included full SCSI devices. Now your PCMCIA-equipped laptop can in theory be connected to any SCSI device you like, including disk drives, WORM and read/write optical drives, scanners, DAT (digital audiotape), and so forth. There were other exciting things, but for me, OS/2, Windows in general and Windows NT in particular, and the PowerPC chip were dominant. They also generated a story.

IBM’s OS/2 operating system has some nifty features. There aren’t many commercial OS/2 applications, but more are coming, and they work superbly. OS/2 runs DOS applications better than DOS, and version 2.1 runs Windows applications as well as Windows. The user interface is well thought out. It really does multitasking: I have had two separate communications programs running on two different modems going simultaneously on OS/2, with nary a dropped bit. I sure can’t manage that with Windows. There’s a lot going for OS/2.

Alas, OS/2 won’t work with a lot of hardware. My pet peeve is that I can’t use my Pioneer CD-ROM and read/write optical drives, nor my Network Archivist DAT backup system from Palindrome; indeed, about half the hardware in Chaos Manor doesn’t work properly with OS/2. If you set out to construct an OS/2 system, and buy only hardware that’s known to work with OS/2, you’ll be fine, but most of us aren’t willing to scrap much of our hardware for a new operating system.

OS/2 won’t work with a lot of hardware because it doesn’t have device drivers for them. Device drivers are programs that interface between the operating system and a particular peripheral. There are many different devices out there in the computer world. Writing device drivers can be tricky, and not all programmers do it well; some consider writing device drivers a black art. As a result, operating-system developers, including both IBM and Microsoft, must depend on outsiders to write device drivers.

There are far more Windows device drivers than OS/2 device drivers. Given that OS/2 2.1 is a better DOS than DOS, as good a Windows as Windows, and multitasks better than Windows, one suspects that the lack of device drivers is a major reason that Windows is more popular than OS/2. One also suspects that the presence or absence of device drivers will be a key factor in the coming war between OS/2 and Windows NT. In theory, both companies know this.

Billed as the clash of the titans, Spring Comdex/Windows World opened with Bill Gates “officially announcing”...
NT in his Windows World keynote speech, while IBM’s Jim Cannavino not only demonstrated OS/2 2.1, but announced that it was shipping. It was, too. I was handed a shrink-wrapped copy by IBM’s John R. Patrick at the IBM OS/2 party, and quite a party that was, with several hundred IBM executives, evangelists, programmers, and engineers mingling with equal numbers of developers and hackers—and not a three-piece suit to be seen in the room.

Indeed, there were few suits to be seen on the show floor. When we presented IBM with BYTE’s Best Technology Award for the show, Sheldon Adelson, founder of Comdex, remarked that when he first met me, I was wearing a bush jacket and had a screwdriver in my pocket; “Now Pournelle’s wearing a suit, and the IBM vice president has a T-shirt.”

Microsoft and IBM each had multiple booths. Microsoft dominated Windows World; IBM nearly saturated Comdex. Each had outposts in the others’ territory.

I felt a bit like a war correspondent as I went through the IBM and Microsoft booths. Both sides brought heavy-hitter programmer teams, sharp people indeed. Most of the troops on both sides are BYTE readers, so I had no trouble finding people to talk to about the strengths and weaknesses of the two operating systems. I could write a pretty good story about that, but the bottom line is that at the programmer level, the two companies are evenly matched.

They’re not so evenly matched in organization. When another BYTE editor and I went looking for the PowerPC chip, no one at any of the main IBM booths had any notion of where to find it. Eventually we discovered it over in a far corner, where IBM had a very large and very impressive display of new technologies, easily one of the most interesting booths at the show.

There were other impressive IBM displays. An exhibit of free-form handwriting recognition that could read some of my scrawl. A voice-recognition system that you train by reading scripts so the system knows who you are. I may soon be able to walk up to my machine and say, “I’m Jerry Pournelle, and my voice is my password.” Both those technologies were deservedly finalists for BYTE Best of Comdex Awards.

“Develop Your Device Drivers for OS/2!” proclaimed a sign at IBM’s booth. “IBM Device Driver Source Kit for OS/2 Now Available on CD!” A flier announced “Free WIN-OS/2 source code for seamless VGA Display Device Driver when you order the DDK!” Microsoft has long used CD-ROMs to distribute their development kits, and will even get developers a discount on a CD-ROM drive.

Aha, I thought, now IBM has learned that trick. With any luck, we’ll soon see a flood of new device drivers for both OS/2 and Windows under OS/2, and maybe it won’t be long before I can hook up my Pioneer CD-ROM drive on an OS/2 system. By gum golly, it looks like IBM is doing something right.

Then I got closer, and to my horror, I saw the price. You can get the Device Driver Source Kit for only $499. It wasn’t clear whether that was the regular price or a...
show special. I went up to the young woman who was passing out the fliers.

"I thought the big problem with OS/2 was the lack of device drivers," I said. She gave me a smug look and handed me a flier. "Yeah," I said, "but isn’t 500 bucks a bit steep?" If I go over to Micro and whisper about writ­ ing device drivers for NT, they’ll stuff kit disks into my briefcase." She drew herself up to her full height and said, "Thank you very much for the information." She was too polite to say, "We’re IBM. We don’t care. We don’t have to," and maybe she didn’t think it, but it sure looked like she did.

I went around to some of the sharp OS/2 programmers and told that story. They were disturbed. They hadn’t known the price was that high. That kit, it seems, is sold by a different part of IBM. I spent an hour looking for any policy-level IBM official, or a PR officer, but I never found one to discuss this with.

When I went back to the OS/2 station, the young woman, still smug, said, "Back again?" It was pretty clear she had no use for my observations, so I didn’t offer any.

I didn’t know how much Micro­ soft charged for their kits, so I went over to find out. I’d no more than set foot on their carpet when one of the PR people recognized me and asked if she could help. "If I wanted to write NT device drivers, what should I do?" I asked. "You’re in the wrong booth," she said. "Let’s go over to the NT booth. I don’t know anything about NT, but we’ll find someone.

We walked over—no question that Micro­ soft’s PR people knew where each and every Microsoft booth and display was—and in 7 minutes—I timed it—I was talking to one of the NT product managers. "Well, first you need the developer’s kit, with the compilers and source code and stuff,” he said. "That’s on a CD-ROM for $69. Then you get the DDK. It’s another CD-ROM, same price.”

"Little steep, isn’t it?" I said. "A little," he said, "but there’s a lot there, all the sources we could find, not just ones we wrote but any we could talk people out of. Want a copy?" I think I just may have located the reason why there’s a shortage of OS/2 device drivers, and why there probably won’t be a shortage of NT drivers.

There’s more to this story. When I got home, one of the first things to arrive on my doorstep was an Airborne Express package from Microsoft containing both kits on CD-ROM. I hadn’t even asked for them.

I did ask for the IBM kits, which ar­ rived four weeks later. I also sent by MCI Mail a copy of the above text to IBM’s executives. The reaction was encouraging, in that they took it seriously; but so far the up­ shot has been a fax demonstrat­ ing that IBM isn’t overcharging for their development tools, be­ cause Microsoft now charges more than $500 for their Win­ dows development software. What that totally ignores is that Windows already has lots of ap­ plications and device drivers; they’re not playing catch-up. Moreover, Microsoft’s NT de­ velopment tools don’t cost any­ where near that much.

My wife’s observation is that IBM’s first reactions are like those of the federal government on job creation and the econ­ omy. They don’t understand that if you put obstacles in people’s way, cre­ ative people will go in another direction. IBM is trying to play catch-up with OS/2 applic­ ations and drivers. They should want their development kits in the hands of every independent hacker and start­ up company, not just the big companies: any­ one who can possibly write OS/2 software.

They also ought to be busting their buns to make it easier for nonhackers to develop OS/2 applications.

I’m told that IBM is reviewing the sit­ uation. I hope so, because OS/2 2.1 is a good operating system, with great potential. [Editor’s note: As this column went to press, IBM gave advanced notice of a 90-day special price of $59.95 for the De­ vice Driver Source Kit, good through Sep­ tember 14.]

Meanwhile, at Comdex, BYTE’s Soft­ ware Award went to Windows NT, which also took the Best of Show Award. OS/2 2.1 was a finalist in the software competi­ tion. All the winners in other categories are automatically finalists for Best of Show, so we don’t usually mention what was second for that award; but this time the vote was so close that we thought we had no choice. Windows NT won over the PowerPC chip after three ballots in the closest vote I have ever seen. I don’t have to say which way I voted.

This September is the first one in many years that won’t be back-to­ school-time at Chaos Manor. Richard, our young­ est, has just graduated from UCLA.
Discover why FoxPro, Clipper, and dBASE were all written in C.

There is a good reason why your database language was developed in C. In fact, there are many good reasons.

C code is small. C code is fast. C code is portable. C code is flexible. C is the language of choice for today's professional developer. With the growing complexity of database applications, C is a realistic alternative. Now with CodeBase 5.0, you can have all the functionality, simplicity and power of traditional database languages together with the benefits of C/C++.

C speed - fast code, true executables... FoxPro, Clipper, and dBASE were written in C primarily for speed. But those compilers don't really compile, they combine imbedded language interpreters into your .EXE. Now that's slow. For dazzling performance you need the true executables of C. With CodeBase you get the real thing, C code.

C portability - ANSI C/C++ on every hardware platform... No other language exists on more platforms than C/C++. Why rewrite your entire application for DOS, Windows, Windows NT, OS/2 or UNIX? With CodeBase the complete C source code is included, so you can port to any platform with an ANSI C or C++ compiler. Now and in the future.

data files with any logical dBASE expression. Our new Bit Optimization Technology (similar to FoxPro's Rushmore technology) uses index files to return a query on a 1/2 million record data file in just a second. Automatically take advantage of this query performance by using our new CodeReporter:

C size - small executables, no added overhead... FoxPro, Clipper and dBASE would like you to believe you need their entire development system to build database applications. But remember, those products are all written in C. So why do you need to lug all their extra code around? You don't. CodeBase is a complete DBMS, in C. No fat executables stuffed with unused code. No runtime modules. No royalties. Just quality C code. CodeBase is just what you need.

C portability - ANSI C/C++ on every hardware platform...

No other language exists on more platforms than C/C++. Why rewrite your entire application for DOS, Windows, Windows NT, OS/2 or UNIX? With CodeBase the complete C source code is included, so you can port to any platform with an ANSI C or C++ compiler. Now and in the future.

data files with any logical dBASE expression. Our new Bit Optimization Technology (similar to FoxPro's Rushmore technology) uses index files to return a query on a 1/2 million record data file in just a second. Automatically take advantage of this query performance by using our new CodeReporter:

C speed - fast code, true executables... FoxPro, Clipper, and dBASE were written in C primarily for speed. But those compilers don't really compile, they combine imbedded language interpreters into your .EXE. Now that's slow. For dazzling performance you need the true executables of C. With CodeBase you get the real thing, C code.

New - Design complex reports in just minutes...

Our new CodeReporter takes the painstaking work out of reports. Now simply design and draw reports interactively under Windows 3.1, then print or display them from any DOS, Windows or UNIX application.

SPECIAL - FREE CodeReporter

Order CodeBase 5 before September 30, 1993 and receive CodeReporter for free! This offer includes our no-risk, 90-day money back guarantee, so order today!
Get with the PROgram!

"TouchStone Software's $100 Check/It PRO: SysInfo is the closest thing this category has to perfection."

We Couldn't Have Said It Better Ourselves...

"It made no errors reporting on either of our test systems, and it provided more detailed information on many hardware items in our test bed PCs than did the competition."

"Beyond the basics, Check/It PRO reports on detailed drive mapping with suitable disk controllers and on the kind of UART your serial ports are using. Adding to Check/It PRO's appeal is a set of benchmark comparisons that allows you to make sense out of the numbers that the benchmarks produce. If you get the Sysinfo package and have any interest in diagnostics, you should consider the bundle of Sysinfo & Tests and Tools."

"Quality of information is the key to a good reporting tool. As such, the program of choice for DOS users is TouchStone's Check/It PRO."

—PC Magazine, July 1993
FOR $166, WHY WOULD YOU BUY UNIX FROM ANYONE ELSE?

UNIXWARE PERSONAL EDITION FEATURES

- UNIX SYSTEM V RELEASE 4.2 FOR INTEL PLATFORMS
- X11-BASED DESKTOP MANAGER
- WINDOWING KORN SHELL
- NOVELL NETWORK SUPPORT
- DOS / WINDOWS SUPPORT

ONLY INFORMATION FOUNDATION OFFERS THESE EXTRAS:

- FREE "1-800" product support
- FREE Click-Start™ Training
- No question money back guarantee

INFORMATION FOUNDATION'S INCREDIBLE PRICES

<table>
<thead>
<tr>
<th>PERSONAL EDITION</th>
<th>LIST</th>
<th>I.F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD-ROM VERSION</td>
<td>$249</td>
<td>$166</td>
</tr>
<tr>
<td>TAPE VERSION</td>
<td>$299</td>
<td>$199</td>
</tr>
<tr>
<td>DISKETTE VERSION (NEW)</td>
<td>$399</td>
<td>$266</td>
</tr>
<tr>
<td>TCP/IP FOR UNIXWARE</td>
<td>$449</td>
<td>$99</td>
</tr>
<tr>
<td>C2 SECURITY</td>
<td>$149</td>
<td>$99</td>
</tr>
<tr>
<td>ADVANCED UNIX UTILITIES</td>
<td>$225</td>
<td>$150</td>
</tr>
<tr>
<td>C DEVELOPMENT SYSTEM</td>
<td>$449</td>
<td>$299</td>
</tr>
</tbody>
</table>

PLUS THE COMPLETE UNIXWARE PRODUCT LINE AND UNIX DOCUMENTATION AT UNBEATABLE PRICES!

RESELLER & VOLUME DISCOUNTS AVAILABLE!

CALL: 1-800-GET-UNIX

WHO IS INFORMATION FOUNDATION?

I.F. is in its tenth year as an internationally recognized provider of Open Systems solutions and training. Solutions for customers such as AT&T, American Airlines, UNIX International, US Army to name a few.

Information Foundation is both a USL UNIX source code licensee and a Univel Authorized OEM. We have over 75 UNIX engineers to provide you with unmatched support, training and integration services to meet your most demanding Open Systems needs.

Information Foundation

THE OPEN SYSTEMS MIGRATION EXPERTS™

1200 17th Street, Suite 1900
Denver, Colorado 80202
Phone: 303/572-6486
Facsimile: 303/572-6484
E-mail: sales@if.com

IF is a registered trademark of Information Foundation. UNIX is a registered trademark of UNIX System Laboratories. UnixWare and Univel are trademarks of Univel. All registered trademarks and trademarks are the property of their respective owners.
Everyone makes claims. We make sure.

When the industry wants product testing taken to the nth degree, they take it to NSTL.

In every field, one name sets the standard. In microcomputer testing, the name is NSTL, the leading independent testing lab.

The NSTL compatibility certification seal on a product says that it withstood the toughest lab in the industry — and it's ready for your business.

The seal saves you a lot of comparison and guesswork. It says you'll find the product compatible with a wide range of business applications and hardware. It helps you make the right choice.

Real-world testing for real-world use.

Beyond compatibility testing, we access nearly every conceivable problem — from engineering-level hardware bugs to the everyday usability of business software.

And we test with the end-user in mind, in a real-world environment, just the way your staff uses equipment. Except our trials are more punishing.

Our publications, and others that publish our work.

In a separate facility we also do comparison testing for our own Ratings Reports: Software Digest®, PC Digest® and LAN Reporter®. They're read by people who purchase an average of more than $500,000 in microcomputer hardware and software annually.

And because of the respect we've earned, some of the industry's leading publications, like Data Communications, LAN Times, Unix World and Datapro Research Group publish our test results.

Look for the NSTL seal and be sure.

Experts rely on the NSTL name: now you can, too. The final test of a product is its compatibility in a business environment. The NSTL mark tells you it's already met that test. Look for it when you compare products.

NSTL
Plymouth Corporate Center
Box 1000, Plymouth Meeting, PA 19462
215-941-9600
Micro Channel™ and OS/2™ are trademarks of the IBM Corporation.

Circle 124 on Inquiry Card.
Attention
U.S. BYTE
Subscribers

Watch for the next BYTE DECK mailing that will be arriving in your mailbox soon!

Use this as a fast, convenient tool to purchase computer products and services. It's loaded with essential hardware and software products that you should be aware of when making your buying decisions... and it's absolutely FREE!

If you have a computer product or service, and would like to reach 275,000 influential BYTE magazine subscribers, please give Brad Dixon a call today at (603) 924-2596.

Here's what a BYTE Deck advertiser has to say:

"The BYTE Deck does very well for us -- we've been in for over two years -- and will continue advertising in '93."

Karen Tacy
Rainbow Technologies, Inc.

Sensation comes with a well-done tutorial that begins with basics like how to use a mouse, what word processing is, and how spreadsheets work. From there, you can graduate to more sophisticated stuff, like how to use the fax modem, about which Jenny reports, "When I had to send out my résumé, it was all right there, and I had it sent to 20 places in an hour, starting with knowing nothing about fax modems."

She's since taken a position with a firm that deals in sales-automation software, and she still finds the Sensation useful. It's a good system for people who have never used a computer before, but it's also a general-purpose machine that can run any DOS or Windows software.

When I began this column, donkey's years ago, one of the first of Pournelle's laws was "silicon is cheaper than iron," by which I meant that a general-purpose computer was always to be preferred to a dedicated word processor or other specialized system. The Sensation illustrates that nicely: people who learn on it won't be surprised by the other things computers can do.

The Sensation comes with completely integrated multimedia capabilities: an internal CD-ROM drive, on-board sound, and an internal speaker. There's even a music-box program that lets you play an audio CD in the background as you work with the computer—something Jenny finds surprisingly convenient while working on documents. It also comes with enough software to get you going. Microsoft Works isn't the best word processor, spreadsheet, or database, but as I've said before, it's good enough at all three to take care of most beginners and many sophisticated users. The Sensation has good tutorials on using Works, and it comes with a number of templates that will let beginners sit down and right away do something useful with the computer.

There's also a ton of "infomercials": demonstration versions of software, everything from communications programs to sophisticated spreadsheet applications. BYTE readers won't be impressed by those, but they're a godsend to beginners who don't understand what computers are capable of.

The Sensation isn't perfect. While the WinMate Desktop—a Windows desktop shell—is great for beginners, after a while it gets in the way, and the documentation doesn't tell you how to just use Program Manager. WinMate also interferes with Norton Desktop, which is a pity because Norton Desktop for Windows is an excellent productivity enhancement once you've learned to use Windows. The only reliable way to get rid of WinMate is to go into WIN.INI, and that is something the people who get a Sensation won't do. There ought to be a "WinMate On/Off" button, which would take care of it.

There are other minor annoyances, but on balance I know no better introductory machine, and the Tandy Sensation is a candidate for the User's Choice Award as best beginner's system.

The most useful software for school will naturally depend on what you're studying. Richard isn't in hard science, but he still has to do a fair amount of number crunching, particularly statistical analyses of voting patterns, including correlations with socioeconomic factors. Despite all the specialized statistical software available at Chaos Manor, Richard finds that Microsoft Excel does just about everything. It computes primary statistics, does correlations, and draws graphs. The resulting papers have been very good for his grade point average.

Students write a lot of papers. Richard was captain of the UCLA debate team (they won the national championship that year, too), so he had to deal with more written material than most students. He got used to Microsoft Word when he was a Mac user, and now that he's converted to Windows, he still uses Word. He finds that a full-featured word processor lets him do fancy papers, with footnotes or endnotes as the professor prefers, font changes—the trick, he says, is to choose a font that makes the paper look longer without the professor realizing you did that—and inserted graphs and graphics. About 80 percent of all the work he has to do at school can be handled by Excel and Word.

For organization, he uses Ascend, a Windows program I've recommended before. It must be working, because he's better organized now. Come to think of it, I'm better organized than I was before I took up using Ascend.

The standard printer for students is Hewlett-Packard's DeskJet. Most will want the standard monochrome DeskJet 500, which works with DOS or Windows. The Mac has HP's DeskWriter series, greatly preferred to the standard Apple dot-matrix ImageWriter, because it's faster.
does startlingly prettier work, and doesn't actually cost much (if any) more than the ImageWriter. (Apple also has a fine series of non-dot-matrix printers, but we haven't tested them.)

