DO YOU NEED MS-DOS 6.0?

APRIL 1993

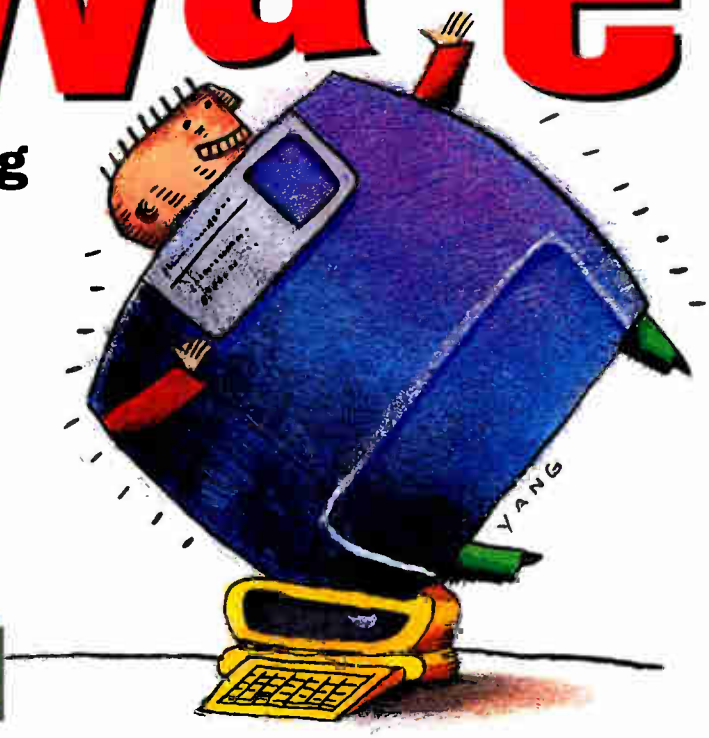
BYTE

THE WORLDWIDE COMPUTING AUTHORITY

Best Little PCs
Page 164

Fighting Fatware

Software keeps getting bigger and bigger, demanding faster PCs and more disk space. Fortunately, there are solutions. Turn to page 98.



SPECIAL REPORT: Page 150

Shrink your data

8 new ways to extend your Mac PowerBook

11550-2125
HEMPSTEAD NY
23 KENSINGTON CT
BILL BURNS
9100 0003373518 FEB94 MIA 7061
|||||||

ombos From Gateway!

HandBook Combo: Two Computer Systems, in Tune with Each Other, for One Low Price!

When you buy a HandBook Combo, you get two PCs for less than you could pay for a single system. Our combo offers include the HandBook, our notebook-palmtop hybrid, and one of Gateway's high-performance, feature-packed desktop systems. The HandBook is the ideal portable PC for most users because it's marvelously compact – just 6 x 10 inches and 2.75 pounds – yet it does everything most people need to do on a portable PC. With its auto-resume feature, access to thousands of available DOS applications is almost instantaneous. You can quickly touch-type a note on its comfortable keyboard, check your schedule on the HandBook's backlit screen, or access 40 megabytes of data instantly, all without waiting to boot-up. When you come back to your office, you can easily connect your HandBook to your desktop. To transfer files back and forth, your HandBook actually functions as a logical drive on your PC. It's a snap! We've included everything and set it all up for you, even MS Works on both computers.

Two computers. Two functions. One low price. Can you dig it? Call Gateway!

World Radio History

Whether You're On The Road Or Playin' A Local Gig...

World Radio History

World Radio History

We've Got The Portable Solution That's In Tune With You!

HandBook Combos—The HandBook is regularly $1295. Buy it with a desktop and save! See our other ad for more detailed desktop features.

HANDBOOK & 4SX-33

HandBook™

- 1MB RAM, 40MB Hard Drive
- Backlit 7.6" 640 x 400 Screen
- 2.75 Lbs., 5.9" x 9.75" x 1.4"
- 4.5-Hr. Battery & AC Pack
- MS-DOS,®InterLink,®MS Works™ for DOS

And 4SX-33 Mini Desktop*

- 486SX-33, 4MB RAM, 170MB Hard Drive
- Windows Accelerated Video w/ 1MB
- 14" Color CrystalScan 1024NI
- 124-Key AnyKey Keyboard, MS Mouse
- MS-DOS, Windows & MS Works for Windows

$2495

HANDBOOK & 4DX-33

HandBook

- 1MB RAM, 40MB Hard Drive
- Backlit 7.6" 640 x 400 Screen
- 2.75 Lbs., 5.9" x 9.75" x 1.4"
- 4.5-Hr. Battery & AC Pack
- MS-DOS,®InterLink,®MS Works™ for DOS

And 4DX-33 Mini Desktop*

- 486DX-33, 8MB RAM, 250MB Hard Drive
- Windows Accelerated Video w/ 1MB
- 14" Color CrystalScan 1024NI
- 124-Key AnyKey Keyboard, MS Mouse
- MS-DOS, Windows & MS Works for Windows

$2995

HANDBOOK & 4DX2-66V

HandBook

- 1MB RAM, 40MB Hard Drive
- Backlit 7.6" 640 x 400 Screen
- 2.75 Lbs., 5.9" x 9.75" x 1.4"
- 4.5-Hr. Battery & AC Pack
- MS-DOS,®InterLink,®MS Works™ for DOS

And 4DX2-66V Desktop*

- 486DX2-66, 8MB RAM, 340MB Hard Drive
- VLB ATI Ultra Pro with 1MB VRAM
- 15" Color CrystalScan 1572FS
- 124-Key AnyKey Keyboard, MS Mouse
- MS-DOS, Windows & MS Works for Windows

$3995

Nomad 486 Notebooks and Combos—The performance of a desktop in a lightweight, full-featured portable!