Richard has been using the DeskJet 550C, which has a color capability, but in fact he seldom needs or uses color, in part because his primary computer is the NCR 3170 laptop. You can hook a color monitor to the 3170, and for some academic disciplines, the color capability would be important. Obviously, the DeskJet's color print quality at 300 dots per inch isn't up to dye-sublimation printer standards, but it's not bad—and a color cover, or a color illustration inserted into a term paper, can do wonders for getting a busy professor's attention.

Richard reports that the DeskJet comes with printer drivers for both DOS and Windows. The Windows drivers install on top of the standard printer drivers that come with Windows, and they slow Windows printing even more than usual. On the other hand, Windows gives a great deal more flexibility in fonts and formatting, and particularly for final drafts is usually the way to go. There's a software-selectable lower-quality output you can use for faster printing of intermediate drafts.

The DeskJet's sheet feeder tends to be a bit fussy depending on what you're putting into it. There's also a problem with envelopes: some software doesn't recognize where the DeskJet thinks the envelope is. Getting things set properly to print the Accident daily appointment and record sheets is a bit of a task as well; but all in all, the DeskJet, either the black-and-white model or the fancier color model, is in my judgment the right printer to send off to college with your student. Recommended.

BSE's Flashdrive, a portable hard drive, was the other accessory we sent with Richard. That serves both as a backup system—when the 3170's drive became read-only, he was able to save everything off to the Flashdrive—and a storage place. The Flashdrive is about the size of a cigar box and comes in a variety of capacities. Installation is simple, and I've used these drives for years without problems. They now have a new model featuring Toshiba's 340-MB 2½-inch hard drive. All the Flashdrives work fine compressed with Stacker—I don't recommend MS-DOS 6 compression—meaning that you can have 700 MB of storage in a system you can hold in the palm of your hand. Amazing.

I consider a CD-ROM drive essential to any college—or high school for that matter—student's computing equipment. Years ago, I said for the record that "CD-ROM will change the world," a sentiment that Microsoft Press used to quote on every CD-ROM they published; and that prediction is coming true. There was a recent Wall Street Journal article about how the CD-ROM has revolutionized educational publishing. That revolution will continue: you can now tailor-make CD-ROMs for particular schools, courses, and classes, and produce them economically. CD-ROMs offer vast amounts of information on nearly any subject you like, all organized and indexed for rapid searches. Incidentally, this is going to be of increasing importance to local school boards, because textbooks tend to drive curricula.

A good CD-ROM drive for school use is the SyDOS Personal CD-ROM Drive. This is a small, self-contained unit that interfaces through your computer's parallel port. Hook it to a portable computer, and you can use your system in places where they won't let you check out the CD-ROM. You can transfer selected data onto your hard disk for incorporation into papers and reports. The SyDOS Personal CD-ROM Drive is bundled with a number of CD-ROM packages, and it's a good deal. Unfortunately, parallel-port access is slow compared to an internal drive.

The interesting thing about the SyDOS drive is that there's also an interface bus card for desktop systems that will let you use that same CD-ROM drive for multimedia as if it were an internal unit. Of course, the Tandy Sensation comes with a CD-ROM drive; and for upgrading desktop systems without a CD-ROM, I recommend Creative Labs' Multimedia Upgrade Kit, which gives you both internal CD-ROM and sound capability.

Incidentally, the SyDOS parallel interface software was written by BSE, so I have great confidence in it. I've never had a problem with anything BSE does.

Once you have a CD-ROM drive, you'll find many almost indispensable CD-ROM titles. One is the updated Microsoft Bookshelf, which incorporates a reasonable encyclopedia, Bartlett's Familiar Quotations, The American Heritage Dictionary, and more. (Bookshelf is included...
Announcing British Airways First Class Sleeper Service™. It puts you in total control of your flight. Choose all your in-flight options before you board, slip into one of our special sleeper suits and relax. You see, we've finally put to bed the notion that airline seats can't be slept in. It's the way we make you feel that makes us the world's favourite airline.

BRITISH AIRWAYS
The world's favourite airline*

Circle 69 on Inquiry Card.
Ascend is the best Windows-based calendar and time management program I’ve seen. It’s $249 from Franklin Quest Co., 2550 South Deer Lake Blvd., Suite 26, Salt Lake City, UT 84119, (800) 877-1814 or (603) 975-9992. Circle 1146 on Inquiry Card.

Buzz Aldrin’s Race Into Space ($69.95) recreates the space race of the 1960s. Build up your systems. Allocate funds to R&D. Watch a Mercury ship rise from the Cape and zoom off to orbit. Interplay Productions, 17922 Fitch Ave., Irvine, CA 92714, (800) 989-7529 or (714) 533-6787. Circle 1147.

HP’s Deskjet ink-jet printers are both reliable and affordable. The Deskjet Portable sells for $479 from Hewlett-Packard Co., Direct Marketing Organization, P.O. Box 58059, MS511L-SJ, Santa Clara, CA 95051, (800) 752-0900. Circle 1148.

Flashdrive portable hard drives connect to your printer port or use an add-in card. Drive sizes range from 25 MB to 340 MB, and prices are from $295 to $1049. The BSE Co., Inc., 2114 North Fourth St., Flagstaff, AZ 86004, (602) 527-8843. Circle 1149.

DeLorme Mapping’s Global Explorer is the most detailed CD-ROM world atlas I’ve ever seen. The Street Atlas USA CD-ROM offers street maps for every major city in the U.S. Both are available for DOS systems and sell for $169. Contact DeLorme Mapping, Lower Main St., P.O. Box 298, Freeport, ME 04032, (207) 885-1234. Circle 1150.

Library of the Future, 2nd Edition offers the complete text of over 950 classic works on CD-ROM. It requires DOS and sells for $299 from World Library Inc., 12914 Haster St., Garden Grove, CA 92840, (800) 443-0238 or (714) 748-7197. Circle 1151.

Monarch Notes on CD-ROM ($69.95) summarizes the great works of literature for harried college students. Great Literature ($54.95) contains the text of 1896 classics. Both are DOS programs only. They’re available from the Bureau of Electronic Publishing, 141 New Rd., Parsippany, NJ 07054, (800) 828-4766 or (201) 808-2700. Circle 1152.

The NCR 3170 notebook computer has wonderful provisions for communications, does Windows extremely well, and is an all-around handsome and handy unit. Prices start at $2533. Contact NCR Corp., 1700 South Patterson Blvd., Dayton, OH 45479, (800) 225-5627 or (513) 445-5000. Circle 1153.

Palindrome’s Network Archivist backup system uses a unique DAT rotation system to ensure that your system or server never loses data. Prices start at $1695 (software only) or $4695 (with Fast2000 DAT drive) from Palindrome Corp., 600 East Diehl Rd., Naperville, IL 60563, (800) 288-4912 or (708) 505-3300. Circle 1154.

OS/2 2.1. IBM’s robust 32-bit operating system, runs DOS and Windows applications in a true multitasking environment that’s pretty well bulletproof. It sells for $249 ($99 on CD-ROM or $119 on disk until September 14). Professional programmers will also want the maps on CD-ROM, including Street Atlas USA, with street maps of every major city in the U.S. Another, Global Explorer, has to be the most detailed CD-ROM world atlas I’ve ever seen.

There are also hundreds of specialized maps on CD-ROM, including Street Atlas USA, with street maps of every major city in the U.S. Another, Global Explorer, has to be the most detailed CD-ROM world atlas I’ve ever seen.

with the Tandy Sensation.) Another is the Bureau of Electronic Publishing’s Monarch Notes, and you definitely should look with the Tandy Sensation.) Another is the Bureau of Electronic Publishing’s Monarch Notes, and you definitely should look with the Tandy Sensation.) Another is the Bureau of Electronic Publishing’s Monarch Notes, and you definitely should look with the Tandy Sensation.) Another is the Bureau of Electronic Publishing’s Monarch Notes, and you definitely should look...
Vendors make performance claims. Compatibility claims. Support promises. As a buyer of PCs and peripherals, you need the TRUTH. Based on objective, head-to-head tests of major competitors in each product category, so you can choose the right products the first time.

Since the dawn of the microcomputer era, buyers making high-stakes purchases have been using National Software Testing Laboratories (NSTL) for authoritative evaluations of standalone and networked systems and peripherals. NSTL originated the concept of testing PC products. Today our state-of-the-art benchmarks and methodologies set the mark that others imitate.

ACCESS TO NSTL TEST RESULTS

PC Digest, published by NSTL/BYTE, gives you direct access to NSTL's test results. So you can make smarter, easier, more confident purchase and upgrade decisions.

No other testing system uncovers core performance, versatility and usability differences. We force products to show their strengths and weaknesses in head-to-head, feature-to-feature competition. In real-world, applications-based environments like the one you work in every day.

CLEAR-CUT WINNERS

The result: clear-cut winners that give you the best value for your money. Concisely and clearly described by expert test technicians — without ads or distractions of any kind.

Every issue focuses on a new technology that you need to know — or features a roundup of established technologies in price-competitive categories.

- 486 66MHz systems
- EISA Ethernet cards
- Pen systems
- Mobile computers
- Multimedia upgrades
- Unix servers
- High res monitors
- Color notebooks
- SCSI disk drives
- PostScript printers
- CD-ROMs
- 9600 V.42 bis modems

PC Digest’s features charts are so complete that vendors consult them before designing upgrades. Shouldn’t you consult us before buying your next piece of equipment?

FREE BINDER

To help you build your resource library, you get a FREE durable, 3-ring binder with tabbed subject dividers upon payment.

2 FREE ISSUES

Include payment with your order now (check or credit card) and receive two additional issues with our compliments.

ORDER NOW!

YES, please enter my subscription to PC Digest for one year (20 issues) at $44.50, and send my free binder with my first issue. If I elect to include payment now, add two additional issues to my subscription at no cost. I must be completely satisfied with PC Digest or I will receive a full refund of my entire investment.

MAIL TO: PC Digest, P.O. Box 551, Highstown, NJ 08520-0551

NAME

COMPANY NAME

COMPANY ADDRESS

CITY/STATE/ZIP

PHONE

PAYMENT INFORMATION:

□ Payment enclosed
□ Please bill me PO. # required
Charge my: □ Visa □ MasterCard □ AMEX

ACCOUNT NUMBER

EXPIRATION DATE

SIGNATURE

Orders outside North America: Please add US $20 for airmail delivery.

PCDIG933

MONEY-BACK GUARANTEE

If at any time you are not COMPLETELY satisfied with your subscription, you will receive a full refund of your entire investment.
CD-ROMs, on subjects from anatomy to zoology.

Exeter Software publishes an interesting catalog called Scientific Software for Teaching and Research. (You can contact them at 100 North Country Rd., Building B, Setauket, NY 11733.) It’s intended more for teachers than students, but it does show the kinds of scientific-education software available. I haven’t been able to look at everything in their catalog, but many of the programs they feature have been recommended in this column, and I see none I dislike in there.

My disk directory got munged the other day. I knew when I tried to do disk defragmentation and was told that I had lost chains. Norton Disk Doctor—an indispensable program—found the lost chains and reported that my directory structure was invalid; in particular, the ASKSA directory wasn’t really a directory, and did I want it turned into a file? I didn’t have much choice, so I let NDD do that.

Fortunately, I had backed up the system since the last time I used askSam, so it would be no trick restoring everything from Network Archivist—except it was. Network Archivist gave a cryptic message and asked for tapes; eventually it asked for every tape I’d ever made, after which it said it couldn’t restore that directory.

Inspection showed why: there was a file called ASKSA (made by NDD, of course), and since that file existed, Network Archivist couldn’t create a directory with that name. Once the file was erased, it did the restoration in seconds using only one tape. Annoying, but if that’s the worst thing Network Archivist ever does to me, I can’t complain.

I can’t prove it, but I think what munged my directory in the first place was moving files across the Windows for Workgroups network. I had a similar problem the last time I used W4WG’s File Manager to move a couple of directories. When I get this column out, I’m going to back things up good and do some tests; meanwhile, I recommend that if you’re going to do a lot of file moves under W4WG, back things up first.

The game of the month is Buzz Aldrin’s Race Into Space. This is an exciting and well-done representation of the original space race. Build up your systems. Allocate funds to R&D. Watch a Mercury ship rise from the Cape and zoom off to orbit—or blow up, as many of them did. Digitized animation, photos, music, and sound effects—it’s all there, and all told by people who were there when it happened.

My only objection to this game is that you’re stuck with the historical alternatives: back in those heady days, some of us advocated systems and approaches that I still think would have worked better. That’s a minor quibble, though. This game captures a lot of the look and feel of NASA’s glory days. Get one for your son or daughter.

The book of the month is the revised edition of James Dale Davidson and Lord William Rees-Mogg’s The Great Reckoning (Simon & Schuster, 1993). It’s subtitled Protect Yourself in the Coming Depression, and I hope I’m being an alarmist in recommending it.

The computer books of the month are the Waite Group series on Visual Basic. Microsoft’s Visual Basic 3.0 is a wonderful program, and those who learn it will not regret that. The Waite Group has done a splendid job with books for everyone from beginners to advanced programmers.

I know I promised more on networking, and I’ll get to that Real Soon Now. Meanwhile, the computer industry continues to be a bright spot in the general economic gloom, and I can’t emphasize enough that it’s worth whatever you have to do to get your kids a good start as computer users—and to keep up with it yourself.

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

Whether you're monitoring a nuclear reactor or handling credit-card transactions, you need realtime performance you can count on around the clock. The kind of performance QNX® has delivered for well over a decade. ~QNX sustains a host of successful mission-critical applications in a wide range of industries. From POS to medical instrumentation, from SCADA to voice mail, thousands of VARs and OEMs rely on QNX for their realtime solutions. It's easy to see why. QNX is a microkernel OS combining realtime executive-class speed with a rich, self-hosted development environment. You won't have to waste time on cross-development, so you'll see faster time-to-market and easier maintenance for your applications. ~QNX is remarkably flexible. You can easily strip it down to an embedded system or build it up to a vast network serving hundreds of CPUs. ~QNX follows Open Systems standards like POSIX and TCP/IP, so all your applications become all the more portable and interoperable. And you can run most popular DOS packages— even Microsoft® Windows® 3.1 in standard mode under QNX. ~So if you're looking for a time-tested foundation for your mission-critical applications, it's time for a real realtime solution. ~It's time for QNX.
What's New

**ACTIVE-COLOR NOTEBOOK**
The Compaq 425 TXT notebook computer ($3,695) from Compaq Computer (Austin, TX) has a 9.1-inch active-matrix display with 640 by 480-pixel resolution and 256 colors. Based on a 25-MHz 486SX, the 6.1-pound notebook includes a 200-MB hard drive, an internal fax modem, 4 MB of RAM, 512 KB of video memory, a PCMCIA slot, and a built-in trackball.
Phone: (512) 250-2000.
Circle 1139 on Inquiry Card.

**PCMCIA SERIAL CARD**
The Serial I/O Card ($215) from Socket Communications (Hayward, CA) fits into a PCMCIA Type II slot to provide serial data transfer rates of up to 115,200 bps. You configure the communications parameters port via software. The 5-inch unit has an attached cable that is 8 inches long, terminating in a male DB-9 connector. Power consumption from the host system is 150 mW when active and 50 mW when inactive.
Phone: (800) 552-3300 or (510) 670-0300.
Circle 1144 on Inquiry Card.

**NETWORK TIFF-IMAGE PRINTING**
From Talaris Systems (San Diego, CA), the 17-ppm 1794FT Imagestation ($7,490) network laser printer can accept simultaneous TIFF files from a variety of inputs without host software or setup commands. The 1794FT automatically skips ASCII banner pages and recognizes and switches among eight optional printer languages.
Phone: (619) 587-0787.
Circle 1067 on Inquiry Card.

**MULTIMEDIA CARD AND DRIVE**
A Multimedia Upgrade Kit ($499) from ATI Technologies (Thornt Hill, Ontario, Canada) includes an ATI Stereo F/X-CD sound card, a Mitsumi LU005 internal CD-ROM drive, and Windows Master and Game Master CD-ROM disks. The sound card has 8-bit, 44-kHz stereo playback and 22-kHz stereo recording capabilities, and the CD-ROM drive exceeds MPC specifications.
Phone: (416) 882-2600.
Circle 1276 on Inquiry Card.

**VOICE-PROCESSING PACKAGE**
Talking Technology’s (Alameda, CA) multiline Voice Ranger ($599) card records and plays messages in compressed and uncompressed modes under DOS. The two-port Voice Ranger is expandable to 16 ports. The card can record speech simultaneously from multiple lines.
Phone: (510) 522-3800.
Circle 1271 on Inquiry Card.

**WORKSTATIONS WITH FASTER GRAPHICS**
Two graphics accelerator boards based on the S3-928 chip set provide improved graphics performance for Mobiis’s Protege workstations (from $3,883). The workstations include 16 MB of RAM, a 240-MB hard drive, a monitor, Unix software, and a CX+/CX+ TrueColor VESA Local Bus interface board. The boards have a standard resolution of 1280 by 1024 pixels with 256 colors. The CX+/TrueColor board can also run at 1600 by 1200 pixels in 256 colors.
Contact: Mobiis Computer Corp., Pleasanton, CA, (800) 662-4871 or (510) 460-5252.
Circle 1061 on Inquiry Card.
Heavy-Duty Cursor Controller

Designed for unfriendly environments, the DuraPoint cursor controller ($279) from Interlink Electronics (Camarillo, CA) contains no moving parts and is sealed against liquids, dirt, and dust. Compatible with DOS, Windows, and OS/2, the unit includes serial and PS/2 mouse-port interfaces.

Phone: (805) 484-1331.
Circle 1275 on Inquiry Card.

PCMCIA SCSI Adapter

New Media’s (Irvine, CA) Visual Media PCMCIA SCSI adapter card ($229) lets you connect your Type 1 PCMCIA slot-equipped laptop or notebook computer to as many as seven logical SCSI-based peripherals via a 22-inch cable with Centronics, DB-25, or SCSI-2 connector options. The card includes 312 KB of memory, an ASPI Manager driver, diagnostics, and test software.

Phone: (714) 453-0100.
Circle 1069 on Inquiry Card.

Automatic Color Monitors

An 8-bit microprocessor automatically controls the picture size, position, brightness, contrast, and color balance of Idex/Iiyama North America’s (Warminster, PA) 21-inch, 1600-by 1200-pixel VisionMaster color monitors (from $2895). You can manually adjust color temperatures for color matching for color printers and other monitors. The Idex monitors meet EPA and European energy-saving requirements and MPR II low-radiation safety standards.

Phone: (215) 957-6543.
Circle 1070 on Inquiry Card.

400-DPI Plotters

Xerox Engineering Systems’ (Stamford, CT) 8770 Series plotters (from $25,900) incorporate the company’s patented Advanced Silicon Imaging to print documents with laser-like quality (400 dpi). The plotters have high-voltage integrated circuitry that’s etched onto an amorphous silicon wide-format print head and feeds a rectangular nib. The plotters operate with 24- or 36-inch media, including opaque, vellum, and translucent paper and clear and matte-back film.

Phone: (800) 937-8255 or (203) 968-3000.
Circle 1071 on Inquiry Card.

Portable Multimedia PC

The lunch box-style Regal/Multimedia Portable PC ($4995) from Micro Express (Santa Ana, CA) is based on a 33-MHz 486DX and includes a 10-inch active-color VGA LCD display, a CD-ROM drive, a 200-MB hard drive, a Sound Blaster Pro card, external stereo speakers, and a microphone. Simultaneous LCD and external Super VGA displays are possible.

Phone: (800) 989-9900 or (714) 852-1400.
Circle 1068 on Inquiry Card.

One-Finger Typing Aid

Intended principally for one-finger typing, the Keypen ($98) from AIZ (Idaho Falls, ID) is a stylus for pressing keys on a keyboard. The pen-like wand has Ctrl, Alt, and right- and left-hand Shift buttons and a small rubber tip. For a Ctrl, Alt, or Shift function, you use the keys on the Keypen, eliminating the need to simultaneously hold down two keyboard keys.

Phone: (800) 353-9736 or (208) 525-1814.
Circle 1072 on Inquiry Card.

A Trio of Color Monitors

The Diamond Scan 15-, 17-, and 21-inch color monitors (from $645) from Mitsubishi Electronics America (Cypress, CA) incorporate 0.28-mm dot-pitch and flat-square CRTs with Invar masks. Resolutions range from 1024 by 768 pixels (15-inch) to 1600 by 1280 pixels (21-inch) noninterlaced. You can store a series of programmable setup parameters and factory presets in the Diamond Scan monitors’ scan-mode memory.

Phone: (800) 828-6372 or (714) 220-2500.
Circle 1274 on Inquiry Card.
What's New Hardware

DIAL-IN LAN SERVER
From Gateway Communications (Irvine, CA), the 20-MHz 386SX LAN Access Server (from $1795) includes 4 or 8 MB of RAM, VGA capability, and data-compression software. The compact system connects directly to any NetWare-based Ethernet LAN as an independent node, eliminating the need for a dedicated PC. Supplied with DOS 5.0, the unit is compatible with several versions of NetWare. Access method is via direct dial over switched analog lines and RS-232 at up to 57,600 bps.

Phone: (800) 367-6555 or (714) 553-1555.
Circle 1073 on Inquiry Card.

CARD ADDS PS/2 HARD DRIVES
You can mount two 2½-inch IDE drives on a CardDrive ($179) and control two additional 3½- or 5¼-inch drives mounted elsewhere in a system, for a total of four IDE hard drives. CardDrive plugs into a PS/2 Micro Channel bus slot and is available with or without hard drives from Productivity Enhancement Products (Laguna Hills, CA). The CardDrive is compatible with OS/2, DOS 3.0 through 6.0, Windows 3.x, and Novell NetWare. The 16-bit card is compatible with 32-bit systems.

Phone: (800) 451-3475 or (714) 348-1011.
Circle 1074 on Inquiry Card.

UPS FOR FAXES, MODEMS, AND MORE

 From Upsonic (Tustin, CA), The Magician ($99) is a UPS that is designed for use with fax machines, modems, and other small business equipment. The UPS provides power- and data-line surge protection as well as battery-backup power. During a power outage, The Magician provides a fax machine with up to 45 minutes of standby battery time, or up to 15 pages of transmission and up to 20 pages of reception. An audible alarm signals when power is lost. Measuring 3 by 3½ by 10¾ inches, The Magician UPS unit weighs 6 pounds.

Phone: (800) 877-6642 or (714) 258-0808.
Circle 1137 on Inquiry Card.

A LOW-COST ETHERNET ADAPTER
Implementing the ISA bus-master DMA mode for low CPU utilization and high throughput, the HP PC LAN Adapter NC/16 TP ($119) from Hewlett-Packard (Palo Alto, CA) supports 14 major network operating systems. The HPNCS utility software auto-configures the DMA channel and other parameters and can run in a batch mode to set up multiple adapter installation.

Phone: (800) 752-0900.
Circle 1273 on Inquiry Card.

FAX PROTOCOL ANALYZER
Used to monitor, capture, and analyze communications sequences between fax machines and/or PC fax cards, the GD-Fax protocol analyzer ($4200) includes card-resident data-capture and user-interface software.

From Gray Associates (Truckee, CA), the GD-Fax plugs into an AT slot and records T.30 and T.4 transaction and timing data to disk for analysis against CCITT standards.

Phone: (916) 582-8623.
Circle 1135 on Inquiry Card.

ETHERNET PRINT SERVER
The NPS 550 Ethernet Print Server ($695) from Axis Communications (Davens, MA) provides simultaneous printing capabilities for NetWare, TCP/IP, and EtherTalk environments. Included is support for two high-speed Centronics parallel and one RS-232 serial printer with up to eight programmable logical printer entries and throughputs of up to 120,000 bps. The NPS 550 also has status-logging, security, accounting, and multiple-router-support features.

Phone: (508) 777-7957.
Circle 1131 on Inquiry Card.

PORTABLE PEER-TO-PEER ADAPTER
An external LAN adapter that operates at 500,000 bps, Pocket WinLAN ($169) from Apexx Technology (Boise, ID) uses a parallel port and telephone wiring to configure peer-to-peer networking via any networking software that supports Microsoft's NDNS driver specification. You can daisy-chain as many as 250 PCs up to 600 feet away via the adapter's two RJ-11 jacks. Included are a 25-foot phone cable and a driver disk.

Phone: (208) 336-9400.
Circle 1065 on Inquiry Card.
As you may know, CTX monitors are manufactured through stringent internationally recognized quality standards, such as ISO 9000.

Authored by International Standards Organization (ISO), ISO 9000 was initially devised to meet the quality requirements of the European Economic Community (EEC) in 1993. It defines the basic ingredients of a quality system from design, production, inspection to service. Obtaining an ISO 9000 certification is synonymous to having a seal of quality.

CTX proudly presents to its world-wide users crisp, steady and brilliant images with advanced features, while maintaining its reliability and affordability. To get a closer look at the world-standard monitor, contact your nearest CTX dealer today.
A MONITOR WITH A TWIST
A 15-inch color monitor for PCs running Windows provides portrait and landscape views. You can use Portrait/15 Plus ($799) from Portrait Display Labs (Fremont, CA) in the usual landscape mode to run applications such as your Windows spreadsheet or database. Or you can physically rotate the monitor to a vertical orientation to run your Windows word processing or desktop publishing program. The monitor’s vertical mode lets you view a full 8½ by 11-inch document.
Phone: (510) 249-0444.
Circle 1064 on Inquiry Card.

POCKET DATA-ACQUISITION SYSTEM
Modular Computer Concepts’ (Huntington Beach, CA) MCC-24 pocket A/D data-acquisition system (from $299) measures 2.5 by .65 by 2 inches and plugs into a PC parallel port. Input specifications are eight 12-bit channels and 0- to 5-V input with ±30-V overvoltage protection. The MCC-24 requires no batteries and no jumpers, and you control all functions via software. The converter includes programming libraries; applications software is available.
Phone: (714) 963-0620.
Circle 1136 on Inquiry Card.

PC/VCR GRAPHICS CONVERTER
With the Mediator LC ($599) graphics-to-video converter from VideoLogic (Cambridge, MA), you can record PC graphics on a VCR or output images in S-Video, composite, or RGB video formats. The unit supports conversion of 640- by 480-pixel VGA, Super VGA, or XGA graphics to NTSC video output and includes controls for image positioning, brightness, color, and picture quality. You can view images simultaneously on a PC and a video output device.
Phone: (617) 494-0530.
Circle 1138 on Inquiry Card.

PC AND MAC FAX MODEMS
Available in models for PCs ($229) and Macs ($269), the SupraFaxModem 144LC external fax modems from Supra (Albany, OR) operate at rates of up to 14,400 bps for fax and data communications. The metal-cased units have two phone jacks and 13 status lights. For PCs, WinFax Lite and FaxTalk (fax) and COMit (data) software is included; for Macs, FaxSoft (fax) and MicroPhone LT (data) software is included.
Phone: (800) 727-8772 or (503) 967-2400.
Circle 1140 on Inquiry Card.

HIGHSPEED PORT/PRINT BUFFER
Configurable with up to 4 MB of RAM, the DataBlaster buffer card (from $349.99) plugs into an AT-bus computer and has a serial input/output rate of 250,000 bps/19,200 bps and a parallel input/output rate of 25,000 cps/12,500 cps. From Blistrixon (Murphys, CA), the card has serial/parallel and parallel/serial conversion built in; the included software controls configuration and diagnostics.
Phone: (209) 795-0738.
Circle 1272 on Inquiry Card.

ISA GRAPHICS ACCELERATOR
The Volante Warp24 graphics board (from $499 with 1 MB of video RAM) provides 1024- by 768-pixel and 1280- by 1024-pixel noninterlaced resolutions with 93-kHz horizontal scan and 80-Hz vertical-refresh rates. From National Design (Austin, TX), the card includes color dithering, object shading, surface mapping, polygon pattern fills, and clipping, as well as BitBlt, hardware cursor, and line-draw Windows accelerator functions. A Windows screen utility lets you change resolution, font size, and vertical-refresh rate and restart Windows automatically.
Phone: (512) 329-5055.
Circle 1142 on Inquiry Card.

FULL-MOTION CAPTURE/PLAYBACK BOARD
Sigma Designs’ (Fremont, CA) WinMovie full-motion videocapture and playback board ($299) includes Video for Windows, Xing Technology’s Picture Prowler, and utility software. WinMovie captures video at 30 fps from NTSC or PAL S-Video or composite sources, and it is compatible with all Super VGA adapters. The board supports resolutions of from 80 by 60 pixels to 640 by 480 pixels in 8-, 16-, or 24-bit colors and requires at least a 33-MHz 386.
Phone: (510) 770-0100.
Circle 1143 on Inquiry Card.

NETWARE RAID-5 ARRAY
RAIDon LT 1120 for NetWare 3.11 and 4.0 ($6300) from Micropolis is a 1-GB, three drive, fault-tolerant storage subsystem that includes Novell-certified RAIDware optimized for NetWare drivers. Each self-contained module has a separate power supply, a cooling fan, and a disk drive; this facilitates hot-swapping and fast repairs. You can expand the subsystem in 500-MB modules up to a total of 28 GB.
Contact: Micropolis Corp., Chatsworth, CA, (818) 709-3300.
Circle 1063 on Inquiry Card.
Here is a serious misconception in the software industry that the more a program costs, the better it is... if you purchase a less expensive program, your results will suffer.

It is time this rumor was laid to rest.

To create this ad, our artists were asked to create the same drawing using three different programs with everything else being the same. Same computer, same graphics board, same monitor, etc.

Each rendering was created with the program's base package. No add-ons.

As you can see, DesignCAD produced the highest quality rendering while priced considerably less.

In the interest of fairness, you could get a better rendering with AutoCAD providing you pay an additional $3,000 for their materials shading package (making your total cost almost $7,000.) But keep in mind DesignCAD comes complete with its own built-in materials rendering package at no extra charge. Plus, you can render directly on the drawing screen without having to export to a separate rendering package.

We would also like to note that the AutoCAD drawing took the longest, was the most difficult to produce and continually caused our machine to crash. Of course we're not the PC Magazine labs. Although it's not generally true, there are times when you can get more for less. DesignCAD proves it. Your eyes see it.

To get your own DesignCAD information pack with a free demo disk, just call, fax or write.

American Small Business Computers
One American Way, Pryor, OK 74361

Phone (918)825-7555
Fax (918)825-6359

Circle 65 on Inquiry Card.
**What's New Software**

**EXTRA MUSCLE FOR CAD**
TrueCAD for Windows ($395), a full-featured CAD package from Choice Computing (Los Altos, CA), lets you take advantage of the graphical environment and offers an intuitive interface that makes the program easy to use. Its construction geometry lets you quickly design and create complex entities. With DXF and HPGL import and export capabilities, the software lets you share drawings with such applications as Word for Windows and CorelDraw.

Phone: (800) 828-2770 or (415) 949-2615.

*Circle 1300 on Inquiry Card.*

**BREATHING NEW LIFE INTO APPLICATIONS**
The Quantify software development package (from $1198) measures the performance of a program and its components and graphically displays its evaluation. Pure Software (Sunnyvale, CA) says this will help C and C++ developers to pinpoint and eliminate performance bottlenecks and improve the speed of their applications. The package uses Object Code Insertion technology to analyze entire programs, including shared and third-party libraries.

Phone: (408) 720-1600.

*Circle 1292 on Inquiry Card.*

**PUTTING A NEW FACE ON AUTOCAD**
Panalcon ($99) provides an icon-based interface for AutoCAD release 12. From Panacea (Londonderry, NH), the software can take AutoCAD drawing files and convert them to iconic menus. Panalcon supports multiple nested icon menus that can be dynamically resized. By selecting an icon, you can call or execute any AutoCAD function, ADS, or AutoLisp routine.

Phone: (800) 729-7420 or (603) 437-5022.

*Circle 1282 on Inquiry Card.*

**TUNE UP YOUR HARD DISK**
SoftLogic Solutions' (Manchester, NH) Disk Optimizer for Windows ($49.95) defragments the files on your hard disk while the system is idle. The application enables you to consolidate the free space on your hard disk. A layout display shows you all the available space and its location. Disk Optimizer for Windows can handle large-capacity drives using expanded or extended memory.

Phone: (603) 627-9900.

*Circle 1284 on Inquiry Card.*

**MORE ANIMATION FOR WINDOWS**
Animation Paint Box ($299.95) from Azeena Technologies (Long Beach, CA) integrates painting and animation tools for the Windows environment. The package’s onion-skin tool lets you simultaneously see the previous, current, and following frame of an animation for precise alignment of objects between frames. The rub-through tool brings underlying objects to the top screen. Animation Paint Box supports various file formats, including AVI (Audio Video Interleave).

Phone: (310) 988-1889.

*Circle 1283 on Inquiry Card.*

**SPEED UP COMMERCIAL FORECASTING**
SmartForecasts 32-bit Batch Edition ($5995) helps you take on massive forecasting problems, such as estimating customer demand for large inventories or projecting cash flow for financial institutions. The Smart Software (Belmont, MA) program uses 386DOS-Extender technology, providing greater internal data capacity and faster calculations.

Phone: (800) 762-7899 or (617) 489-2743.

*Circle 1285 on Inquiry Card.*

**OCR SOFTWARE FOR WINDOWS**
TextBridge ($99) from Xerox Imaging Systems (Peabody, MA) lets you convert hard copies of documents into leading word processing, spreadsheet, and database formats while working in Windows. The OCR software accepts TIFF files from most fax-modem software, and the Lexifier enhanced technology improves the software's handling of degraded and non-word-based documents.

Phone: (800) 248-6550 or (508) 977-2000.

*Circle 1293 on Inquiry Card.*

**FORECASTING**
SmartForecasts 32-bit Batch Edition (B) $5995 helps you take on massive forecasting problems, such as estimating customer demand for large inventories or projecting cash flow for financial institutions. The Smart Software (Belmont, MA) program uses 386DOS-Extender technology, providing greater internal data capacity and faster calculations.

Phone: (800) 762-7899 or (617) 489-2743.

*Circle 1285 on Inquiry Card.*

**AUTOMATE CROSS-PLATFORM WORK FLOW**
JetForm for E-Mail's Mac version (five users, $495; 20 users, $1495) joins DOS and Windows packages to provide cross-platform, enterprise-wide forms automation with a mail-enabled system. The intelligent forms product includes work-flow tools that let you route and track forms using standard E-mail systems and your existing equipment and networks.

Contact: JetForm Corp., Waltham, MA, (800) 538-3676 or (617) 647-7700.

*Circle 1278 on Inquiry Card.*
The MasterPiece TrueType Font Library from Attitude, Inc. now contains over 150 one-of-a-kind, designer TrueType soft fonts. These totally unique display and headline fonts are what you need in order to get the attention your memos, brochures, flyers and correspondence deserve. And with the MasterPiece TrueType Font Library you'll have the headline fonts to complement your collection of text faces. So don't settle for the basic vanilla text fonts. Get an Attitude!

Also included is the new Attitude TrueType Installer. This utility will allow you to view any TrueType format font, either on screen or in a printout, as well as install, remove or check if any font is already installed.

Attitude, Inc.
14742 Beach Blvd., Dept. 440
La Mirada, CA 90638
TEL: (714) 680-8112  FAX: (714) 680-6640

This is only a partial listing of the over one hundred and fifty fonts in this package.
What's New Software

PLAN YOUR PROJECTS IN WINDOWS

Prisma Software (Cedar Falls, IA) has introduced GanttChart ($89), a business graphics program that you run under Windows. The program organizes projects on worksheets and schedules them on time-line charts. You can tailor your screen display to focus on important aspects of a project. GanttChart allows you to create and print presentation-quality charts and switch their time frame among daily, weekly, or monthly increments with the click of a mouse.
Phone: (800) 437-2685 or (319) 266-7141.
Circle 1287 on Inquiry Card.

CRYSTAL BALLS FOR INVESTORS

Money Maker for Windows ($99) from Q-West Associates (San Diego, CA) graphically builds securities and portfolio analyses. After you define the type of investment that you're working on, a storyboard is assembled, showing the potential gains and losses and the projected rate of return under various market conditions. A financial toolbox assembles and tracks investments, profits, and costs.
Phone: (619) 484-6648.
Circle 1288 on Inquiry Card.

With The Yellow Pad ($49.95), you can experiment with a variety of investment scenarios, examining the effects of different assumptions on your assets and income. The financial calculator from Orinda Software (Orinda, CA) can enter data on your total assets and perform one computation, or it can work with data for individual assets and income groups, computing a report for each one.
Phone: (510) 254-3503.
Circle 1289 on Inquiry Card.

BRIDGING COMMUNICATIONS PROTOCOLS

Zoomit's (Toronto, Ontario, Canada) X.400 & SMTP Dual Stack (from US$8000) enables those using the SMTP and X.400 protocols on a Banyan Vines network to exchange mail. The software automatically configures message-transfer agents and routing tables to simplify direct connectivity. It also features audit trails and message logging and tracking.
Phone: (416) 866-7442.
Circle 1290 on Inquiry Card.

ONE SMART X SERVER

XVision 5 ($495; upgrade, $95), a PC server from VisionWare (Menlo Park, CA), lets you connect via the X Window System standard to Unix and VMS host-based applications while working in Windows or NT. The software detects network transports, optimizes graphics speed, and substitutes fonts. XVision 5 offers a drag-and-drop object-oriented desktop, a built-in VT320 terminal emulator, and file transfer and local printing.
Phone: (415) 325-2113.
Circle 1291 on Inquiry Card.

POWERFUL POINT-AND-CLICK EDITING FOR MOTIF USERS

A Motif-based text editor, Siren Editor runs on several Unix platforms, including Sun SparcStation, HP 9000, IBM RS/6000, Silicon Graphics, and SCO workstations. Siren Editor offers column editing and traditional line-editing capabilities, and its window management facilities let you view and edit multiple files in an integrated environment. A shell extends the software's capabilities to include all Unix commands, programs, and scripting facilities. Administrators can customize Siren Editor to meet their organization's needs. Prices: single user, $249; network, from $995.
Circle 1279 on Inquiry Card.

Software Update

Generic CADD 6.1 ($495), Auto­desk (Bothell, WA), adds an AutoCAD-style menu option, an on-line function that cross-references Generic CADD and AutoCAD commands, and the ability to write files in AutoCAD's DWG format.
Phone: (800) 228-3601 or (206) 497-2233.
Circle 1301 on Inquiry Card.

Morph 2.0 ($239), Gryphon Software (San Diego, CA), adds dynamic morphing, caricaturing, and customized warping.
Phone: (619) 536-8815.
Circle 1302 on Inquiry Card.

MKS RCS 6.1 ($349), Mortice Kern Systems (Waterloo, Ontario, Canada), adds support for Windows 3.1.
Phone: (519) 864-2251.
Circle 1303 on Inquiry Card.

Lazarus for Novell 1.5 (PC li­cense, $74.99; server license, $299; site license, $1495), Software Marketing Group (Des Moines, IA), reduces the TSR size to under 4 KB, supports Open Data-Link Interface drivers, and adds automatic reattachment to servers.
Phone: (515) 284-0209.
Circle 1304 on Inquiry Card.

CorelDraw 4 ($595 U.S.; $695 Canada), Corel (Ottawa, Ontario, Canada), adds an animation module, OCR software, and more. See our review on page 169.
Phone: (613) 728-8200.
Circle 1305 on Inquiry Card.

NetWare for Macintosh 4.0 ($1195), Novell (Provo, UT), adds access to NetWare directory services, DOS file­extension mapping, HFS CD-ROM access, and more.
Phone: (801) 429-7000.
Circle 1317 on Inquiry Card.
Picture This ... a real-time television monitor built right into your PC. Now, picture using this monitor while running Windows™ applications at the same time. And, picture taking that crystal clear video image and resizing (right down to icon size!) or clicking and dragging it to any position on the screen as easily as moving any other Window. This is Win/TV™, the video overlay, frame and clip capture board from Hauppauge Computer.