NOMAD 425SXL

- 25MHz 486SX Intel® Processor*
- 4MB RAM
- 3.5" Diskette Drive
- 80MB IDE Hard Drive
- Backlit 10" VGA Screen, 64 Grays
- Simultaneous Video with 256K
- Size 8.5" x 11" x 1.8", 5.6 Lbs.
- 6-Hr. NiCad Battery & AC Pack
- 2400bps Fax/Modem
- 1 Parallel/1 Serial Port
- 79-Key Keyboard & FieldMouse™
- MS-DOS 5.0 and Windows 3.1
- MS Works for Windows 2.0

$1995

NOMAD 425DXL

- 25MHz 486DX Intel Processor*
- 4MB RAM
- 3.5" Diskette Drive
- 120MB IDE Hard Drive
- Backlit 10" VGA Screen, 64 Grays
- Simultaneous Video with 1MB
- Size 8.5" x 11" x 1.8", 5.6 Lbs.
- 6-Hr. NiCad Battery & AC Pack
- 2400bps Fax/Modem
- 1 Parallel/1 Serial Port
- 79-Key Keyboard & FieldMouse
- MS-DOS 5.0 and Windows 3.1
- MS Works for Windows 2.0

$2495

NOMAD 450DXL

- 50MHz 486DX2 Intel Processor*
- 8MB RAM
- 3.5" Diskette Drive
- 200MB IDE Hard Drive
- Backlit 10" VGA Screen, 64 Grays
- Simultaneous Video with 1MB
- Size 8.5" x 11" x 1.8", 5.6 Lbs.
- 6-Hr. NiCad Battery & AC Pack
- 1 Parallel/1 Serial Port
- 79-Key Keyboard & FieldMouse
- MS-DOS 5.0 and Windows 3.1
- MS Works for Windows 2.0

$2995

NOMAD 425SXL COMBO

- Nomad 425SXL*
- 15" Color CrystalScan 1572FS
- 124-Key AnyKey Keyboard
- Microsoft Mouse

$2495

NOMAD 425DXL COMBO

- Nomad 425DXL*
- 15" Color CrystalScan 1572FS
- 124-Key AnyKey Keyboard
- Microsoft Mouse

$2995

NOMAD 450DXL COMBO

- Nomad 450DXL*
- 15" Color CrystalScan 1572FS
- 124-Key AnyKey Keyboard
- Microsoft Mouse

$3495

Every Gateway 2000 system is backed by:
■ 30-Day Money-Back Guarantee ■ One-Year Limited Warranty ■ Lifetime Toll-Free Technical Support
■ On-Site Service Available to Most Locations (Factory Service Only for Notebooks)
■ Lifetime BBS Membership

intel inside

*Contains an Intel486™ microprocessor

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 • 605-232-2000 • Fax 605-232-2023
Sales Hours: 7am-10pm Weekdays, 9am-4pm Saturdays (CT)

©1993 Gateway 2000, Inc. All prices and configurations are subject to change without notice. Handbook, AnyKey, FieldMouse, CrystalScan and TelePath are trademarks of Gateway 2000, Inc. The Intel Inside Logo is a trademark and Intel is a registered trademark of Intel Corporation. All other brands and product names are trademarks or registered trademarks of their respective companies.

World Radio History

Circle 162 on Inquiry Card.

World Radio History

So Powerful It Can't Be A PC.

Transform Your PC With The INTERACTIVE UNIX System.

Unleash the 32-bit power in your PC with the INTERACTIVE™ UNIX® System from SunSoft. Charge through applications at record speeds. Use real-world multitasking and networking. Get on the path to a distributed computing future.

Just Say No To SCO.

Why? The INTERACTIVE UNIX System is easy to use, simple to administer, all at a great price.

*Open Systems Today** says the INTERACTIVE UNIX "system management...is easier to use and more comprehensive" than SCO™ and "is simply a masterpiece of good design."

Looking Glass Professional™ desktop manager makes the INTERACTIVE UNIX System easy enough for novices, yet powerful enough for experienced UNIX users. And the award winning Easy Windows makes setting up graphic environments infinitely simpler.

You can't afford *not* to take advantage of the already low cost of the INTERACTIVE UNIX System.

And SCO UNIX/XENIX® users can save an additional 50% by switching to the INTERACTIVE UNIX System today. That's something to say yes to.

Everything You Like About Your PC—And A Lot More.

INTERACTIVE UNIX System V/386 Release 3.2 supports hundreds of the most popular Intel-based platforms and peripherals. So getting started is fast, easy, and cost-effective.

Thousands of UNIX and XENIX applications are at your command. And our VP/ix package runs virtually all DOS software. You get Lotus®, WordPerfect®, and Oracle®. You get SCO applications. You get it all.

See What Develops.

The INTERACTIVE UNIX System is the environment of choice for 80X86 application development. You get access to a full range of development tools including compilers, debuggers and libraries. And for graphical applications, the X11 INTERACTIVE environment is a revelation.

Partner With Power.

The INTERACTIVE UNIX System is a powerful business partner for companies who know something about power. Companies like BMW, Goodyear, Leica, and Dunlop to name a few. That power can be yours, too. All from SunSoft, the leading supplier of 32-bit UNIX system software.

Call today and save 50% on UNIX power that's so cost-effective, it can't be anything *but* a PC. 1-800-227-9227.

SunSoft
A Sun Microsystems, Inc. Business

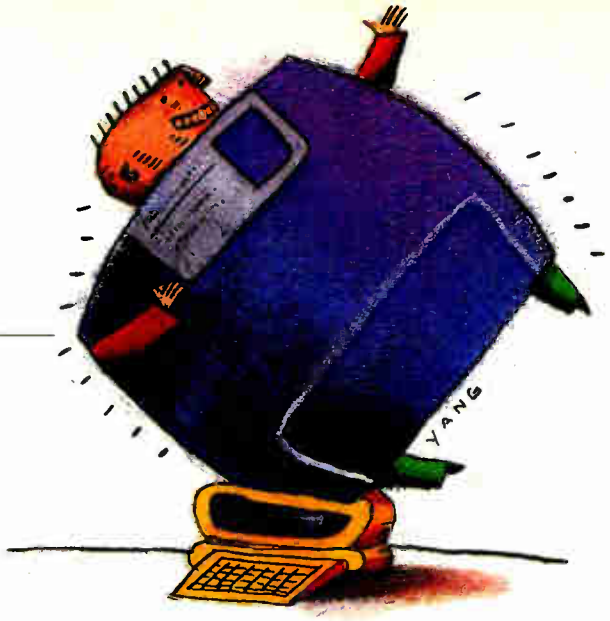
*Issue date: April 13, 1992 ©1992 Sun Microsystems, Inc. Sun, Sun Microsystems, the Sun logo, SunSoft, the SunSoft Logo, VP/ix and Easy Windows are trademarks or registered trademarks of Sun Microsystems, Inc. INTERACTIVE is a trademark of INTERACTIVE Systems Corporation. UNIX is a registered trademark of UNIX System Laboratories, Inc. Looking Glass Professional is a trademark of Visix Software, Inc. All other trademarks and registered trademarks are the properties of their respective holders. The promotional discount is available to SCO UNIX/XENIX users and is subject to certain restrictions. Contact SunSoft for terms and conditions of promotion. SunSoft reserves the right to stop the promotion at any time. SunSoft can be reached at 2550 Garcia Avenue, Mountain View, CA 94043, (510) 460-3267.

B-4/93

World Radio History

BYTE

April 1993 *Volume 18, Number 4*



COVER STORY

FEATURE

Fighting Fatware

PAGE 98

NEWS

28 **MICROBYTES**
Tandy and Casio stand poised to compete with Apple's Newton PDA.

41 **REPORT FROM CROATIA**
Recovery Through Technology
by Neven Prasnikar
Technology helps a troubled country rebound.

44 **FIRST IMPRESSIONS**
Easy Does It with MS-DOS 6.0
by Jon Udell
Microsoft adds compression and memory management to the venerable operating system.

49 **Photoshop Now Does Windows**
by Tom Yager
Version 2.5 is new for Windows and improved for the Mac.

55 **Stylus 800,** Epson is back in the ink-jet business

Encarta, a multimedia CD-ROM encyclopedia worth exploring

microWriter, Texas Instruments' low-cost laser printer

AudioMan, an easy and inexpensive approach to Windows sound

62 **WHAT'S NEW**
The Dauphin 5500 Color Pentop flips its display, the Pocket Faxxer sends paperless faxes, ParaSet helps you develop and maintain software, and more.

FEATURES

98 **Fighting Fatware**
by Ed Perratore, Tom Thompson, Jon Udell, and Rich Malloy
Bloated software slows you down, but help is on the way.

111 **Putting Fuzzy Logic into Focus**
by Janet J. Barron
Fuzzy-logic applications arrive on the desktop.

JAPANESE LEADERS IN FUZZY LOGIC
by Jeffrey D. Shepard

STATE OF THE ART

VISUALIZATION

120 **Overview: Visualization: Seeing Is Believing**
by Jack Weber
Visualization lets you see the meaning of numeric data.

VISUALIZATION APPLICATIONS
by Maxine D. Brown

129 **Navigating the Data Flood**
by William Ribarsky
Find your way through large data sets visually.

INSIDE MULTIDIMENSIONAL DATA
by Lloyd A. Treinish

137 **Image Building**
by Peter Wayner
A look at the core of modern visualization software.

143 **The Difficulty with Data**
by Nahum Gershon and Jeff Dozier
Visualization requires diverse data types and formats.

148 **Resource Guide: Visualization Software**

COVER IMAGE: JAMES YANG © 1993

World Radio History

REVIEWS

150 **SOLUTIONS FOCUS**
Shrink to Fit
by Rick Grehan and Stan Wszola
The BYTE Lab tests on-the-fly data compressors for Macs and PCs.

164 **Ultraportable PCs: Worth the Trade-offs?** ▷
by Robert E. Calem
Subnotebook or palmtop? BYTE looks at the alternatives.

173 **PowerBook Peripherals**
by Tom Thompson
New hardware makes your Apple notebook more useful.

177 **OS/2's Multimedia Extensions**
by Tom Yager
IBM builds a strong multimedia foundation for OS/2.

179 **Two Ways to Say VL-Bus**
by Raymond GA Côté
Testing two motherboards that mix VL-Bus and EISA.

183 **Teaching Macs to Fetch** *by Stanford Diehl* ▷
Aldus introduces Fetch, a new multiuser, mixed-media database for the Mac.