Picture Perfect ... Using Win/TV and Microsoft's Video for Windows™, you can capture full motion video, saving synchronized audio and video clips to disk. With Win/TV's "frame grabber" you can capture any video frame and save it to disk in the most popular formats like TIF, TGA, PCX and BMP. Seamlessly integrate still and full motion video clips into multimedia applications such as databases, marketing and training presentations. Great for Microsoft PowerPoint, Asymetrix Compel, Corel Draw, Tempra and lots more!

Picture Yourself ... owning your own "Windows on the World"! Access 122 channel television with Win/TV's built-in cable ready tuner, plus two optional video sources (video cameras, VCR's, laser disks, etc.) Maybe you want to work on your spreadsheets but don't want to miss an important news flash or a current stock market report. Keep an eye on current events while keeping control of your inventory!

Whether you're enjoying live TV, grabbing a frame and exporting it to a desktop publishing document, or creating your own video clips with Microsoft's Video for Windows, you'll be wowed by the clarity of Win/TV images.

Get Win/TV and open a window on some fresh, new and exciting possibilities.

Suggested retail: $495.00 ($549.00 with Video for Windows)

Available from PC Connection, Microwarehouse, PC Zone, plus many other computer stores throughout the U.S., Canada, Europe and Japan.

GSA# GS03K92AGS6156 PS01


Circle 88 on Inquiry Card (RESELLERS: 89).
What's New Software

Automated GUI Testing

In what Software Quality Automation claims is the first automated GUI-testing solution to be implemented on a team/workgroup model, SQA TeamTest ($1,495 per license) integrates automated GUI testing with team work-flow tracking and reporting. Based on a network Test Repository that coordinates the work of any number of testers on a network, the software is built on the company's Team Testing Architecture. During testing on individual PCs, the Test Repository is automatically updated during all stages of the process.

Contact: Software Quality Automation, Woburn, MA, (800) 228-9922 or (617) 932-0110.
Circle 1280 on Inquiry Card.

Macs and PCs Sharing Data

Conversions Plus ($149), a file transfer and translation utility from DataViz (Trumbull, CT), lets you exchange documents between popular Mac and PC applications and retain original document formatting. The package has a translator library with more than 350 translation combinations for word processing and graphics programs and a Mac disk-mounting utility that moves files to and from high-density Mac disks inserted in PC drives.

Phone: (203) 268-0030.
Circle 1294 on Inquiry Card.

Unix-Based Collaboration

X/TeleScreen (initiator license, $995), an X Window System application-collaboration tool based on Motif, lets X displays on Unix networks share unmodified, off-the-shelf X applications. National Information Systems' (San Jose, CA) software lets network users confer with each other; interact with applications; and update documents, graphics, and spreadsheets in real time. X/TeleScreen is available on certain Sun Microsystems, Silicon Graphics, and DEC workstations.

Phone: (800) 441-5758 or (408) 985-7100.
Circle 1295 on Inquiry Card.

Building Visual GUIs

With CenterLine Software's (Cambridge, MA) ViewCenter for Motif ($2,995), software developers can interactively create, modify, test, and generate C++ code and object components for GUIs. The development tool is based on Visual Edge's UIM/X 2.5 GUI builder and is tightly integrated with CenterLine's CodeCenter and ObjectCenter Unix programming environments. ViewCenter for Motif supports certain Sun Microsystems and Hewlett-Packard workstations.

Phone: (617) 498-3000.
Circle 1296 on Inquiry Card.

Managing Your Inventory

Inventory Analyst Professional ($495), a menu-driven, spreadsheet-based inventory-control system for DOS and Windows users, does batch forecasting and scheduling for thousands of items simultaneously, automatically choosing appropriate forecasting methods, and ranks and groups items by dollar volume. Intex Solutions' (Needham, MA) planning and analysis application works with all DOS versions of Lotus 1-2-3, with Excel, and with Quattro Pro.

Phone: (617) 449-6222.
Circle 1297 on Inquiry Card.

Customizing Installers

For developers and product managers who want the ability to create custom installers for their products, Aladdin Systems' (Watsonville, CA) StuffIt InstallerMaker (prices vary) provides a selection of predefined destinations for files being installed and determines what files to load based on the configuration of the end user's computer. The program compresses the files, reduces the number of distribution disks and providing one-button installation.

Phone: (408) 761-6200.
Circle 1298 on Inquiry Card.

Finding Out About Yourself

BrainWorks ($49.99), a self-assessment test that helps you determine your own learning style, measures the extent to which you favor your right or left brain. The 20 multiple-choice questions in the test, from Synergistic Learning (East Grand Rapids, MI), involve subjects ranging from personal opinions to word associations.

Phone: (616) 956-7557.
Circle 1299 on Inquiry Card.

Software Update

Crystal Ball 3.0 for Windows ($295), Decisioneering (Denver, CO), adds a chart that indicates the weight of each factor in its analysis, four probability distribution types, dynamic cell references, and an improved interface with Excel.

Phone: (303) 292-2291.
Circle 1300 on Inquiry Card.

BusinessWorks 8.0 (from $395), Manzanita Software Systems (Roseville, CA), adds general ledger, accounts payable, accounts receivable, and system features.

Phone: (916) 781-3880.
Circle 1307 on Inquiry Card.

BasePak 2.0 ($3800), Protocom (Trevose, PA), adds the ability to store video files on a Novell partition, support for additional video software platforms and compression technologies, utilities that maximize system performance, and a customized network protocol.

Phone: (215) 245-2040.
Circle 1308 on Inquiry Card.

VBAssist 3.0 ($179), Sheridan Software Systems (Melville, NY), adds a drag-and-drop feature that links table columns to bound controls, the ability to update in one window all fields in a database associated with the bound data control, and automatic forms generation.

Phone: (516) 753-0985.
Circle 1309 on Inquiry Card.

CadDesign 3.0 (from $395), Tailor Made Software (Kent, WA), adds additional image-manipulation techniques for contrast, brightness, and color; support for Super VGA and the HP LaserJet 4; and 600-dpi printing.

Phone: (206) 631-1513.
Circle 1310 on Inquiry Card.
BYTE introduces Your Direct Link – An enhanced service for BYTE readers that gives you free information on products – faster and easier!

In the NEW Direct Link section, here's what you'll find:

Alphabetical Index to Advertisers Including Phone Numbers
Now dial companies directly.

Product Category Index to Advertisers
Order information on individual products or complete product categories.

Redesigned Editorial Index
Free information from companies covered in articles, columns, or news stories.

New Enhanced Direct Link Card
Receive free information quickly by filling out and mailing or faxing Your Direct Link Card today!

Send for FREE product information by filling out Your Direct Link Card found in the back of every issue.

Buy It Through BYTE!
PAINTER/X2 ADDS MULTIPLE LAYERING

Fractal Design's (Aptos, CA) Painter/X2 ($149) is an extension to Painter 2.0 ($399) that adds the capability to layer multiple objects within paintings. Painter/X2 speeds up drawing tasks by incorporating multiple graphics elements through the use of floating selections. A new feature called the Portfolio allows you to save an image for future use by simply dragging it into the Portfolio, where it appears as a thumbnail view for easy identification. The package is available for Windows and the Macintosh.

Phone: (408) 688-5300.
Circle 1329 on Inquiry Card.

Q+E EXTENDS IMPROV FOR WINDOWS

Q+E Extend for Improv ($199) client/server edition from Q+E Software (Raleigh, NC) is a database access tool for bringing data from PC and SQL databases into Lotus’s Improv for Windows spreadsheet. It adds database access commands directly to Improv’s tools menu. Extend for Improv provides you with direct access to more than 20 PC and SQL database formats, automatically creating the structures needed to present and analyze data in Improv’s multidimensional views. Queries that are built with Q+E Software’s Q+E Database Editor can be opened in Improv without translation.

Phone: (919) 859-2220.
Circle 1331 on Inquiry Card.

EISToolKit UPDATED FOR UNIX

MicroStrategy’s (Wilmington, DE) EISToolKit (Designer version, $1995; 10-pack User version, $7995) application development system is available for Unix systems running the Sun OpenLook and Motif environments. EISToolKit offers a GUI, presentation graphics, database connectivity, and spreadsheet modeling tools in addition to a full-featured spreadsheet for data analysis, and HyperScript, a 4GL (fourth-generation language) for detailed project customization. Unix clients will initially have access to Informix databases and later to Oracle and Sybase. EISToolKit for Unix ships with the Informix DataLink API.

Phone: (800) 927-1868 or (302) 427-8800.
Circle 1318 on Inquiry Card.

STOP WAITING FOR YOUR PC

Quick Restart ($39.95) from PowerPro Software (Foster City, CA) is an auto-resume utility for Windows and DOS PCs. The program lets you restart your computer and instantly return your application where you left off, without waiting for lengthy morning boot-ups and with no loss of data or system state, PowerPro says.

Phone: (415) 345-9278.
Circle 1315 on Inquiry Card.

Qf 2.1 ($1295), Gpf Systems (Modouls, CT), adds the ability to generate native OS/2 2.1 Presentation Manager Workplace Shell and Windows 3.1 interface code from one design; support for C and C++ compilers; and the ability to automatically generate DLLs.

Phone: (800) 831-0017 or (203) 837-3300.
Circle 1312 on Inquiry Card.

WALL DATA’S MIGRATION TO WINDOWS

Wall Data’s (Redmond, WA) Rumba APPC (Advanced Peer-to-Peer Communications) suite of tools ($495) integrates Windows with SAA (Systems Application Architecture) networks and enables you to access and run AS/400, mainframe, and APPC applications on the same SNA (Systems Network Architecture) networks. The Rumba APPC engine is implemented as a native Windows application. With Rumba for the Mainframe and Rumba for the AS/400 APPC editions, you can simultaneously run 3270, 5250, and APPC applications.

Phone: (800) 487-8622 or (206) 883-4777.
Circle 1319 on Inquiry Card.

QUICK AND EASY OPTIONS

Quickbyte (Cayucos, CA) offers options for its Telefinder 3.1 ($425), Spider Island Software (Irvine, CA), adds internode messaging, chat rooms for live conferences, file preview, and full-text formatting.

Phone: (714) 669-9260.
Circle 1311 on Inquiry Card.

Alpha Four 3.0 (single user, $495; network, $995), Alpha Software (Burlington, MA), adds full mouse support on all screens; multi-file data entry; the ability to design screens with scrolling windows that display data from linked databases; real-time modification of fields in linked databases; and cascading and conditional lookup tables.

Phone: (617) 229-2924.
Circle 1312 on Inquiry Card.

SQL/Workbench 2.1 ($8400 per server), Intelligent Environments (Tewksbury, MA), adds support for OS/2 and Windows client/server development tools and an import/export feature that lets you pull SQL statements across multiple workbenches.

Phone: (508) 640-1080.
Circle 1314 on Inquiry Card.

Abacus II (single user, $995), Abacus Systems (Minot, ND), adds a simplified startup procedure; inventory tracking; and a Quick Pay feature for real-life, one-time events.

Phone: (701) 838-4686.
Circle 1320 on Inquiry Card.
UNIX is changing the world of computers, the world of business—quite simply, changing the world. It’s revolutionizing office automation. It’s required for U.S. government computer contracts. It’s the backbone of information strategies worldwide.

That’s why you need *UnixWorld*—the magazine that keeps you up to date on the rapidly changing world of open systems computing. Each issue brings you the latest product trends and technical advances that can affect your business. The inside story on some of the biggest high-tech companies. Easy-to-understand programming tips and tutorials that can help your company use UNIX to its fullest. And unbiased hardware and software reviews to help you invest wisely when you buy.

*UnixWorld*’s in-depth features go beyond dry technical facts to show how the pieces fit together—to tell you what’s important about the advances and strategies that are changing your world. And *UnixWorld* consistently offers the freshest, most down-to-earth writing that you’ll find in any computer publication.

Subscribe today and receive the next 12 issues of *UnixWorld* for just $18.00—half the regular newsstand price. Save even more by ordering for two or three years. You can’t lose—every subscription to *UnixWorld* comes with a no-risk guarantee*.

Subscribe now! Call toll-free: 1-800-257-9402 ext. 29

If you’re into UNIX, you need *UnixWorld*
Quatech manufactures a complete line of communication adapters for PC/XT/AT®, Micro Channel® and compatible buses to meet asynchronous and synchronous, serial and parallel communication requirements with protocols such as RS-232, RS-422, RS-485, Current Loop and IEEE488.

Software support for SCO Unix®, Windows®, Xenix®, OS/2® and DOS.

Data Acquisition and Industrial I/O products manufactured by Quatech are also available. Call for a free Data Acquisition and Communication Handbook today.

Communication adapters featuring: selectable/shareable interrupts, 16550 availability (baud rates up to 256K on standard asynchronous adapters) and address configurable as any COM port. Multiport adapters feature 2, 4, and 8 ports with independent serial interfaces. Most adapters provide AT interrupts (IRQ 2-7, 10-12, 14, 15).

Technical support for our products are available free of charge.

800-553-1170
FAX: 216-434-1409
BBS: 216-434-2481
Mail Order
The latest offerings from vendors supplying products of all leading manufacturers at extremely competitive prices.

Hardware/Software Showcase
This categorized four-color display section makes it easy to find Hardware and Software products from a wide variety of manufacturers and suppliers.

Buyer's Mart
From Accessories to Laptops to Word Processors, you can easily find the dealers you are looking for in this directory of products and services.
Advanced Computers, Inc.

1310 E. Edinger, Santa Ana, CA 92705 • FAX 714-558-8849 • Toll-Free 1-800-FONE ACP • Sales 714-558-8813

Upgrade to Multimedia at ACP Superstore!

Advanced Computers, Inc.

Hard Drives

Your complete Compaq Source • 17-MS-DOS, drive adapers, 1000s of hard drives, preloaded Microsoft software...

Includes: 1.2 Mb 5.25" floppy • 4MB/8MB/16MB hard drives

486 High Performance CPUs • Plus Multimedia Options

AUC's Price $1,399

$299.95

Conner

For More Information: Call 714-558-8800

Toshiba

New for '93 - Upgrade Kits

Advanced Motherboards

12-MHz Special!

MAC's

$269

AJP's PC Special

Call for your special quote

Advanced Graphics

Toshiba

Call for ACP for NoteBook Deals

Advanced Computers, Inc.

MultiMedia-Upgrade Kits

Includes: 1.2Mb 5.25" floppy • 48/86/16/32 MB hard drives

Call for Specials on MultiMedia 

For More Information: Call 714-558-8800

Media-Upgrade Kits

Starting at $99

Software Toolworks Mavis Beacon

ADVANCED

Microsoft

MicrosPart Sales

Circle 300 on Inquiry Card (RESELLERS: 301).
Printer Port Connections Are The New Tools Of The Trade.

Once you discover just how easy it is to install a backpack CD-ROM drive to your computer, you'll never be inconvenienced by conventional installation methods again. Just plug backpack into your computer and you're ready to go. No interface cards, hardware conflicts or expansion slots required. Because of its unique printer port interface, backpack fits all IBM PC compatibles and portables regardless of CPU speed. In addition, a built-in audio circuit with both headphone and line output jacks allows for connection of sound cards or Hi-Fi. You can run thousands of your favorite multimedia programs and view Kodak Photo CDs too, with CD-ROM backpack. Compact and versatile, you can expect backpack to go wherever you go, bringing with you the wealth of information CD-ROM storage makes possible. Printer pass-through is included. Tape drive, hard drive and diskette backpack drives are also available. Call today for ordering information and a dealer nearest you.

MicroSolutions
132 W. Lincoln Hwy. DeKalb, Illinois 60115 Telephone 815.756.3411 Fax 815.756.2028 Call Toll Free 800.295.1214

Circle 198 on Inquiry Card (RESELLERS: 199).
CONTROL UP TO 96 PC FILE SERVERS WITH 1 KEYBOARD AND MONITOR USING...

COMMANDER™

- Select via Keyboard
- Dual access up to 250 feet away (optional)
- No external power
- Mix PC, PC/XT, PC/AT and PS/2
- "AutoBoot™" Feature boots attached computers without operator intervention
- Able to Broadcast to all attached computers

- PS/2 and Serial Mouse support available
- Each unit accommodates from 2 to 8 PCs
- Up to 12 units can be cascaded
- Mounting kit available for 19" and 24" rack installation

CYBEX
4912 Research Drive
Huntsville, AL 35805 U.S.A.
(205) 430-4000
FAX (205) 430-4030

Dealer Program Available

PC, PC/XT, PC/AT and PS/2 are trademarks of International Business Machines Corp.
It's fast. It's small. It's reliable. It's incredibly compatible.

Backpack is the best selling parallel port tape drive on the market. We'd like to tell you why.
With Backpack, tape backup is quick and simple. Just plug it into your printer port and it's ready to use. No hardware conflicts, no slots required. One model fits all IBM PCs, compatibles and portables, regardless of CPU speed.
Backpack can store up to 250MB on a tape using data compression, is completely QIC80 compatible, and reads QIC40 tapes. With its compact size and 1Mbps transfer rate, Backpack is the smallest and fastest parallel port tape drive you can buy.
Micro Solutions is dedicated to the perfection of backup technology.
CD-ROM, hard drive, and diskette Backpack drives are also available. Call today for ordering information and a dealer nearest you.

Call toll free: 800-295-1214

Circle 200 on Inquiry Card (RESELLERS: 201).
## PERSONAL COMPUTER MEMORY

### IBM

<table>
<thead>
<tr>
<th>Model</th>
<th>Memory Size</th>
<th>Memory Type</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>3088</td>
<td>256/512</td>
<td>Dynamic</td>
<td>16/32</td>
</tr>
<tr>
<td>3088</td>
<td>1024</td>
<td>Dynamic</td>
<td>64/128</td>
</tr>
<tr>
<td>3088</td>
<td>2048</td>
<td>Dynamic</td>
<td>128/256</td>
</tr>
</tbody>
</table>

### IBM

<table>
<thead>
<tr>
<th>Model</th>
<th>Memory Size</th>
<th>Memory Type</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>3088</td>
<td>256/512</td>
<td>Dynamic</td>
<td>16/32</td>
</tr>
<tr>
<td>3088</td>
<td>1024</td>
<td>Dynamic</td>
<td>64/128</td>
</tr>
<tr>
<td>3088</td>
<td>2048</td>
<td>Dynamic</td>
<td>128/256</td>
</tr>
</tbody>
</table>

### Memory Upgrades

- IBM 3088 256/512 Dynamic Memory Upgrade
- IBM 3088 1024 Dynamic Memory Upgrade
- IBM 3088 2048 Dynamic Memory Upgrade

### CPU Upgrades

- IBM 3088 256/512 Cachet Memory Upgrade
- IBM 3088 1024 Cachet Memory Upgrade
- IBM 3088 2048 Cachet Memory Upgrade

### Other

- IBM 3088 Personal Computer Memory Upgrade
- IBM 3088 Dynamic Memory Upgrade
- IBM 3088 Cachet Memory Upgrade

---

**Call the Upgrade Experts**

**800-516-9866**

---

**WE SET THE STANDARD:**
- 100% compatible in form, fit, and function
- All products user installable
- Installation instructions included
- Toll-free technical support
- Manufacturer's warranties
- Corporate P.O.'s, APO/FPO's welcome
- Government and Educational pricing
- International orders welcome
- Special volume pricing
- Same day shipping
- Overnight delivery available
- Visa, Mastercard, American Express, and Discover accepted
- No surcharge on credit cards

**DONT SETTLE FOR LESS!**

**CALL FOR ANY MEMORY UPGRADES**

**TOLL FREE FROM USA & CANADA**

**800-516-9866**

**INTERNATIONAL**

**714-588-9866**

**714-588-9872**

**Business hours:** Monday - Friday, 8am-5pm, P.S.T. Saturday, 9am-5pm, Orders Only

**The Source**

**For Apple, AST, Compaq, IBM, Sharp, TI, Toshiba, Zenith, and many other leading and well known manufacturers.**

**FOR 30 DAY GUARANTEE on all memory and laptop memory.**

---

**MEMORY | MEMORY | MEMORY**

---

**CALL THE UPGRADE EXPERTS**

**800-516-9866**

---

**Circle 195 on Inquiry Card (RESELLERS: 196).**
LEAVE IT TO US TO RACK THINGS UP

RECORTEC's Rack Mount PC compatible computers, monitors, keyboards and printer continue the tradition of manufacturing excellence RECORTEC started in 1969. With our broad product line, fast delivery, excellent pre and post sale service, it's no wonder more and more people "leave it to us to rack things up".