185 **Macs and Windows PCs Share Control** *by Tom Yager*
Timbuktu for Windows makes cross-platform remote control possible, but it can be slow.

189 **Sun's C Solution for Solaris** *by Benjamin Fried and Othar Hansson*
Sparcworks Professional C is a solid compiler with a few good tools.

191 **A Beefier MKS Toolkit** *by Ben Smith*
MKS Toolkit 4.1 is a bigger and better collection of Unix tools for DOS and OS/2.

193 **Pioneer's Super CD-ROM Drive** *by Howard Eglowstein*
Pioneer's new minichanger can access six CDs at quadruple speed.

HANDS ON

197 **UNDER THE HOOD**
FDDI Speaks
by William Stallings
The FDDI II standard mixes voice and data on a single medium.

201 **SOME ASSEMBLY REQUIRED**
Processing Magic on the Mac
by Raymond GA Côté
How to exploit the System 7 Process Manager in your applications.

210 **SOFTWARE CORNER**
LAN Remote Control
by Barry Nance, Tom Thompson, and Ben Smith
Remote-control programs for NetWare and AppleTalk.

211 **BEYOND DOS**
Simple MAPI Delivers
by Jon Udell
Microsoft's first-release messaging API is easily supported.

215 **ASK BYTE**
Laptop parallel-port problems and creating dynamic arrays.

OPINIONS

81 **USER'S COLUMN**
What's Hot, What's Not
by Jerry Pournelle
Pournelle's annual Orchid and Onion parade arrives.

194 **BOOK AND CD-ROM REVIEWS**
Markets as Virtual Reality
by Hugh Kenner, Raymond GA Côté, Jon Udell, Tom Thompson, and Rob Mitchell
The Death of Money, *Windows 3.1 Insider*, and other titles.

264 **STOP BIT**
The Learning Organization
by Patricia Seybold
Distributed computing won't work unless companies are willing to change.

12 **EDITORIAL**
Fatware Strategies
by Dennis Allen

20 **LETTERS**
The Amiga 3000T-040/200 and 4000-040/120, OS/2 2.0, Braincel defended, and other reader mail.

READER SERVICE
262 Editorial Index by Company
258 Alphabetical Index to Advertisers
260 Index to Advertisers by Product Category
Direct Link Cards: **258A**

217 **BUYER'S GUIDE**
Mail Order
Hardware/Software Showcase
Buyer's Mart

PROGRAM LISTINGS
From BIX: Join "listings/frombyte93" and select the appropriate subarea (i.e., "apr93"). From the UUNET: ftp to ftp.uu.net, log on 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 additional issues in April and October by McGraw-Hill, Inc. U.S. subscriber rate $29.95 per year. In Canada and Mexico, $34.95 per year. European surface mail subscriptions $60, airmail $80. Non-European subscriptions, $60 surface mail or $85 airmail. All foreign subscriptions are payable in U.S. funds that can be drawn on a U.S. bank. Single copies $3.50 in the U.S., $4.50 in Canada. Executive, Editorial, Circulation, and Advertising Offices: One Phoenix Mill Lane, Peterborough, NH 03458. Second-class postage paid at Peterborough, NH, and additional mailing offices. Postage paid at Winnipeg, Manitoba. Registration number 9321. Registered 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.

INSIDE BYTE

PAGE 8

COVER CORNER PHOTOGRAPHY: SCOTT PARKER / AVIS PHOTOGRAPHY © 1993

World Radio History

TWIN

THE FIRST OPTICAL HARD DRIVE

"It has a 19-millisecond access time and outperformed every other device we tested here. . ."

Stanley Wszola
Byte

"... the PMO-650 delivers unparalleled performance. . ."

John Quain
PC Magazine

TYPE: 3.5" OPTICAL
CAPACITY: 128 MB
SIZE: [illegible] x 2.7" (W) x 5.3" (D)
WEIGHT: [illegible] LBS
MOUNTING: VERTICAL OR HORIZONTAL

First you bought a 40MB hard drive, then an 80MB, stepped up to a 150MB, made the move to a 300MB, and took out a loan to buy a 600MB. It never ends - until today.

Introducing the first line of optical drives that are lightning fast and have a hard-disk capacity. The PMO-150™ and PMO-650™ are the world's fastest and so formed such performance that models out most magnetic hard drives.

OPTICAL VS. HARD DISK

Drive Tested	Pinnacle PMO-650™	Seagate® ST4766N 630MB	Fujitsu M2266SA 1.2GB	Maxtor® XT-8760SH 676MB
	ELAPSED TIME IN SECONDS			
Xcopy 20MB Tree to Optical Drive	135.3	210.6	165.5	178.9
Xcopy 50MB Tree to Optical Drive	379.5	496.8	375.1	428.7

NATIONAL SOFTWARE TESTING LABORATORIES, INC.

OPTICAL VS. OPTICAL

Drive Tested	Pinnacle PMO-650™	Sony® SMO-E502	Maxoptix Tahiti™ II	Hewlett-Packard Corsair™	Ricoh RO-5031E
	ELAPSED TIME IN SECONDS				
Xcopy 20MB Tree to Optical Drive	135.3	506.5	440.6	198.1	477.5
Xcopy 50MB Tree to Optical Drive	379.5	1241.2	1047.9	492.7	1134.8

NATIONAL SOFTWARE TESTING LABORATORIES, INC.

[illegible] Trademarks and registered marks to their respective owners. [illegible] results [illegible] survey [illegible]

[illegible] Technology [illegible] Fax [illegible]

World Radio History

PEAKS

THE LAST DRIVE YOU'LL NEED.

"... the PMO-650 was a veritable rocket."

Christopher Stetson
PC Week

"The PMO-650 is the first rewritable optical drive we've ever tested that can get out and run neck and neck with hard disks"

Rex Farrance
PC World

TYPE 5.25 OPTICAL
CAPACITY 650/600 MB
SIZE 7.3 (H) x 3.5 (W) x 10.0 (D)
EIGHT 7.4 LBS
COUNTING VERTICAL OR HORIZONTAL

Optical technology has many advantages—removability, reliability, infinite storage capacity and a lower cost per megabyte over magnetic media. The PMO™ series are based on Pinnacle's own OTD™ (Optical Hard Drive) technology making Pinnacle the leader in performance and innovation. There is no higher source in the industry. The PMO-150™ and PMO-650™ are the Twin Peaks. Plug-in-play for PC and compatibles, PS/2, MAC, SUN HP, DEC, and Silicon Graphics. It's more than a product—it's an all!

COST PER MEGABYTE COMPARISON

Drive Type	Retail Price	2 Disks	5 Disks	10 Disks	50 Disks
PMO-650 Optical Drive (1 Disk)	$ 4,394	$ 4,593	$ 5,190	$ 6,185	$ 14,145
Magnetic Hard Drive (650 MB)	$ 3,594	$ 6,793	$ 16,390	$ 32,385	$ 160,345

(800) 553-7070

THE OPTICAL STORAGE COMPANY™

Circle 120 on inquiry Card (AF 3 UPPS 121)

World Radio History

INSIDE BYTE

BYTE Topic Index

This index helps you find articles that contain information on each of the listed topics. (The topic list changes each month.) Combined with the table of contents (page 4) and the Editorial Index by Company (page 262), you can identify articles by type, subject, title, author, product discussed, or company mentioned.

ADD-INS 62
ALPHA CHIP 28
AMIGA 20
APPLETALK 173
APPLICATIONS 98
AUDIO 55
AWARDS 81
BOOKS 194
C, C++ 28, 62, 189
CD-ROM 55, 81, 193, 194
COMPRESSION 150
CONNECTIVITY 62
CROATIA 41
DATABASES 183
DESKTOP PUBLISHING 49
DEVELOPMENT 189
ETHERNET 173
FAX 62
FDDI 197
FIBER OPTICS 197
FUZZY LOGIC 194
GRAPHICS 49, 183
INK-JET 55
IPC (INTERPROCESS COMMUNICATIONS) 201
LOCAL BUS 179
LOCALTALK 173
MACINTOSH 173, 201
MAPI 211
MODEMS 215
MOTHERBOARDS 179
MS-DOS 44
MULTIMEDIA 55, 177, 183
MULTIPLATFORM 185
NETWORKS 191, 197, 210
NEURAL NETWORKS 20
OLE 55
OPERATING SYSTEMS 44
OS/2 20, 28, 177
PALMTOPS 164
PERIPHERALS 193
PORTABLES/NOTEBOOKS/LAPTOPS 28, 62, 164, 173, 215
POSTSCRIPT 55
PRINTERS 55
PROGRAMMING 111, 201, 210, 215
REMOTE CONTROL 185
SCSI 62, 173
SHAREWARE 210
SHELLS 177
SOFTWARE 62, 98, 137, 150, 177, 183, 185, 189
SOUND 55
STORAGE 193
SYSTEMS 62, 164
UNIX 62, 191
UTILITIES 191
VESA 62, 179
VIRTUAL REALITY 194
VISUALIZATION 120, 129, 137, 143, 148
WINDOWS 28, 55, 81, 185, 194, 211
X WINDOW SYSTEM 189

GREAT THINGS COME IN SMALL PACKAGES

This powerful print server can tackle your biggest network printing problems

- Connects any parallel printer directly to your Ethernet LAN
- Fully Novell Netware 286 and 386 compatible
- Can attach to 8 file servers simultaneously
- Fast and easy to install
- Combines high-speed printing and exceptional printer control
- Supports encrypted passwords, forms, notify, cancel, and others
- Full one-year warranty and unlimited free technical support
- Made in the U.S.A.

Make the Rose Connection

ROSE ELECTRONICS

10850 Wilcrest Drive • Houston, Texas 77099 • Phone (713)933-7673 • Fax (713)933-0044

1-800-333-9343

Circle 128 on Inquiry Card.

World Radio History

COMPUTER LANGUAGE PRODUCTIVITY AWARD 1991

We slash interface development time across DOS, UNIX, POSIX, VMS...

(and we can prove it!)

C-Programmers: See for yourself how Vermont Views™ can help you create powerful user interfaces—whatever your environment!

If you want to create sophisticated user interfaces—and save *tremendous* time and effort doing it—Vermont Views is exactly what you need.

Vermont Views isn't just a common interface package. It's a deep, flexible, menu-driven screen designer supported by a C library of over 580 functions. It lets you create the ultimate user interfaces for complex database applications—in a fraction of the time it would take to code them yourself!

With Vermont Views, you create screens *interactively*. Designing is fast, and creative. And changes—both tiny adjustments and huge reworks—are incredibly easy.

Pull-down menus, window-based data-entry forms with tickertape or memo fields, scrollable form regions, choice lists, context-sensitive help...All these interface objects (and more) are immediately accessible. And with Vermont Views, even terminal-based applications can have the elegant features usually found only on micros.