QUALITY
All products 100% tested and verified prior to shipment.

RELIABILITY
Field proven components backed by a comprehensive warranty.

SERVICE
Large stock for fast delivery plus assistance by knowledgeable sales and support personnel.

SOLUTIONS
Choose from many models which offer a wide range of solutions for a variety of rack mount needs. We also offer custom designs when a standard product just won't do.

CALL OR FAX FOR MORE INFORMATION.
1-800-729-7654

RECORTEC, INC.
1290 Lawrence Station Road Sunnyvale, CA 94089
Tel: (408) 734-1290 Fax: (408) 734-2140

Circle 202 on Inquiry Card (RESELLERS: 203).
Portability doesn't have to mean isolation from important, timely information, thanks to EMBARC wireless networking.

In over 200 cities in the U.S. and Canada, you're connected—to E-mail from the office and news and weather briefs from USA TODAY, as well as optional services such as sports, key market and financial developments, and HeadsUp™ targeted industry news briefs from INDIVIDUAL, Inc. You can even have your important databases routinely updated—automatically!

All you need is EMBARC's compact, powerful NewsStream receiver (it plugs directly into most laptop, palmtop and notebook computers) and the simple software package that drives it. Pay as little as $395, install it in minutes and you're ready to go—without wires, faxes or phones.

Equip your whole team to receive memos, documents and file updates for pennies per recipient... You'll find EMBARC so cost effective you'll communicate more.

Our corporate trial program lets you try it virtually risk-free. Sign up right now by phoning 1-800-EMBARC4, Ext. 350. Give your team the home-field advantage... even when they're on the road.
KeyPro ... A Legend in Software Protection

Just as the legendary Chinese warrior god Zhong-Kui had the reputation of a fearsome warrior who easily fend off evil spirits, KeyPro has established its reputation as a dependable means of guarding programs against unauthorized copies. Zhong-Kui enslaved and ate ghosts, but KeyPro employs a much more useful and appealing method to protect your software.

While designing the KeyPro software protection device, our engineers considered not only the need of software developers but also the convenience of users. Software developers enjoy KeyPro's protection capability, while users can forget the key after installing it.

The KeyPro Family

- **KeyPro II**: for PC environments
- **Net-KeyPro**: for Netware environments

Outstanding Features

- **Unbreakable Electronics**
  An ASIC-based hardware and a proprietary encryption algorithm are used to prevent code tracing by the most persistent software pirates.

- **Compatibility**
  KeyPro is transparent to the computer and other peripherals that are attached to it. It works on every computer it has been tried on without interfering with computer's normal operations.

- **Cascadability**
  KeyPro can cascade on the printer port with any other KeyPros or the keys manufactured by other companies. Because KeyPro's both sides are transparent, it can sit in any position in the cascade chain.

- **Runtime Reprogrammability**
  A buffer with read/write runtime memory inside the hardware allows developers to protect and write into multiple software programs using only one key.

- **Virus Detection**
  KeyPro provides the protected program a virus detection option to check whether it is infected.

- **User Limit**
  KeyPro allows programmers to designate up to 100 workstations using one software in Netware environment.

- **Driver/External Protections**
  Two protection methods provide the security for a software with or without its source code.

Regional Distributors Welcome!

* KeyPro is a registered trademark of Transcend Information Inc.
* All other trademarks are registered by their respective owners.

Transcend Information Inc.

U.S.A.
U.S.A.
104 Exchange Place, 104 Exchange Place, Pomona, CA 91768 Pomona, CA 91768 TEL: (909) 598-5500 TEL: (909) 598-5500 FAX: (909) 598-5050 FAX: (909) 598-6050

Taiwan
Taiwan
3FL., No. 465, Chung Hsiao E. Rd., Sec. 6, Taipei, Taiwan TEL: (886) 2-7881000 TEL: (886) 2-7881000 FAX: (886) 2-7881919 FAX: (886) 2-7881919

Germany
Germany
Transcend Information Trading GmbH Transcend Information Trading GmbH Lademannbogen 45a, Lademannbogen 45a, 2000 Hamburg 63 2000 Hamburg 63 TEL: (49) 40/538 81 97 TEL: (49) 40/538 81 97 FAX: (49) 40/538 17 81 FAX: (49) 40/538 17 81

Circle 298 on Inquiry Card.
### Memory Super Source

**Hard Drives**
- Quantum
- Fujitsu
- Maxtor
- TOSHIBA
- Micropolis
- Western Digital
- Conner
- ALR

**Math Co-processors**
- Apple
- AST
- NEC

**SIMM Modules**
- TOSHIBA
- Quantum
- IBM

**Local Bus Mother Boards**
- 386/486
- One Board Solution

**Expansion Boards**
- AST Rampage Plus 2MB $169

**Dynamic RAMS**
- 1MB  512K X 8-80NS SIMM $145
- 2MB  1M X 8-80NS SIMM $290

**Cache**
- 1MB  1M X 8-80NS SIMM $145

**Call for Memory Products Not Listed, Call for Prices and Availability**
- 70 NS 4x9 SIMMS
- Call for Latest Super Prices
- Call 1-800-MEMORY-2

**Technical Support**
- 1-215-622-4640

**Order Toll-Free**
- All Credit Cards are Verified for Fraud by E-Check

**Customer Service**
- 215-922-4640

**Worldwide Technologies**
- 437 Chestnut Street, Philadelphia, PA 19106
Take Note: The World's Best SCSI Adapter Just Got Better

SmartCache III is the total, growable SCSI solution!

The world's best SCSI adapter is now the world's greatest bargain—priced lower than any major competitor. An unprecedented value, SmartCache III offers top performance and universal connectivity with all major SCSI-1, SCSI-2 and Fast SCSI devices, including hard drives, tape, CD-ROM and WORM.

It also comes with built-in support from all major operating systems, including DOS, Windows, OS/2, NetWare, Windows NT, NextStep and all versions of Unix.

And only SmartCache III gives you a growth path. Optional plug-on modules let you migrate easily to caching (with up to 64Mb cache), as well as full RAID capability. Storage Manager, our GUI utility, makes installation quick, easy and automatic. Plus, it gives you on-line and remote control over subsystem management, diagnostics, performance monitoring, and disk array configuration and control.

Distributed Processing Technology, Inc.
140 Candace Dr. Maitland, FL 32751 USA

*List price for ISA model PM2021 90 SCSI Adapter Board

Call DPT, today!
800-322-4DPT
FAX 407-260-5366

Circle 193 on Inquiry Card (RESELLERS: 194).
YOU PROBABLY THINK THAT . . .

- Portable computers are slow.
- Portable computers are inflexible.
- Portable computers are too expensive.

LOOK AGAIN . . .

The *AFFORDABLE* Performance Series notebook computer will change your mind.

Give us a call. We will give you all the proof you need that our affordable, powerful and expandable Performance Series notebook computers offer the best solutions for your desktop and mobile computing needs.

MICRO-INTERNATIONAL, INC. 10850 Seaboard Loop, Houston, Texas 77099
National Sales:(800) 967-5667 • Local Sales:(713) 495-9096 • FAX:(713) 495-7791

*Prices start at $1,950 for a 486SX/25M System with 4MB RAM and 80 MB Hard Disk.
Office hours Monday–Friday 8:00–6:00 • Saturday 10:00–1:00 • Sunday–Closed
Decider, decider, decider.

Down-sizing, upgrading, multi-platform environments. Today's computer hardware issues are more numerous, more difficult, more critical than ever. So how do companies make decisions?

According to a new IntelliQuest study, they turn to the only person qualified to decide. Someone like Bob Barrett. A person with 18 years in computers. Who oversees a technical staff of 75. And whose buying decisions and approvals affect nearly 3,000 users worldwide.

In other words, they turn to the BYTE reader. A full 92% of whom control the products and brands their companies buy.

If you want to reach an audience as influential as this, then yours is an easy decision—advertise in BYTE.

BYTE reader Robert N. Barrett, Vice President Management Information Systems, M/A-COM, Inc.

It doesn't get bought without

PLEX™ FAMILY PRODUCTS

DATAVISION

Keyplex Family

- Simple Plug and Play Installation
- Uses Existing Keyboard/Video Ports
- Mix XT, AT and PS/2 Keyboard Controllers Including The New IBM “Type 2”
- Mix CGA/EGA/VGA/XGA/MONO Video

Save Equipment and Space Costs

- Mix Any Operating System or Application
- n-Level Cascading For Unlimited Growth
- Automatic Scanning & Broadcast Modes
- Optical Isolation For Safety/Reliability

Gain Central Control & Greater Productivity Too!

So If You Think This Is Your Only Option...

Think Again!
Manage All Your Systems From A Single Display and Keyboard

Reduced Display Costs • Reduced Keyboard Costs • Reduced Space Costs

Keyplex2/ Videoplex/4

Keyplex4/ Videoplex8/ Omniplex8

Keyplex8/ Videoplex8/ Omniplex8

Call 800-529-5560

Plexview single display installation systems for IBM XT, AT, PS/2 and compatibles.

*Prices subject to change

Circle 189 on Inquiry Card.
**Printer Sharing & Memory**

800-238-9415

**Logical Connection**

4860 Portland Road NE #108
Salem, OR 97305-1658
Tech.: (503) 390-9375
FAX: (503) 390-9372

**PCMCIA 2.0 SRAM Cards:**
- S128 - $120
- 1Mb - $175
- 2Mb - $295

**Toshiba:**
- 1000XE/SE/LE, 1800, 1850, 2000, 2000UX/SX/SEXE, 2200UX/SX
- 2Mb - $60
- 4Mb - $150
- 8Mb - $275
- 32Mb
- 4Mb - $150
- 64Mb - $225
- 440UX/SX
- 4Mb - $150
- 8Mb - $275

**Powerbook & MAC:**
- 120/140/145/150/160/165/180
- 6Mb - $250
- 8Mb - $310
- 10Mb - $390
- DUO/210/220:
- 6Mb - $260
- 8Mb - $320
- 10Mb - $410
- Cent. 510/650, Quad. 800, LC/II
- 4Mb - $345
- 8Mb - $520

**MAC SIMMs (70ns):**
- 1x8 - $32
- 4x8 - $124
- 16Mb - $495

**Logical Connection**

Avoid system lock-ups, halting, and data corruption.

Only 1/2" high and less than 2" square, Nidec's FanSink® Model 1 has the cooling power to allow 486, 68040 and other microprocessors to run at ultra-low operating temperatures with virtually no noise.

The world's first integral heat sink and fan, FanSink mounts directly to most computers, even laptops. Only $39.95 plus shipping. VISA/MasterCard

Phone (800) 746-4332, (800) 74-NIDEC

*Patent Pending*
### Memory Options

**NEW**

**64MB 72-PIN**

16MB X 36 FOR :

- ALR EVOLUTION VQ: $4999.00
- ACER POWER 486E: $4875.00
- AIR 486 EISA-VL BUS: $4995.00

**256K X 36 - 1MB**

**512K X 36 - 2MB**

**1MB X 36 - 4MB**

**2MB X 36 - 8MB**

**4MB X 36 - 16MB**

**8MB X 36 - 32MB**

**16MB X 36 - 64MB**

(PLEASE CALL FOR X 32'S)

---

**IC Card**

- PCMCIA - 2MB: $179.00
- COMPAQ LTE 386 - 1MB: $25.00
- TOSHIBA T-1000LE, SE.XE
  - 1MB: $25.00
  - 1.5MB: $28.00

**Memory Upgrade for**

ONE OF THE MOST POPULAR LASER PRINTERS
THE OKILASER 400 WITH 2MB ONLY $59.00

---

**VOMAX 2000**

The Ultimate Combo:

- Voice Mail
- Fax Mail Box
- Data Modem
- Digital Answering Machine
- ... and more

Feature to feature, this is the Home-office machine of the 90's. Only $399.00

(Please call for your free brochure)

---

**CitiTronics Inc.**

CALL FOR UPDATED LOW PRICES AND NEW PRODUCTS

Office Hours: Mon.-Fri. 7am to 5:30pm pst, Sat. 9am to 1pm pst

TERMS: C.O.D., CASH, VISA OR MASTERCARD. COMPANY AND UNIVERSITY P.O.'S ACCEPTED UPON CREDIT APPROVAL.

TEL. (818)855-5688 FAX (818)855-5687
414 CLOVERLEAF DR., UNIT B, BALDWIN PARK, CA 91706

(PLEASE CALL FOR SIPPS)
<table>
<thead>
<tr>
<th>IBM PS/2 SIMM MODULES</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 32/32X 128404/32</td>
<td>$150.00</td>
</tr>
<tr>
<td>Model 32/32X 128404/64</td>
<td>$300.00</td>
</tr>
<tr>
<td>Model 32/32X 128404/128</td>
<td>$450.00</td>
</tr>
<tr>
<td>Model 32/32X 128404/256</td>
<td>$600.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TOSHIBA LAPTOP MEMORY</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 32/32X 128404/32</td>
<td>$150.00</td>
</tr>
<tr>
<td>Model 32/32X 128404/64</td>
<td>$300.00</td>
</tr>
<tr>
<td>Model 32/32X 128404/128</td>
<td>$450.00</td>
</tr>
<tr>
<td>Model 32/32X 128404/256</td>
<td>$600.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOTEBOOK, LAPTOP MEMORY</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 32/32X 128404/32</td>
<td>$150.00</td>
</tr>
<tr>
<td>Model 32/32X 128404/64</td>
<td>$300.00</td>
</tr>
<tr>
<td>Model 32/32X 128404/128</td>
<td>$450.00</td>
</tr>
<tr>
<td>Model 32/32X 128404/256</td>
<td>$600.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMPATIBLE FONT CARTRIDGE</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 32/32X 128404/32</td>
<td>$150.00</td>
</tr>
<tr>
<td>Model 32/32X 128404/64</td>
<td>$300.00</td>
</tr>
<tr>
<td>Model 32/32X 128404/128</td>
<td>$450.00</td>
</tr>
<tr>
<td>Model 32/32X 128404/256</td>
<td>$600.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LASER PRINTER MEMORY UPGRADES</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 32/32X 128404/32</td>
<td>$150.00</td>
</tr>
<tr>
<td>Model 32/32X 128404/64</td>
<td>$300.00</td>
</tr>
<tr>
<td>Model 32/32X 128404/128</td>
<td>$450.00</td>
</tr>
<tr>
<td>Model 32/32X 128404/256</td>
<td>$600.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>H.P. COMPATIBLE FONT CARTRIDGE</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 32/32X 128404/32</td>
<td>$150.00</td>
</tr>
<tr>
<td>Model 32/32X 128404/64</td>
<td>$300.00</td>
</tr>
<tr>
<td>Model 32/32X 128404/128</td>
<td>$450.00</td>
</tr>
<tr>
<td>Model 32/32X 128404/256</td>
<td>$600.00</td>
</tr>
</tbody>
</table>

**Notes:**
- All products are tested and guaranteed.
- We buy excess inventory.
- Trademarks are registered with their respective companies.
**DEVELOPERS TOOLS**

**EPROM Programmer**
- Programs devices up to 512K bits, plus 27C100, 27C200, 27C100, 27C200, 27C100, 27C200 and more
- 6-bit 8068 and 286/386/486 PC compatible card
- Socket accepts 0.6" DIP IC's to 32 pins

**EPROM Eraser** $39.95
- Quickly and simultaneously erase up to 4 standard EPROMs
- Includes wall plug supply

**Wire-Wrap Prototype Cards**
- 286/386/486 compatible
- Displays Power On Self-Test codes
- Includes AMI Diagnostics software

**低 Cost Windows Accelerator**
- 286/386/486 compatible, supports interlaced and non-interlaced, analog or multisynch monitors
- VESA software compatible
- Up to 1280 x 1024 resolution in 16 colors

**INTERFACES CARDS**

**Fast Multi I/O Card**
- Includes two NS16550 serial ports, one parallel port and one game port
- 8-bit 286/386/486 compatible card

**SYSTEM BASICS**

**3-Button Mouse** $14.95
- Accuracy 290-1450 DPI
- Opto-mechanical design

**MODEMS & FAX**

**2400 Baud Internal Modem**
- 2400/115200 baud operation
- Full Hayes command set compatibility
- QuickLink II communications s/w.

**STORAGE DEVICES**

**5-1/4" & 3-1/2" Combination Drive**
- 5-1/4" half-height beige drive
- Supports 1.44MB, 2.88MB, 120MB, 360MB and 1GB diskettes

**MOTHERBOARDS**

**33MHz 386SX Motherboard**
- 33MHz AMD 80386SX CPU, AMI BIOS supports IDE, shadow RAM, password protection and more
- Uses 256K, 1M & 4M x 8 68K SIMMs (80ns)
- Socketed for 386 processors
- Six 16-bit expansion slots
- MS-DOS, Windows 3.1, DESYO'S 386, Novell NetWare and OS/2 compatible

**MOTHERBOARD OPTIONS**

**33MHz 386SX Module**
- 33MHz AMD 80386SX CPU, AMI BIOS supports IDE, shadow RAM, password protection and more
- Uses 256K, 1M & 4M x 8 68K SIMMs (80ns)
- Socketed for 386 processors
- Six 16-bit expansion slots
- MS-DOS, Windows 3.1, DESYO'S 386, Novell NetWare and OS/2 compatible

**MODEMS & FAX**

**2400 Baud Internal Modem**
- 2400/115200 baud operation
- Full Hayes command set compatibility
- QuickLink II communications s/w.

**SYSTEM BASICS**

**3-Button Mouse** $14.95
- Accuracy 290-1450 DPI
- Opto-mechanical design

**MODEMS & FAX**

**2400 Baud Internal Modem**
- 2400/115200 baud operation
- Full Hayes command set compatibility
- QuickLink II communications s/w.

**STORAGE DEVICES**

**5-1/4" & 3-1/2" Combination Drive**
- 5-1/4" half-height beige drive
- Supports 1.44MB, 2.88MB, 120MB, 360MB and 1GB diskettes

**MOTHERBOARDS**

**33MHz 386SX Motherboard**
- 33MHz AMD 80386SX CPU, AMI BIOS supports IDE, shadow RAM, password protection and more
- Uses 256K, 1M & 4M x 8 68K SIMMs (80ns)
- Socketed for 386 processors
- Six 16-bit expansion slots
- MS-DOS, Windows 3.1, DESYO'S 386, Novell NetWare and OS/2 compatible

**MOTHERBOARD OPTIONS**

**33MHz 386SX Module**
- 33MHz AMD 80386SX CPU, AMI BIOS supports IDE, shadow RAM, password protection and more
- Uses 256K, 1M & 4M x 8 68K SIMMs (80ns)
- Socketed for 386 processors
- Six 16-bit expansion slots
- MS-DOS, Windows 3.1, DESYO'S 386, Novell NetWare and OS/2 compatible
Polaroid Circular Polarizing Filters for computer monitors combine circular polarizer technology with optical quality materials and coatings to provide the ultimate in glare reduction and contrast enhancement technology. Polaroid CP-Filters suppress up to 99% of reflected light and are more effective than any other filter for improving contrast. Also, most CP-Filter models have a transparent electrically conductive coating which reduces up to 96% of the electromagnetic radiation and eliminates static.

Polaroid produces a full range of optical quality anti-glare filters in glass and triacetate to fit most 9"-21" monitors.

Polaroid Corporation, Polarizer Division, N2, 1 Upland Road, Norwood, MA 02062 1-800-225-2770 Fax 617-446-4680

Circle 240 on Inquiry Card.