©Copyright 1991
Vermont Creative Software

Fast prototypes, faster applications.

With most systems, you have to throw away your prototypes when coding begins. But with Vermont Views, *prototypes become the actual applications!*

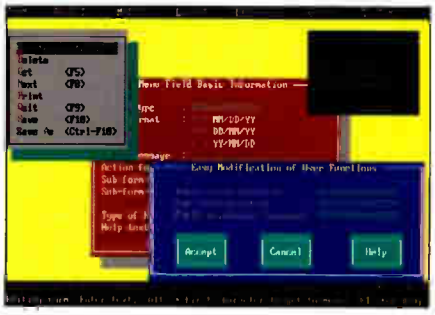
Menus, data-entry forms, and all screen features are usable in the final applications without change. So not only do you avoid creating code from scratch once, you don't have to do it twice!

It's the universal solution.

Vermont Views operates completely independent of hardware, operating system, and database. Any interface you create can be ported easily among DOS, UNIX, POSIX, and VMS.

You can use Vermont Views with any database that has a C-language interface (including Oracle, Informix, db_Vista, and C-Tree). You can run it on PCs, DEC, NCR, HP, AT&T, and other systems. You don't have to pay runtime fees or royalties. And full library source is available, too.

What's more, your DOS applications can have full mouse control, and work in graphics as well as text modes!



Don't take our word for it—put Vermont Views to the test. Call or fax now for your personal, free demonstration kit. Or order Vermont Views with our 60-day, money-back guarantee.

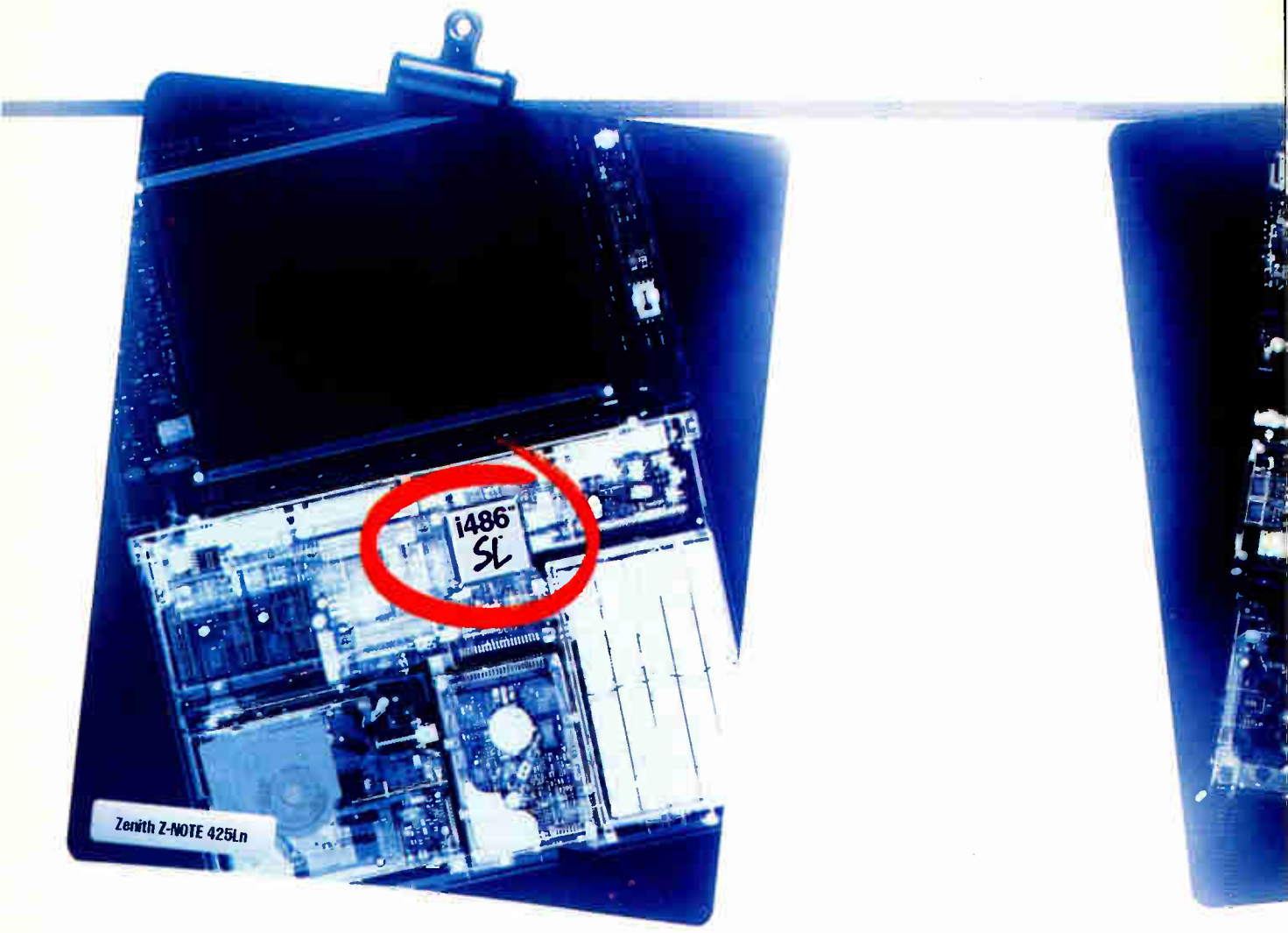
Either way, you'll see immediately that Vermont Views is a cut above the rest.

Call for your FREE demo kit! 800-848-1248

Vermont Creative Software
Pinnacle Meadows
Richford, VT 05476 USA
Phone: (802) 848-7731
FAX: (802) 848-3502

(Please Mention "Offer 386")

World Radio History



We're putting i486™ technol

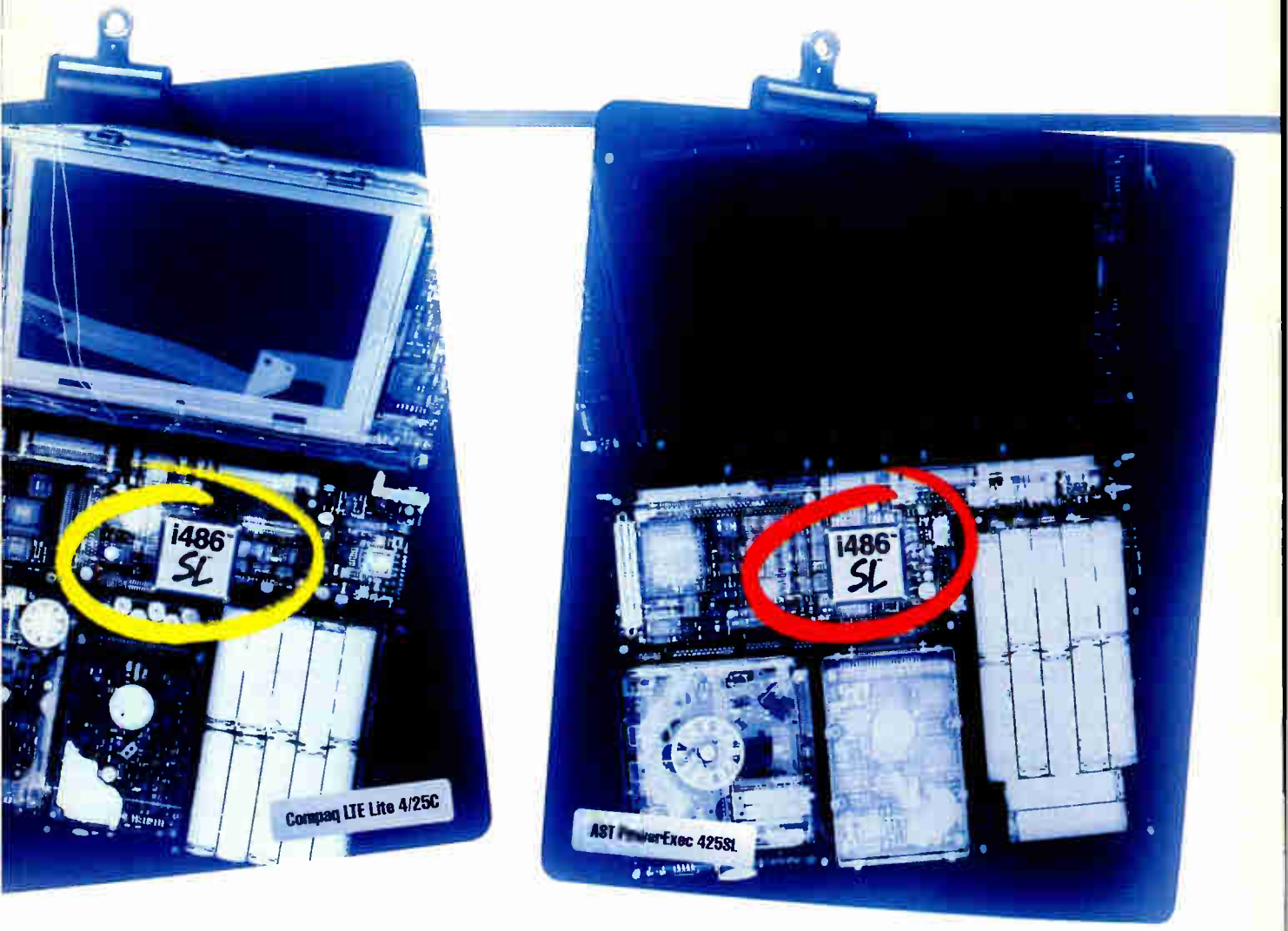
intel inside

Now that we've introduced our i486™ SL processor to the world of mobile computing, you'll never look at notebooks the same. That's because, for the first time, you can have the performance of a true 32-bit i486 DX chip to go, with added features to help you garner maximum power from your mobile computer.

One unique feature, our Intel SL technology, actually conserves precious battery life by routing power only to where it's needed. Battery life is further extended through the i486 SL processor's low 3.3-volt operation—which gives you up to an extra hour of computing. Plus, a unique power management feature retains data and instructions even when power is off.

©1993 Intel Corporation. All products are trademarks of their respective companies. i486 SL microprocessors in this ad are larger than actual size.

World Radio History



ogy in a whole new light.

Perhaps more important, however, is the fact that the i486 SL processor is just the latest step in Intel's long-term strategy to provide mobile computer users with uncompromised desktop performance. Together with our ExCA™ cards such as faxmodems and LAN adapters, Intel's mobile processors will give your notebook more versatility. It's no surprise that leading notebook manufacturers are putting Intel SL technology in the spotlight.

To learn more about the new i486 SL processor, call us at 1-800-228-4549, and let us shed some light on the latest in mobile computing.

intel®

Circle 90 on Inquiry Card.