SCSI • IDE • FLOPPY HOST BUS ADAPTER/CONTROLLER

STANDARD FEATURES
- Drivers for Fixed, Optical and Removable Drives
- Internal and External SCSI Connectors
- Soft and IDE Cables
- On-Board Diagnostics
- Complete Documentation
- Lifetime Warranty
- 30 Day Return Policy
- Made in the USA

SUPPORTS
- Up to 7 SCSI Devices
- Up to 2 IDE Drives
- Up to 4 Floppy Drives
- 2 ROM Addresses
- 1/0 Addresses

OPTIONS
- CD-ROM & Unix Drivers
- ASPI Manager
- 3rd & 4th Floppy Driver

$150.00
($150.00 includes CD w/Option Pack)

$175.00

CONTROL CONCEPTS INC.
(703) 876-6444 • (703) 876-6416 Fax

Circle 259 on Inquiry Card.

Add-In Boards • Bar Coding

Tough and durable. For multiprotocol serial controllers in demanding environments, you need Star Gate.

Built to withstand the rigors of industrial and commercial environments, Star Gate I/O controllers are offered in a broad range of price and performance options for ISA, EISA and Micro Channel.

Added Benefits: Enables a single PC expansion slot to support from 2 to 128 serial devices • Unmatched reliability in harsh, noisy environments with fully-shielded cables and rugged metal connection panels • Exclusive SureGuard™ option includes complete transient surge suppression • EIA-232, -422, -485 • Supports DOS, OS/2, Unix, Xenix, Novell, Windows, TCP/IP.

Find out more. Call 1-800-782-7428.

Star Gate Technologies, Inc. • Solon, OH • 216-349-1860 • FAX: 216-349-2056

Circle 268 on Inquiry Card.

Portable Bar Code Readers

TimeWand® I DuraWand® TimeWand II

Data collection is fast, easy, and extremely accurate when using Videx portable bar code readers. Cordless operation, compact size, and lightweight allow you to take the wands wherever the work needs to be done. Call Videx today for your free information kit: 503-759-0521. Prices starting at:

TimeWand I .......... $298
DuraWand .......... $495
TimeWand II ........ $698

1105 NE Circle Blvd., Corvallis, OR 97330-4285 503-759-0521 • FAX 503-752-5285

TimeWand, DuraWand, and Videx are registered trademarks of Videx, Inc. GC0355

Circle 248 on Inquiry Card.
Communicating with a Higher Intelligence

GMMA SyncA/CCPTM
- High Performance 16 MHz 16-bit CPU.
- 80856 code compatible.
- 4-Sync/Async Ports / 82522, 82422, RS485
  (2 Serial Ports with Full Duplex DMA).
- Uses Zilog 85230, 85230 SCC chip.
- 512K Dual Port Ram (STD)
  (1, 2, or 4 MEG Dual Port Ram - optional).
- 16K, 164, 325, 646 Window Size (Programmable).
- 8 Software Selectable and Shareable Interupts.
- Two Port Com. CoProcessor also available.

GMM Products Are All Made in USA.

GMM Research Corporation

Light-Speed Serial Communications

PCSS-8FX Intelligent Serial Coprocessor
- Better than 1 byte/second transfer rate.
- No load on Host Processor!
- 1/0 Mapped - No host memory used.
- FASTER than Dual Ported Memory!
- Looks like IBM Uart with huge QUEUE!

GTEK, INC. • DEVELOPMENT HARDWARE & SOFTWARE • P.O. Box 2310
Dayton, OH 45429-2310 USA • Minimodule & Technical Support 601-467-8048
Fax 601-467-9935 • OEM & Dealer Inquiries Welcomed!

Voice Response/Caller ID for Windows

Would you like to develop multi-tasking multi-line non-blocking interactive Voice Response applications for Windows? PIKA offers the high quality, feature rich AVA-B series 1,2 & 4 line voice cards with hardware voice compression.

Also, the new PIKA IdSFi 1,2, & 4 line Caller ID cards are the answer to many new and exciting Windows server applications. All PIKA cards are available (at affordable prices) with Windows DLL & DDE developer toolkits for C & Visual Basic.

PIKA TECHNOLOGIES INC.
154 Teresa Matthews Cres., Kanata, Ontario K2M 2A4, Canada
Tel: 1-613-591-1555 Fax: 1-613-591-1488

IEEE-488
- Interfaces + Software
- Analyzer + Converter
- Extender + Cables
- DOS, Windows, Q5/2, UNIX, SunOS

PCXI INDUSTRIAL PC:
MODULAR PLATFORM FOR ACQUISITION, CONTROL, INSTRUMENTATION.
- Fully compatible PCAT.
- Modular, interchangeable, multiwindow.
- Rugged, ISA or AT bus.
- Noise, emissions, power, ground, airflow & cooling engineered for highest performance.

RAPID SYSTEMS
Phone: (206) 784-4311
FAX: (206) 784-0333
**Computer Systems • Data Acquisition**

**Data Acquisition**

- **Disk & Optical Drives**
  - Rackmount Components - Qty 1 Pricing
    - Rackmount Chassis 19"/17" $183
    - Rackmount VGA Monitors $331
    - Rackmount Monitor Shelf $113
    - Rackmount Keyboard Shelf $58
  - Rackmount Platforms - Qty 1 Pricing
    - RM548H-335RSA $1799
    - RM398H-34 $814
    - RM48-23 $1443
    - Rackmount System Platforms include 7 Rackmount Chassis, 200W Power Supply, Motherboard, 1.0MB Memory, IDE, FDC, 2-Scr, Par. 1.2MB or 1.4MB Floppy Disk Drive, 1 Year Warranty

**THE VALLEY TECHNOLOGY INC.**

2468 Armstrong Street, Livermore CA 94550

(510) 447-2030 FAX: (510) 447-4598

---

**Data Acquisition • Disk & Optical Drives**

The Intelligent Solution For Data Acquisition

**Computer Systems**

- **Data Acquisition**
  - Rackmount Solutions
    - Rackmount Components - Qty 25 Pricing
      - Rackmount Chassis 19"/17" $183
      - Rackmount VGA Monitors $331
      - Rackmount Monitor Shelf $113
      - Rackmount Keyboard Shelf $58
    - Rackmount Platforms - Qty 1 Pricing
      - RM548H-335RSA $1799
      - RM398H-34 $814
      - RM48-23 $1443
      - Rackmount System Platforms include 7 Rackmount Chassis, 200W Power Supply, Motherboard, 1.0MB Memory, IDE, FDC, 2-Scr, Par. 1.2MB or 1.4MB Floppy Disk Drive, 1 Year Warranty

**ADVANCED TECHNOLOGY INC.**

200 East American Ave.
Montclair, CA 91763

(818) 840-2816 FAX: (818) 840-2817

---

**Data Acquisition for Notebook PCs**

- High-speed, PC parallel-port connection
- 2-ch. A/D & 16-ch, 100-kHz A/D
- 16 digital I/O
- 16 high-speed digital inputs
- 5 counter/timer channels
- AGC or battery operable
- MS Windows graphical software

---

**FREE, 288 PAGE**

1993 DATA ACQUISITION CATALOG AND REFERENCE GUIDE

IBM PC/XT/AT, PS/2, MICROCHANNEL COMPUTERS AND COMPATIBLES

---

**THE TOTAL BACKUP SOLUTION**

PSS portable tape backup system, plugs into any standard parallel port. Combined backup 5 verify at true 11MB/min.

---

**PS/2 Hard Drives**

- **PS/2 50 50z 55sx 60 70 80 P70**
  - Interchangeable drives - May be used in a high performance replacement or to co-exist with original IBM drive. Compatible with OS/2 4.0, 5.0, 5.0.9, 5.0 and 6.0, Novell. Includes IDE or SC55-ISO controller, hard drive, mounting kit, ribbon cable, manual, and hardware.
  - 105mb, 15ma, Internal Seagate IDE Drive Kit $389
  - 120mb, 15ma, Internal Maxtor IDE Drive Kit $414
  - 145mb, 15ma, Internal Maxtor IDE Drive Kit $599
  - 250mb, 15ma, Internal Maxtor IDE Drive Kit $789
  - 340mb, 15ma, Internal Maxtor IDE Drive Kit $953
  - 540mb, 15ma, Internal Maxtor IDE Drive Kit $1128

---

**THE TOTAL BACKUP SOLUTION**

250MB-2GB capacities in native mode. QIC Industry standard format. Supports MS DOS, Windows, OS/2, Novell, SCO UNIX and SCO XENIX. Complete with powerful solution-minded software series:

- **BUS** (Backup Supervisor Software) - The ultimate in backup prompting and enforcement.
- **SM** (Script Manager) - Creates files (scripts) specifying data and files to backup, verify and compare.
- **SDB** (SCSI Disk Backup) - Selective backup and restoration of files (hidden and security included) from all desktop, portable and network computers, including file servers.

INFO AND ORDERS: 1-800-998-7939

---

**Circle 254 on Inquiry Card.**

---

**Circle 216 on Inquiry Card.**

---

**Circle 264 on Inquiry Card.**

---

**Circle 232 on Inquiry Card.**

---

**Circle 225 on Inquiry Card.**

---

**Circle 272 on Inquiry Card (RESELLERS: 273).**
Add up to 7 SCSI devices to your parallel port and **still** use your printer!

Up to twice as fast as our original MiniSCSI™ parallel-to-SCSI adapter, the MiniSCSI Plus adapter lets you run a CD-ROM, tape backup, SyQuest®, Bernoulli® or other SCSI device from almost any parallel port. For most notebook users, it's the only way to use SCSI devices. An integrated cable makes it a snap to share SCSI devices with desktops.

**Key Features:**
- 100% Printer Passthrough
- Weighs just 7.2 Ounces
- Fully Compatible With Bidirectional and Unidirectional Parallel Ports
- Powered By SCSI Bus
- Only $319

See your dealer or call:
Trantor Systems Limited
5111 Renfrew Place • Fremont, CA 94538-3151
FAX: (510) 770-9416

Adapted Interactive FAX: (408) 957-7109

1-800-TRANTOR
Trantor® Abrams & Company

© 1991 Trantor Systems Limited. MiniSCSI™ and Trantor® are trademarks of Trantor Systems Limited. All other trademarks used herein are owned by their respective owners.

**Money Back Guarantee & 1 Yr. Warranty**

**Popular**

**Space-Saver Keyboard**

**$98.00**

Saves 60% desk space. Footprint 27.3 x 15.2 cm. 100 full-travel tactilly responsive keys. Standard left-right spacing for easy touch typing. IBM XT/AT PS 2 compatible. Many language versions available.

**Call Toll Free To Order:** 1-800-DATALUX

**DATALUX**

155 Aviation Dr. • Winchester, VA 22602
Tel 1-703-662-1500 • FAX 1-703-662-1675

- VISA, MC, AmX - Auto-FAXed Spec FAX 1-703-662-1675

Is the unhandy numeric section of your portable computer's keyboard dragging you down?...Give your productivity a boost by using our Micropad. The ergonomically designed Micropad is ideal for spreadsheet and accounting applications that require fast and accurate entry of numeric data.

The Micropad attaches to the parallel port of any MS-DOS computer while providing a clean pass through connection to the printer. Power usage is negligible. Lightweight and compact, the Micropad is fully programmable and is also available with connectors to fit keyboard and serial ports.

**Boost data entry speed, accuracy and convenience with Genovation's Micropad,™ the innovative numeric keypad for portable computers.**

**To Computer**

**To Printer**

(800) 822-4333
17741 Mitchell, North Irvine, CA 92714 USA
TEL (714) 833-3355
FAX (714) 833-0322

Circle 253 on Inquiry Card.
STAND-ALONE LCD MONITORS
STN Color or Monochrome

$1495 | DATALUX introduces its new high quality, high brightness color LCD monitor in the same case as the popular Monochrome version.
• 640 X 480, 256 Colors, VGA compatible, 2 CCFT backlight
• Driven by ISA Bus Controller Card, no external power supply, optional CRT output
• Adjustable desk stand, folds for wall mounting or portability, 1.75Kg weight
• 197 X 147mm display (9.4 inch diag), non-reflective glass face
• Contrast ratio of 15:1, 200ms Rise and 150ms Fall time

$795 | Monochrome version 640 X 480, 64 gray shades.
• Wide viewing angle.

To Order Call Toll-Free: 1-800-DATALUX

Multimedia

With VGA→TV Elite, any color TV can be your computer monitor!

Supporting 640 x 480 resolution in 32,768 colors, the VGA→TV Elite provides flicker free high quality video conversion. Rock solid and easy to use, the portable VGA→TV Elite is a true savior to the Presentation professional. Convert your computer presentation or Animation to show on TV or record to your VCR. Even play computer games on big screen TV! Supports RCA and S-Video Inputs to TVs and VCRs.

$399.

A MESSAGE TO OUR SUBSCRIBERS

FROM TIME TO TIME WE MAKE THE BYTE SUBSCRIBER list available to other companies who wish to send our subscribers material about their products. We take great care to screen these companies, choosing only those who are reputable, and whose products, services or information we feel would be of interest to you. Direct mail is an efficient medium for presenting the latest personal computer goods and services to our subscribers.

Many BYTE subscribers appreciate this controlled use of our mailing list, and look forward to finding information of interest to them in the mail. Used are our subscribers' names and addresses only (no other information we may have is ever given).

While we believe the distribution of this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive such promotional literature. Should you wish to restrict the use of your name, simply send your request to the following address.

BYTE Magazine
Attn: Subscriber Service
P.O. Box 555
Hightstown, NJ 08520

Circle 279 on Inquiry Card.

Circle 271 on Inquiry Card.

Circle 224 on Inquiry Card.
**IMAGING CARDS**

- **Model** - 1-800-292-1160
- **-512/24** - 512x480x24 - New Full 24 bit color board, mult. in, 24 bit RGB out .............. $795
- **-512** - 512x480x8 - Advanced grayscale board. Multi res/multi image, 4 inputs, in/out LUTS, dual ping-pong buffers, RGB out ........................................ $595
- **-02** - 256x240x8 Workhorse 8 bit grayscale. 2 inputs, 24 bit Video FRAMEGRABBERS for the XT/AT/386

- Real time grab/display
- Complete with software
- 60 & 50 Hz. Video
- Quality since 1987!
- Money back guarantee

---

**Universal Programmers**

**From $995**

Support for virtually all devices and packages

**Configurable as:**
- Entry Level
- Fully Universal
- Gang for IC Cards
- Gang for Memory & Micros

**Serial Memory Programmer**

**From $395**

- 32 pin EPROMs to 4Mbytes, Flash EPROMs, Intel Micros
- Gang Module (4 sockets), Motorola Micros Module
- RS232 Interface; Internal eraser option; Stand-alone capability

**Intelligent Rom Emulator**

**From $395**

- "In-Circuit Emulator'' type features: Address Compare (with HALT output), Address Snapshot, Trigger Input, Reset Output
- Standard Parallel Printer Port (64Kbytes in 10 seconds)
- Stand-alone operation (rechargeable NiCad battery)

---

**Multimedia**

- Printers/Plotters
- Programmable Hardware

---

**Programmable Hardware**

**IMAGING CARDS**

- Video Framegrabbers for the XT/AT/386
- Real time grab/display
- Complete with software
- 60 & 50 Hz. Video
- Quality since 1987!
- Money back guarantee

---

**For Your Development Needs!**

**MODEL 9000**

**EPROM PROGRAMMER**

- QuickPulse and intelligent algorithms.
- Programs Eproms (up to 4M), EEproms & MPU's.
- Up to 7K baud.
- Ultra Fast!

**ORDER TOLL-FREE**

**800-282-4835**

---

**MINIATURE CONTROLLERS**

- C-Programmable, Low cost, Expandable

**$389 as shown**

1724 Picasso Avenue
Davis, CA 95616
916.753.7737
916.753.5141 FAX

24-Hour Information Service 916.753.0618
Call from your FAX and request data sheet #54.

---

**Primax Made it a Snap!**

Primax Electronics created and originally manufactured the modular printer sharing concept, and others put their name on it. Now you can get the original ModularLINK™ and its reliable technology directly from the Original Equipment Manufacturer! For truly hassle-free printer networking, look to ModularLINK™ — the original Simple Printer Network™!

- Over 500,000 nodes installed worldwide
- Connects 16 computers with a single printer
- Starter Kit for 2 computers and 1 printer only $129.95
- Fully compatible with existing SNAP™ networks
- Power-free for most applications

---

**SUGGESTED ACCESSORIES**

**CONFIGURABLE AS:**
- Entry Level
- Fully Universal
- Gang for IC Cards
- Gang for Memory & Micros

**AVAILABILITY:**
- RS232 Interface; Internal eraser option; Stand-alone capability

---

**Davison • WORTH CORPORATION**

1-800-866-2767 Tel: (318) 850-0637 Fax: (318) 860-1602

---

**Call for free Demo Disk!**

---

**For Your Development Needs!**

**MODEL 9000**

**EPROM PROGRAMMER**

- QuickPulse and intelligent algorithms.
- Programs Eproms (up to 4M), EEproms & MPU’s.
- Up to 7K baud.
- Ultra Fast!

**ORDER TOLL-FREE**

**800-282-4835**

---

**MINIATURE CONTROLLERS**

- C-Programmable, Low cost, Expandable

**$389 as shown**

1724 Picasso Avenue
Davis, CA 95616
916.753.7737
916.753.5141 FAX

24-Hour Information Service 916.753.0618
Call from your FAX and request data sheet #54.

---

**Call for free Demo Disk!**

---

**For Your Development Needs!**

**MODEL 9000**

**EPROM PROGRAMMER**

- QuickPulse and intelligent algorithms.
- Programs Eproms (up to 4M), EEproms & MPU’s.
- Up to 7K baud.
- Ultra Fast!

**ORDER TOLL-FREE**

**800-282-4835**

---

**MINIATURE CONTROLLERS**

- C-Programmable, Low cost, Expandable

**$389 as shown**

1724 Picasso Avenue
Davis, CA 95616
916.753.7737
916.753.5141 FAX

24-Hour Information Service 916.753.0618
Call from your FAX and request data sheet #54.

---

**Call for free Demo Disk!**
Flexible support for PLCC, TSOP, SOT, SOIC, QFP, PGA, SIMM/SIP ... with up to 256 pins.

- Tests TTL74, CMOS 40/45, DRAM and SRAM.
- Optional EPROM EMULATION capability.
- Free software updates via BBS or mail.

All products are backed with a 1 year warranty and a 30 day money back guarantee.
smARTWORK PCB Software

The first printed-circuit-board program for the IBM PC, and still the first choice for designers of 2-sided PCBs, occasional users, and educators. The program’s features include unmatched ease of use, continual design-rule checking, automatic pad shaving, trace filleting, soldermasks, and silkscreen. smARTWORK with autorouting is $895 ($495 without) and has a 30-day money-back guarantee. Call (800) 742-6809 or (317) 448-1903.

Circle 250 on Inquiry Card.

Introducing a new approach to scientific data analysis

Analysis Advisor is a free interactive analysis software tutorial that includes demonstrations of graphical and traditional programming methodologies for analysis. Using this interactive tutorial, you can investigate Digital signal processing, Digital filtering, Windowing, Curve fitting, Signal averaging, Simulation, Interpolation, and Descriptive statistics. Requires Windows 3.1 and 8 MB of memory.

National Instruments
6504 Bridge Point Parkway, Austin, TX 78730
(512) 794-0100
(800) 433-3488 (U.S. and Canada)
Fax (512) 794-8411

Circle 236 on Inquiry Card.

DADiSP

Windows for Engineers

- Collect, analyze, and display data in a multi-window graphical environment
- Point and Click menu driven operation
- Data reduction and editing
- Series and scalar math
- Matrix math

DADiSP is currently in use in engineering, laboratory data collection, matrix processing, manufacturing, science, signal processing, chemical and mechanical applications in automotive, aerospace, defense, medical, and other industries.

CALL 1-800-777-5151

for your free DADiSP Trial Kit for SUN, HP, IBM, NeXT, DEC, Concurrent, and Silicon Graphics workstations, and of course, PCs under Windows™.

Circle 226 on Inquiry Card.

BYTE Breaks the 4-Color Price Barrier with the Hardware/Software Showcase

See how affordable it is to advertise to BYTE’s 500,000 computer professionals in this section!

Call for more advertising information:
(603) 924-2695 or (603) 924-2598

Circle 226 on Inquiry Card.
Software Developers...

Ask Corel, AT&T, EXXON, Sharp, Inset Systems, and a thousand others...

why they picked LEADTOOLS for their image application.

They'll say from document to true color imaging, LEAD Technologies is innovative. LEAD pioneered image compression technology that achieves compression ratios of over 200 to 1, constructed tools for quick integration of images into any application, and built a toolkit with a reputation for speed! Call for a free evaluation diskette to see for yourself.

LEAD Technologies, Inc.
1-800-637-4699 • Fax 704-548-8161
**JMP® Statistical Discovery Software**

"JMP, from the SAS Institute, is the most surprising Mac product in years...with the most helpful Mac interface of all the statistics programs and one of the best interfaces ever produced for scientific software. It's nothing less than dazzling."

Call today for a free demo disk and Points of Interest from the leading name in data analysis software...SAS Institute Inc. 919-677-8000. Fax 919-677-8166.

JMP is a registered trademark of SAS Institute Inc. Copyright © 1992

---

**BASIC Compiler 8051/52 & Derivatives**

**BXC Version 4.0 New Release!**

- 100% BASIC-52 compatible & in line assembly
- Full floating point, integer, byte and bit variables
- Compatible with any RAM or ROM memory mapping
- Compile BXC program into CALLable subroutine
- Compile program to coexist with BASIC-52 interpreter
- DS/5000 chip support and extensions
- Dynamic length variables and many string functions
- Advanced run-time error trapping & buffered serial I/O

BXC51 $295

Call now! 508-369-9556 or FAX 508-369-9549

Binary Technology, Inc.
P.O. Box 541 • Carlisle, MA 01741

---

**APL**

Complete APL system $60.

Ken's new APL for teaching and research.

Shareware and documentation $24. Source $90.

NEW! True Windows 3.1 versions.

GUI programming for APL and J

Write for product catalog and price list.

Iverson Software Inc.

33 Major St., Toronto, Ontario, Canada M5S 2K9

Phone (416) 925-6096 • Fax (416) 488-7559

---

**TCP/IP Windows Developer's Kit**

- Binary TCP/IP Transport
- PDS for DCS
- Windows Sockets API

**Development Components**

winsock.dll is a dynamic link library (DLL) which allows windows applications to dynamically bind for TCP/IP services. The winsock.h, .lib, .def files are also provided for the C/C++ developer.

/build contains the source and executables for Windows Sockets finger client. This is useful for testing winsock, configuring the build environment, and as an example of both message-based and synchronous Windows Sockets programming.

winsock.HLP provides online help for Windows Sockets version 1.1.

---

**POWER & PRECISION**

Scientific Graphs and Statistics

Call Now: 517-339-9859

Advanced Capabilities in a next generation product. Used and tested by over 30,000 scientists and engineers worldwide.

Error-free performance, total control and flexibility, hundreds of templates and samples, full support for all types of data files, ease of use, and free tech support make Plot-IT 3.0 your best scientific graphing software choice.

We are so confident you will find Plot-IT 3.0 for WINDOWS to be an indispensable research tool, we offer a 60-day money back guarantee.

---

**BYTE's HARDWARE/SOFTWARE SHOWCASE**

our newest, affordable, 4-color advertising section!

Call for more details:

(603) 924-2695 or (603) 924-2598
THE BUYER’S MART

THE BUYER’S MART is a unique classified section organized by product category to help readers locate suppliers. Each ad has inquiry numbers to aid readers requesting information from advertisers.

AD FORMAT: Each ad will be designed and typeset by BYTE. Do NOT send logos or camera-ready artwork. Advertisers should furnish typewritten copy. 2’x1/4” ads include headline (23 characters maximum), descriptive text (300 characters is the maximum recommended) plus company name, address, telephone and fax number. 2’x2’/4” ad has more space for descriptive text (850 characters is the maximum recommended).

DEADLINE: Ad copy is due approximately 2 months prior to issue date. For example: November issue closes on September 8. Send your copy and payment to: THE BUYER’S MART, BYTE Magazine, 1 Phoenix Mill Lane, Peterborough, NH 03458. For more information call: Margot Gnade at 603-924-2656.

FAX: 603-924-2683.

THE BUYER’S MART

A DIRECTORY OF PRODUCTS AND SERVICES

THE BUYER’S MART is a unique classified section organized by product category to help readers locate suppliers. Each ad has inquiry numbers to aid readers requesting information from advertisers.

AD FORMAT: Each ad will be designed and typeset by BYTE. Do NOT send logos or camera-ready artwork. Advertisers should furnish typewritten copy. 2’x1/4” ads include headline (23 characters maximum), descriptive text (300 characters is the maximum recommended) plus company name, address, telephone and fax number. 2’x2’/4” ad has more space for descriptive text (850 characters is the maximum recommended).

DEADLINE: Ad copy is due approximately 2 months prior to issue date. For example: November issue closes on September 8. Send your copy and payment to: THE BUYER’S MART, BYTE Magazine, 1 Phoenix Mill Lane, Peterborough, NH 03458. For more information call: Margot Gnade at 603-924-2656.

FAX: 603-924-2683.

ACADEMIC COMPUTING

LEARN PARALLEL PROCESSING Transputer Education Kit $396

Kit includes ready-to-use PC add-in board with T400 transputer, 1MB of RAM, and PC interface. Complete with Daemon1 and C compiler, assembler, source-level debugger, example programs and 1500 pages of documentation (print, electronic). Computer System Architects 100 Library Plaza, 15 North 100 East, Provo UT 84606-3100 (801) 752-425A Fax (801) 752-2309

Inquiry 651.

AUTO FILE PROTECTION

Keep Snooper Off Your File! Automatic encrypt/cryptoprotect data on hard disk and floppy, you set drives and data types. Fast and secure background encryption/cryptop. Is fully transparent to you and your software. Javelin provides you easy access to what is inside. Works with DOS and Windows programs. Super Tech at low cost. Limited time! Javelin3D $75 (L-8.75%) + $5 s/h. COD (cash/credit card) $85

APTON CORPORATION P.O. Box 34620, Chicago, IL 60634 Tel: 312-777-3382 Fax: 312-777-3075

Inquiry 655.

BAR CODE

Labeling Software On EPSON, IBM, OKI, or Laserjet. Easy WYSIWYG design. Any format/size. Up to 120 fields per label. 18 text sizes to 3" readable at 100%. A4g, HR, 8x10, Sears, Mail-STD, Pennys, 20x15, 128, UPC/EAN, Code 39. File Input & Scanned PCX graphics - $279. On programs from $139.

Worthington Data Solutions (408) 458-9938 800-345-4220

Inquiry 656.

ACCESSORIES


800-729-5537 or Tel/Fax: (302) 655-3800 Aware Electronics Corp. P.O.Box 4265, Wilmington, DE 19807

$149.50

Inquiry 652.

PORTABLE READER

Portable Reader Simple, Powerful, Easy-to-use

- AA Battery Operated, with backup coin battery
- 2 x 16 Superview LCD Display
- 32 Raised Rubber Keys
- Real-time Clock Built-In for Date/Time Stamps
- 2 Built-In Inventory Programs
- 3 User Defined Programs, & 3 User Data Files
- Wand, CCD, or Laser Scanner Input
- Doubles as Non-Portable Reader
- Serial Interface and Keyboard Interface
- Reads 205, 128, Code 39, etc.
- Uploads with furnished Programs or Xmodem
- 64K Complete with Steel Wand - $799

Worthington Data Solutions Swiss Office Avenida de las Americas 1004 Mail Code 178, P.O. Box 01321 San Francisco, CA 94111 Phone: 415-886-2400 Fax: 415-886-2403

$350

Inquiry 653.

BAR CODE

Thermal Printer Package Allegro Thermal Transfer Printer-2" per sec speed. Up to 4" label width-Only 20 lbs. weight-Prints UPC/EAN, 205, 120-Code 39, 128-Prints scalable text and PCX graphics with bar codes-Package with LabelRIGHT Software, serial cable, ribbon and labels-Complete + $1500. Worthington Data Solutions (408) 458-9938 (800) 345-4220

Inquiry 656.

KEYBOARD, VIDEO, MOUSE, AUDIO

KEYBOARD Extends signals from PC with EXTENDER Split signals with COMPANION/PNP EXPANDER Switch signals among PCs with COMMANDER Boosts signals up to 600 feet. Control up to 96 PCs with one keyboard, monitor and mouse.

CYBEX CORPORATION 4912 Research Dr., Huntsville, AL 35805 Phone: 205-430-4000 Fax: 205-430-4030

Inquiry 652.

PARALLEL GAME PORT

Turn your notebook computer into a flying machine
- Connect two or more joysticks, yokes or pedals to the parallel port of your portable (or desktop) computer.
- Program the joystick’s switches to meet your needs.
- Eliminate all hardware game port problems.
- Available NOW, only $45.

GENOVATION, Inc. 17741 Mitchell North, Irvine, CA 92714 (800) 822-4333 (714) 822-3355 Fax (714) 822-6222

Inquiry 653.

VGA SPLITTERS

- Connect 2, 4, or more monitors to your computer
- Bright and crisp presentation simultaneously on all monitors - Guaranteed
- Works with all VGA, SVGA, and RGB monitors
- Small durable metal case, MADE IN USA
- Extension cables available

H & R TECHNOLOGY Santa Ana, CA (714) 641-6607 800-959-6439

Inquiry 654.

Bar Code Readers

Portable Bar Code Reader
- Use as a PORTABLE, WEDGE, or SERIAL
- 9V Battery Operation with Lithium Backup
- 2x16 Superview LCD Display
- 54 Key Keyboard with Separate Numeric Keys
- Real-time Clock Supports Data & Time Stamps
- Reads all Popular Bar Codes (19 types)
- Wand, CCD, Laser, or Serial Input Devices
- Built-In Program Generator
- Create Your Own Custom Programs
- Built-In Inventory Programs
- Up to 250 Programs Can Reside in Memory
- Support in up to 250 Data Files per Program
- Built-In Calculator
- Supports HAYES Compatible Modems
- 64K Memory with Data Compression
- 30-day $5 Back Guarantee + 1 Year Warranty
- Complete Unit with WAND Scanner - $795

Worthington Data Solutions Swiss Office Avenida de las Americas 1004 Mail Code 178, P.O. Box 01321 San Francisco, CA 94111 Phone: 415-886-2400 Fax: 415-886-2433

$350

Inquiry 653.

YOUR SALES MESSAGE

John, about the special computer product or service that you provide - make it brief and in print

THE BUYER’S MART can help you reach computer professionals and produce valuable inquiries for your company!

Call Margot Gnade or more information

603-924-2683

or

Fax: 603-924-2683

Inquiry 656.
CD-ROM CONVERSIONS

CD-ROM CONVERSIONS
Create your own CD-ROM by converting archival or back-up data to CD-ROM. Customized CD-ROM production available from virtually any archival data, disk or tape format. Search/Retrieval Engine development offered. Call for Info.

Pivar Computing Services, Inc.
165 Arlington Hts. Rd. #3C, Buffalo Grove, IL 60089
(800) CONVERT (708) 459-6010

COMMUNICATIONS

PC VOICE MAIL KIT $1795
• Voice Processing on your PC • Software and 4 line board included • Order Taking • AUDIOTEX • Voice Messaging • Never miss another call • HUNDREDS OF USES • Don’t pay $1,000s CALL TODAY FOR FREE DETAILS • 2 yr warranty
Amerifax Services Corp.
572 W. Miam St. 45, Akron, OH 44303
(216) 233-8778 • (216) 762-6050 Demo

Inquiry 669.

EASY EDI

EDI to FAX, E-Mail X-400 & Hardcopy
Send or receive EDI transactions translated into human readable documents & delivered as Fax, E-Mail and X-400 messages.

Complete EDI services
EMS
800 521-1129

Inquiry 670.

LOW-LOW-LOW

LOW-LOW-LOW
Computer Systems/Notebook/Network Solutions
IBM Apple-Compaq-AST-ALL-Everywhere & others
SUSAH 35614/IBM/AMIGA/Motherboards • CD ROMS • Tape Backup • Pocket FAX Modern LAN Cards • Hard Disc/Floppy Drives • Memory/Upgrades • DRAMS • SIMM Modules • Laser Printers/Scanners • Printers & A/D Converters
SUSAH Inc.
44120 Doped Rd., Fremont CA 94539 USA
(800) 543-1001 Nationwide Orders

Inquiry 674.

CROSS ASSEMBLERS

Cross Assemblers Simulators Disassemblers PseudoCorp
716 Thimble Shoals Blvd. Newport News, VA 23606
(804) 873-1947 Fax (804) 873-2154

BBS (804) 873-4838

Inquiry 675.

DATA ANALYSIS

ADVANCED DATA ANALYSIS...

at a click!
CLICK-X™ software, the most user friendly data analysis – everything! • Edi t/Graph/Data • Analyze • Advanced Math / Regression / Engineering / Statistics • Import/Export. FREE demo disk. Custom software available.

SoloSoft
P.O. Box 2546, Stamford, CT 06906-0548
Phone: (203) 977-6101 Fax: (203) 977-6237

Inquiry 676.

DATA RECOVERY

Data Recovery & Repair
• High Success Rate/Fast Turnaround
• Lowest Prices on Disk Drive Repair
• Clean Room Processing

We Recovery MFM/RLL/SCSI/ESDI/IDE AA Computech Inc.
28110 Avenue Crocker #306, Valencia, CA 91355
(800) 360-8801
(800) 267-6801

Inquiry 677.

CD ROM CONVERSIONS

CONVERSION SPECIALISTS
Thousands of disk/tape cartridge conversions, rapid disk/tape duplication, CD-ROM development, tape-stream scanning, key entry, document production for Interleaf and other DTP systems, bar code conversion, and programming.

FREE Tests & Quotations FREE MEDIA CONVERSION CORP.
111 Southport Rd., D-106, Glen Ellyn, IL 60137
(800) 860-1033 FAX (708) 469-1277

Inquiry 680.

DISK DUPLICATION

Trace Diskette Duplication Products
Trace/St. Family of Duplication Systems
• Low-cost, standalone duplicators
• High throughput, network solutions
Flexible PC-based Disk Duplication Software
• In-line label printing capabilities
Automatic Disk Printing and Labeling Solutions
Trace 1040 E. Brokaw San Jose, CA 95131
(800) 872-2318

Inquiry 681.

EDUCATION

B.S. & M.S. IN COMPUTER SCIENCE
The American Institute for Computer Sciences offers an in-depth home study program to earn your Bachelor of Science or Master of Science degrees in Computer Science at home. B.S. subjects covered are: MIS/OS, BASIC, PASCAL, C, File Processing, Data Structures & Operating systems. M.S. program includes subjects in Software Engineering and Artificial Intelligence.

AMERICAN INST. FOR COMPUTER SCIENCES
210-1 BY Magna Ave. Dept. 251, Birmingam, AL 35205
800-767-1947 205-333-6191

Inquiry 682.

ETHERNET TEST EQUIPMENT

ONTRACK DATA RECOVERY
• Professional service recommended by major hard drive manufacturers • Expertise is virtually every operating system & media storage device • 24-hour support with weekend, priority, & on-site service available • For fast, successful results, call:
MN: 1-800-872-2599 • CA: 1-800-752-7557
UK: 44-81-974-5522 • GERMANY: 0130-815-198
Corp. Headquarters: 3321 Boy Driv, Eden Prairie MN 55346

Inquiry 678.

FLOW CHARTS

BrainMaker:
"The most fascinating computer software I've ever seen...learn about this stuff." John Dvorak, PC Mag. Predicts stocks, bonds, sales, inventories. Comprehensive manual. Menus. 16,000 sold. PC or Mac. Only $19.95
Free Flyer: 800/284-8112, 916/478-9040
California Scientific Software

Inquiry 683.

COMPUTER BOOKS

COMPUTER BOOKS at a discount
We specialize in ADVANCED books for developers, programmers, computer professionals, and academics. 15% discount. Latest books from over 50 publishers. Free catalog. UPS & international shipping. Personal service. MCVISA/AMEX, Computere 79007, 1333.
GO CBK. Windows, C++, OS/2 3.2 UNIX, M/C, OCP
CompuBooks
Rt. 1, Box 271-D
515-347-4255
Cedar Creek, TX 78001
800-880-6816

Inquiry 672.

DATA/DISK CONVERSION

DATA/DISK CONVERSION
The #1 Choice in disk & tape conversion for many leasing companies, government agencies, law firms, and companies in every industry worldwide.

Free test • Satisfaction Guaranteed

Graphics Unlimited Inc.
3062 Second St. North, Minneapolis, MN 55411
(612) 588-7871 FAX: (612) 588-6723
1-800-746-7871

Inquiry 679.

COMPUTER INSURANCE

INSURES YOUR COMPUTER SAFERWARE. Computerowner's coverage provides replacement of hardware, media and purchased software. As little as $49 a year covers accidents, theft, power surges and more. One call does it all.

TOLL FREE 1-800-848-3469
SAFERWARE, The Insurance Agency Inc.
PO Box 82011, 9359 N. ll Sub., Columbus, OH 43202

New available in Ontario, Canada

Inquiry 673.
STATISTICS

NCSS 5.x Series — $125
Easy-to-use menus & spreadsheet. Multiple regression, t-tests, ANOVA (up to 10 factors, rep. measures covariates), forecasting, factor, cluster, & discriminant analysis. Nonparametrics, Cross Table/Tabulation, Graphics: histograms, box, scatter, etc. Reads ASCII/Lotus. Many new add-on modules.

NCSS
329 North 1000 East, Kaysville, UT 84037
Phone: 801-546-0445 Fax: 801-546-3907

Inquiry 715.

UTILITIES

PEN PLOTTER EMULATOR
FPLOT turns your printer into an HP pen plotter. Fast hi-res, no jagged lines. Vary line width, color. Screen preview — zoom, pan. Works with most CAD programs. Supports most printers. Requires DOS 2.1 or higher. $119+$3 S&H. Visa/MC/Cheq/MO.

FPLOT Corporation
24-16 Steinway St., Suite 605, Astoria, NY 11103
718-545-3505

Inquiry 716.

BACKFLIP™
...a unique and easy-to-use system for labelling, organizing and keeping track of back-up data
All for $79 MC/VISA To order call
(619) 431-5120 FAX (619) 931-6516
INTERNATIONAL FINANCIAL SYSTEMS (IFS) INC.
Suite 300, 2131 Palomar Airport Road, Carlsbad, CA 92039

Inquiry 717.

VOICE MAIL/FAX/MODEM
★ Have a NICETALK to you ★
MODEM + FAX + VOICE MAIL Series from 3400 bps modem to data compression 57600 bps fax/modem and voicemail...over 30 models...more than meets the eye — Amagic Technologies, Inc., 17742-B Mitchell ★ Irvine, CA 92714 ★ USA
Tel: 714-474-3976 Fax: 714-474-3979
Also welcome to request 3D Hologram Information...from mfg to end products

Inquiry 718.

VOICE PROCESSING

VOICE/FAX MAIL KITS
BigmOuth single line $169.00
Add a Fax-on-demand system for only $199.95
AllAnder multi-line voice mail features:
Guest Mail Boxes, Fax-on-Demand, Audiotext, Unlimited Mail Boxes, Auto Attendant, Call Screening/queue/transfer, Remote modem access, etc. Only $495.00

COMPU-TEL
86 Marlow Ave., Toronto, Ontario M4J 3V1
(416) 405-0252 Fax (416) 406-0253

Inquiry 719.

WINDOWS

FOREIGN LANGUAGES
Arabic, Hebrew, Russian, Chinese, Japanese, Indian, S.E. Asian — all the world's languages in Windows. Full support for mixing Arabic, Peranakan, Urdu, Hebrew + English. Chinese and Japanese type vertically/horizontally. Easy to use. From $149.95. Call or write the Win-Language experts!

Gamma Productions, Inc.
Tel 310-394-8622 Fax 310-395-4214
710 Wilshire Blvd, #909, Santa Monica, CA 90401

Inquiry 720.
<table>
<thead>
<tr>
<th>Inquiry No.</th>
<th>Page No.</th>
<th>Phone No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>61-62</td>
<td>510-850-3008</td>
</tr>
<tr>
<td></td>
<td>300-301</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>320-321</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>322-323</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>324-325</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>326-327</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>328-329</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>330-331</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>332-333</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>334-335</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>336-337</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>338-339</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>340-341</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>342-343</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>344-345</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>346-347</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>348-349</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>350-351</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>352-353</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>354-355</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>356-357</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>358-359</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>360-361</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>362-363</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>364-365</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>366-367</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>368-369</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>370-371</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>372-373</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>374-375</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>376-377</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>378-379</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>380-381</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>382-383</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>384-385</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>386-387</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>388-389</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>390-391</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>392-393</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>394-395</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>396-397</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>398-399</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>400-401</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>402-403</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>404-405</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>406-407</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>408-409</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>410-411</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>412-413</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>414-415</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>416-417</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>418-419</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>420-421</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>422-423</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>424-425</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>426-427</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>428-429</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>430-431</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>432-433</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>434-435</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>436-437</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>438-439</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>440-441</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>442-443</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>444-445</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>446-447</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>448-449</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>450-451</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>452-453</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>454-455</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>456-457</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>458-459</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>460-461</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>462-463</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>464-465</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>466-467</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>468-469</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>470-471</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>472-473</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>474-475</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>476-477</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>478-479</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>480-481</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>482-483</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>484-485</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>486-487</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>488-489</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>490-491</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>492-493</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>494-495</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>496-497</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>498-499</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>500-501</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>502-503</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>504-505</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>506-507</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>508-509</td>
<td>212-340-6300</td>
</tr>
<tr>
<td></td>
<td>510-511</td>
<td>212-340-6300</td>
</tr>
</tbody>
</table>

**YOUR DIRECT LINK**

**ADVERTISER CONTACT INFORMATION**

To order products or request FREE information, call advertisers directly or send in the Direct Link Card by mail or fax. Let them know you saw it in BYTE.
For FREE product information from individual advertisers, circle the corresponding inquiry numbers on Your Direct Link Card!
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1320</td>
<td>242</td>
<td>1397</td>
<td>486-3</td>
<td>1362</td>
<td>486-3</td>
<td>1274</td>
<td>94</td>
</tr>
<tr>
<td>Acousticus</td>
<td></td>
<td>AciSoft</td>
<td></td>
<td>Amana</td>
<td></td>
<td>MIT</td>
<td></td>
</tr>
<tr>
<td>System</td>
<td></td>
<td>Analysis</td>
<td></td>
<td>Technology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Research</td>
<td></td>
<td>Systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Development</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1470</td>
<td>242</td>
<td>1453</td>
<td>486-3</td>
<td>1311</td>
<td>221</td>
<td>1278</td>
<td>94</td>
</tr>
<tr>
<td>ActiveCom</td>
<td></td>
<td>Acquire</td>
<td></td>
<td>Abacus</td>
<td></td>
<td>Abacus</td>
<td></td>
</tr>
<tr>
<td>Systems</td>
<td></td>
<td>Database</td>
<td></td>
<td>Technology</td>
<td></td>
<td>Technology</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Software</td>
<td></td>
<td>Systems</td>
<td></td>
<td>Systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1456</td>
<td>242</td>
<td>1446</td>
<td>486-3</td>
<td>1308</td>
<td>242</td>
<td>1303</td>
<td>94</td>
</tr>
<tr>
<td>ALC</td>
<td></td>
<td>Adcom</td>
<td></td>
<td>ActiveMedia</td>
<td></td>
<td>ACAM</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CD</td>
<td></td>
<td>Technology</td>
<td></td>
<td>Technology</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1318</td>
<td>242</td>
<td>1302</td>
<td>486-3</td>
<td>1268</td>
<td>486-3</td>
<td>1279</td>
<td>94</td>
</tr>
<tr>
<td>Aikon</td>
<td></td>
<td>AimSoft</td>
<td></td>
<td>Adobe</td>
<td></td>
<td>Adobe</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Analytics</td>
<td></td>
<td>Systems</td>
<td></td>
<td>Systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1470</td>
<td>242</td>
<td>1443</td>
<td>486-3</td>
<td>1315</td>
<td>486-3</td>
<td>1305</td>
<td>94</td>
</tr>
<tr>
<td>Alcatel</td>
<td></td>
<td>AIM</td>
<td></td>
<td>Alcatel</td>
<td></td>
<td>AIM</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Technology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1437</td>
<td>242</td>
<td>1437</td>
<td>486-3</td>
<td>1303</td>
<td>486-3</td>
<td>1301</td>
<td>94</td>
</tr>
<tr>
<td>Alcor</td>
<td></td>
<td>Amazon</td>
<td></td>
<td>Adobe</td>
<td></td>
<td>Adobe</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>System</td>
<td></td>
<td>System</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1482</td>
<td>242</td>
<td>1486</td>
<td>486-3</td>
<td>1280</td>
<td>242</td>
<td>1288</td>
<td>94</td>
</tr>
<tr>
<td>Altec</td>
<td></td>
<td>Anaren</td>
<td></td>
<td>Atlantix</td>
<td></td>
<td>Advanced</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Software</td>
<td></td>
<td>Technologies</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1391</td>
<td>242</td>
<td>1324</td>
<td>486-3</td>
<td>1258</td>
<td>94</td>
<td>1277</td>
<td>94</td>
</tr>
<tr>
<td>Alvis Technologies</td>
<td>242</td>
<td></td>
<td></td>
<td>Acer</td>
<td>486-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Amdahl</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1455</td>
<td>242</td>
<td>1439</td>
<td>486-3</td>
<td>1269</td>
<td>94</td>
<td>1304</td>
<td>94</td>
</tr>
<tr>
<td>Altus</td>
<td></td>
<td>Apogee</td>
<td></td>
<td>AMD</td>
<td></td>
<td>AMD</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Technology</td>
<td></td>
<td>Technology</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1324</td>
<td>242</td>
<td>1326</td>
<td>486-3</td>
<td>1280</td>
<td>242</td>
<td>1306</td>
<td>94</td>
</tr>
<tr>
<td>America</td>
<td></td>
<td>Apple</td>
<td></td>
<td>Advanced</td>
<td></td>
<td>Advanced</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Technologies</td>
<td></td>
<td>Technologies</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1305</td>
<td>242</td>
<td>1477</td>
<td>486-3</td>
<td>1268</td>
<td>486-3</td>
<td>1291</td>
<td>94</td>
</tr>
<tr>
<td>AmericaOn</td>
<td></td>
<td>Apple</td>
<td></td>
<td>Advantech</td>
<td></td>
<td>Advantech</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Technology</td>
<td></td>
<td>Technology</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1317</td>
<td>242</td>
<td>1451</td>
<td>486-3</td>
<td>1305</td>
<td>486-3</td>
<td>1302</td>
<td>94</td>
</tr>
<tr>
<td>Americas</td>
<td></td>
<td>Anumen</td>
<td></td>
<td>Ableton</td>
<td></td>
<td>Ableton</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Speech</td>
<td></td>
<td>Speech</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1309</td>
<td>242</td>
<td>1453</td>
<td>486-3</td>
<td>1291</td>
<td>486-3</td>
<td>1301</td>
<td>94</td>
</tr>
<tr>
<td>AmericaOn</td>
<td></td>
<td>Anumen</td>
<td></td>
<td>AII5</td>
<td></td>
<td>AII5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Software</td>
<td></td>
<td>Software</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1458</td>
<td>242</td>
<td>1445</td>
<td>486-3</td>
<td>1298</td>
<td>486-3</td>
<td>1301</td>
<td>94</td>
</tr>
<tr>
<td>Americas</td>
<td></td>
<td>Anumen</td>
<td></td>
<td>AII5</td>
<td></td>
<td>AII5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Software</td>
<td></td>
<td>Software</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1310</td>
<td>242</td>
<td>1447</td>
<td>486-3</td>
<td>1258</td>
<td>94</td>
<td>1301</td>
<td>94</td>
</tr>
<tr>
<td>AmericaOn</td>
<td></td>
<td>Anumen</td>
<td></td>
<td>AMD</td>
<td></td>
<td>AMD</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Technology</td>
<td></td>
<td>Technology</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1450</td>
<td>242</td>
<td>1455</td>
<td>486-3</td>
<td>1268</td>
<td>486-3</td>
<td>1292</td>
<td>94</td>
</tr>
<tr>
<td>AmericaOn</td>
<td></td>
<td>Anumen</td>
<td></td>
<td>Advanced</td>
<td></td>
<td>Advanced</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Technologies</td>
<td></td>
<td>Technologies</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1309</td>
<td>242</td>
<td>1449</td>
<td>486-3</td>
<td>1268</td>
<td>486-3</td>
<td>1292</td>
<td>94</td>
</tr>
<tr>
<td>Americas</td>
<td></td>
<td>Anumen</td>
<td></td>
<td>Advantech</td>
<td></td>
<td>Advantech</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Technology</td>
<td></td>
<td>Technology</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1308</td>
<td>242</td>
<td>1450</td>
<td>486-3</td>
<td>1292</td>
<td>486-3</td>
<td>1301</td>
<td>94</td>
</tr>
<tr>
<td>Americas</td>
<td></td>
<td>Anumen</td>
<td></td>
<td>Advanced</td>
<td></td>
<td>Advanced</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Technologies</td>
<td></td>
<td>Technologies</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For more information on any of the companies covered in articles, columns, or news stories in this issue, circle the appropriate inquiry number on Your Direct Link Card. Each page number refers to the first page of the article or section in which the company name appears. IS pages appear only in the International edition.
BIX: Your Coach to the Internet!

Give BIX a try with our new 5 for Free Offer! Join BIX today and get 5 hours of evening and weekend access for free! Take the rest of the calendar month to explore BIX, and then continue for our standard $13 monthly membership fee. Further details and complete rate information are provided during registration. Using any communications program, dial 1-800-695-4882. At the "logon" prompt enter bix. Then at the "name?" prompt enter bix.bytes39. If you have any questions, call us at 1-800-695-4775 (voice). Or fax us at 617-491-6642. Send Internet mail to info@bix.com. Windows users can order BIXnav, our graphical interface for BIX, for easy point and click access. Details are available during registration.

The Internet connects you with more than 10 million people at universities, companies, and other online services. Now, get full access to the Internet free of charge when you subscribe to BIX! You'll also get expert assistance from BIX moderators who can help you find your way around the Internet.

These experts can guide you through the many services and features available, and help you find the information you're looking for. Anytime you need help, just join our special 'internet' conference and get fast answers to your questions.

As you become more familiar with the Internet, you'll be able to download files from all over the world using FTP, connect to other sites and services through telnet, read and reply to Usenet Newsgroups, access utilities like finger and whois, and much more! BIX and the Internet together provide the largest and most effective technical resource for computing professionals.

And with over 600 local access numbers in the U.S., plus telnet access via the Internet, BIX makes it easy to connect. Try BIX today through our special 5 for Free offer - and become part of the top technical team!

BIX
If you can hack it

Under the 5 for Free plan, daytime rates ($9/hr) apply for access during prime time hours. The 5 for Free offer is valid for first-time members only.
Installer Hell

Designed to help users, auto-installers often wreak havoc behind the scene

Open your mouth and close your eyes,” goes the children’s rhyme, “and I’ll give you something to make you wise.” The unsuspecting child then gets a mouthful of dirt. We usually learn this particular bit of wisdom around the age of five, and it’s a lesson we don’t forget. Never again will we stand passively with our mouths gaping and our eyes closed.

Never, that is, until we buy a computer. Modern computer users face this childhood trick in its bland adult form: “Insert Disk 1 and Run the Installer.” Dutifully, we do as we are told, swapping disks and hoping for the best. We have no choice these days; nearly all software vendors deliver their applications with installers. Vendors say installers are necessary because programs are more complicated. Large applications may require dozens of separate files to be located at specific places on the disk.

Furthermore, we are told, a new generation of computer users doesn’t know much about the workings of the computer and doesn’t want to learn. These users require automatic installation. Fair enough. But the method that assists naive users assists lazy vendors, too. And we learn the consequences.

My niece calls me up. She’s 10. “My computer crashed.” “What happened?” “I installed something called Computer Fun Disk.” “Is it compatible with your operating system?” “It doesn’t say.” “What’d it do?” “I don’t know. I just followed the directions.”

Before we were done, she had to reformat her hard drive and reinstall her system and all her files. There wasn’t any choice, because we had no way to know what the installer did, what files it placed, or where.

Or: My DOS portable has a relatively small hard drive. I’d like to dump files I don’t need. I just installed an update of my word processor, and when I look at the directory, I see what look like all sorts of drivers and converters. I’m sure I don’t need them all. But which can I safely discard? Good luck. There’s no documentation. Those files in my directory might as well be Mayan hieroglyphs.

Or: I’ve got my PowerBook while I’m on vacation, and I want to call my office and transfer files. But I can’t connect, and a call to Apple doesn’t help. It turns out that a file called Serial Port Arbitrator is necessary. I dumped it because I have only one port on this machine, so what’s to arbitrate? Wrong. Reinstall, dummy.

When I reinstall, I get 25 drivers for modems that I don’t have in my system. But am I going to take the drivers out? Not on your life. Because now I understand the modern rule of computers: Don’t touch anything.

At one time, in the early days of personal computers, a friend proudly showed me his method of booting, driven by a batch file he’d gotten from a friend. It turned out he was loading his word processor, quitting it to install a keystroke macro, and reloading his word processor again. Watching him, I realized I was seeing superstitious behavior in a college graduate. My friend had no idea what he was doing—he was just blindly following directions, like one of those Skinnerian pigeons that walk in a semicircle while waiting for the food to drop from the bin.

My friend’s case was extreme, and his batch file easy enough to fix. But these days, undocumented, obligatory installation programs turn us all into superstitious pigeons. For those who have lived through the evolution of computers, this is an ironic outcome. The early promise of personal computers was freedom and knowledge, not mysterious machines that we couldn’t understand. Particularly with Apple computers, the interface guidelines were meant to enable users to understand what their machines were doing.

But all that is gone. Now we must install. What does the installer-driven future hold? Increasingly passive users, increasingly lazy vendors, and much bigger hard drives to hold the accumulated junk. More inexplicable crashes. More undocumented incompatibilities. More time on the phone with vendors and dealers. More time on-line with other users, trying to figure out what is going on. In short, installer hell.

What’s the solution? It’s simple: Make obligatory installers a thing of the past. They’re fine for naive users. But every application should also come with adequate instructions to enable you to install manually. This should include a detailed list of what all those files are, what they do, and where they go. There should also be a clear list of minimum system requirements.

Anything less is treating you like a child. A dumb child.

Michael Crichton is the author of such best-sellers as Jurassic Park and Rising Sun. You can reach him on bbs c/o “Editors.”
THE GATEWAY TO THE HOTTEST PC TECHNOLOGY ISN'T GATEWAY.
DELL DIMENSION™ 486/33
1486™ DX 33MHz SYSTEM
$1,799†
• BUSINESS LEASE: $67/MO.
• 4MB RAM
• 64MB MAX RAM
• 230MB (17ms) HARD DRIVE
• UPGRADEABLE PROCESSOR
• 6 16-BIT ISA EXPANSION SLOTS AVAILABLE
• ACCELERATED LOCAL BUS VIDEO
• ULTRASCAN 14C MONITOR
(14", 1024 x 768, .28mm, Ni)
• COMBO DISKETTE DRIVE (3.5" AND 5.25")
• 101-KEY KEYBOARD
• MS-DOS® 6.0/MICROSOFT® WINDOWS™ 3.1/MOUSE
† Promotional price expires 9/30/93.

DELL DIMENSION XPS 450V
1486 DX2 50MHz SYSTEM
$2,199†
• BUSINESS LEASE: $71/MO.
• 8MB RAM
• 64MB MAX RAM
• 230MB (17ms) HARD DRIVE
• 128KB EXTERNAL CACHE
• UPGRADEABLE TO PENTIUM™ OVERDRIVE™
• 6 16-BIT ISA EXPANSION SLOTS AVAILABLE,
1 ON VL-BUS
• VL #9GXE VIDEO CARD
• 1MB VIDEO RAM
• ULTRASCAN 15FS MONITOR
(15", 1024 x 768, .28mm, Ni)
• ONE DISKETTE DRIVE
• 101-KEY KEYBOARD
• MS-DOS 6.0/MICROSOFT WINDOWS
3.1/MOUSE

DELL DIMENSION XPS 450V
1486 DX2 50MHz SYSTEM
$2,498†
• BUSINESS LEASE: $81/MO.
• 8MB RAM
• 64MB MAX RAM
• 340MB (17ms) HARD DRIVE
• 128KB EXTERNAL CACHE
• UPGRADEABLE TO PENTIUM OVERDRIVE™
• 6 16-BIT ISA EXPANSION SLOTS AVAILABLE,
1 ON VL-BUS
• VL #9GXE VIDEO CARD
• 1MB VIDEO RAM
• ULTRASCAN 15FS MONITOR
(15", 1024 x 768, .28mm, Ni)
• ONE DISKETTE DRIVE
• 101-KEY KEYBOARD
• MULTI-SESSION, DOUBLE-SPIIN CD ROM DRIVE
• MS-DOS 6.0/MICROSOFT WINDOWS
3.1/MOUSE

Now that you’ve witnessed the sheer technological superiority Dell wields over Gateway, there are only two decisions you have left to make.

Which Dell Dimension XPS PC is right for you?
And what kind of software would you like to go with it? Whatever it is, we can help out.
That’s right. You can order your software at the same time you order your Dell Dimension XPS. That way, you’ll be up and running right out of the box.

Purchase your favorite combination from 100 of the most popular and competitively priced DOS and Windows applications and have them pre-loaded onto your machine for one low $15 installation fee.

And should you ever want to add a peripheral, upgrade a software package
or order a new application, we can help you there too. With DellWare, a selection of over 2,400 software and peripheral items that you can order direct from us at discount prices. And if you want your DellWare selections in a real hurry, we'll ship your order to you overnight for only $5 extra. For no charge at all, we'll send you a free DellWare catalog. Packed full of software and peripheral products for you to choose from.

And when your catalog arrives, you can spend a leisurely afternoon looking at some more techie goodies that Gateway doesn't have to offer you.

TO ORDER, CALL
800-365-9977
HOURS: MON-FRI 7AM-9PM CT SAT 10AM-6PM CT SUN 12PM-5PM CT
IN CANADA CALL 800-668-3021. PLEASE REFERENCE #11EAD
THE FASTEST VIDEO ON PLANET EARTH.

Super fast double-spin CD ROM drive.
450MB local bus IDE hard drive.
Five available expansion slots that let the 466V Ultimate expand to meet your wildest ambitions.

For just $199 you can add two amplified, full-powered Labtec CS550 stereo speakers and a 16-bit Soundblaster stereo CD-quality sound card to your Dell Dimension XPS 466V Ultimate.

The Viper board is available as an upgrade from Gateway, but the Dell Dimension XPS 466V Ultimate certainly is not.

If you’ve been bitten by the speed bug, sink your teeth into our Dell Dimension™ XPS 466V Ultimate. A blistering fast 486 rocket.

Featuring the Diamond Viper VL video board configured with 2MB video RAM, (the fastest PC graphics accelerator board on planet Earth) this speed demon is the perfect solution for color publishing, multimedia and high-end graphics applications.

Thanks to the Viper, the 466V Ultimate features a virtually flicker-free display at all resolutions. You can work with a palette of up to 16 million brilliant colors. For added speed and performance, the Viper comes with its own turbo drivers to drive all of your Windows™ 3.1 applications even faster. Oh and before we forget, the Viper has 2 megabytes of its own VRAM for the kind of face-warping acceleration that leaves others blinking in the dust.

The 466V Ultimate comes fully decked out. With 16MB of RAM upgradeable to 64MB. A 450MB local bus IDE hard drive. High speed 256KB static RAM external cache. Five available 16-bit expansion slots — one of which can support an additional high-speed VL device. A 15-inch UltraScan™ 15PS non-interlaced monitor with 1024 x 768 pixel display. One internal diskette drive. Our double-spin CD ROM drive. Configured with MS-DOS® 6.0, Windows 3.1 and of course, a mouse.

All for just $3,198 (Business Lease*: $118/MO.). You can order one today from Dell. And get the ultimate in performance.

TO ORDER, CALL
800-245-3519

*Dell assumes no responsibility for face-warping acceleration injuries. **Performance measured by running WinBench version 3.11 at 1024 x 768, 256 colors.