World Radio History

EDITORIAL

DENNIS ALLEN

FATWARE STRATEGIES

The problem of fatware really should not be news. In fact, it should not even be a problem. For years, we have seen the coming of larger, more complex software. We wanted better graphics and more features, and it was simply a matter of waiting for the CPU horsepower that software makers could exploit.

The 486 largely delivered the horsepower (arguably, more is still needed), and the software industry was ready with applications that consumed every iota of that power. The problem was that the software industry assumed that along with increased CPU horsepower came more disk storage and more memory. That wasn't a bad assumption, but it was wrong.

The major culprit in the problem of fatware is the industry's price war

The culprit is the PC price war. While we have all benefited from rapidly falling hardware prices and incredibly good deals for 486-based machines, the hardware industry quietly lured many people into buying inadequate systems. It wasn't a contemptuous act on the part of hardware makers; it was simply a matter of marketing and price competition. The market seemed to cry out for 486 systems for $2000, and seemingly no one cared about hard drive and memory size. For many systems, 4 MB of RAM and a 100-MB hard drive are standard fare.

So here we are with software fat with features and inadequate systems on which to run it. The obvious short-term solution is to upgrade your hard drive and RAM on 486 systems and to replace 386 and remaining 286 PCs. If you go by today's standards, 8 MB of RAM and a hard drive of 170 to 200 MB will do. And that's the configuration that most system vendors are leaning toward. That's still short-term thinking, though. The 8 MB of RAM may be reasonable because it is so easy to upgrade later, but going with a hard drive of less than 250 MB is not a good plan.

It doesn't take a lot of software to fill up that first 100 MB of disk space, and the second 100 MB will go fast, too. As you know, it doesn't take many applications to fill a hard drive. While software developers are trying to address the fatware problem with shared code in object-oriented environments, that solution will not be realized for this generation of systems—and perhaps not even the next.

Meanwhile, fat software will get fatter. One of the reasons, again, is the price war. While the price war has largely been limited to the hardware industry, the software industry is now getting into the fray. After all, when you can buy a computer for as little as $1000 or less, why should you have to pay $795 for a software package?

Already we've seen some aggressive software pricing—mostly in the form of upgrade pricing for existing users and competitive upgrade pricing to entice users to switch spreadsheets or word processors. Also consider the $99 introductory offer for Microsoft Access, a program that reportedly cost $60 million to develop.

Prices will drop only so far, though. It's not reasonable to expect complex software to sell for less than $100, although undoubtedly some will anyway. It is reasonable to expect that software makers will continue the trend of adding more features, and many of those features will come in the form of additional utilities, clip-art libraries, and bundled applications.

So for, say, $75 you might buy a very good graphics program that comes with 15 MB of clip-art images. Or maybe the next version of your word processor will come with a library of business letters that takes up 4 MB of disk space. Or your next spreadsheet program will come with a 10-MB library of financial models. The possibilities are endless, and it's one of the best ways for software companies to compete.

What all this means is that you'll need lots of disk space just for the programs and libraries you'll want to use—not to mention your data. Add to that the increased emphasis on graphics and video, which hog many megabytes of space, and, well, you see what I mean.

How much disk space is enough? I recommend no less than 250 MB and strongly suggest 300 to 500 MB for desktop systems. Also, as I've said before, get a CD-ROM drive so that not everything has to reside on your hard drive. At least one manufacturer, Gateway 2000, says it is making CD-ROM drives a standard feature in its high-end desktop systems. and I expect other companies to follow.

The bottom line is this: Don't let the marketers' packaged system configurations dictate what size hard drive you buy.

—Dennis Allen
Editor in Chief

World Radio History

THE WORLDWIDE STANDARD

New dBASE IV v2.0 gets you home for dinner

Get your work done faster

New dBASE IV® version 2.0 is up to ten times faster than version 1.5 and dBASE III PLUS®! Browsing data, executing queries, and generating reports are all faster—even on networks.

But program speed is only part of dBASE's overall performance superiority. dBASE® gets your work done faster because it's more usable. A recent study proves it!* For everyday tasks, dBASE users got their work done 25% faster than FoxPro users.

COMPUTERWORLD DOS-BASED

PREFER TO DO BUSINESS WITH

PLAN TO BUY

INSTALLED IN COMPANY

★1992★ DATA BASED ADVISOR Readers Choice Award

BEST NEW DATABASE MANAGER

MOST IMPROVED DATABASE PRODUCT

dBASE IV outfoxes the competition

	dBASE IV	FoxPro
Industry standard	Yes	No
Designed for users	Yes	No
Designed for programmers	Yes	Yes
Queries optimized for stand-alone & networked computers	Yes	No
Instantly accessible visual design tools	Yes	No
Full cross-platform compatibility	Yes	No
Transaction processing	Yes	No
Multiuser ready	Yes	No

dBASE makes it easy to do more

Whether you're a database user or application developer, dBASE puts your information to work. Visual design tools let you create database tables, queries, forms, and reports onscreen. Query By Example gives you fast answers to your questions. No wonder NSTL rated dBASE tops in versatility and usability.†

The #1 choice for application developers

The dBASE language lets you use English-like commands to create powerful applications with less code. And now you can generate royalty-free .EXEs using the new, 100% language-compatible **dBASE Compiler**!

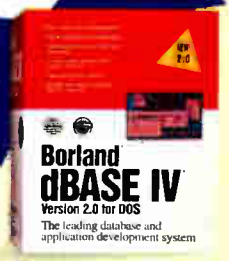
Get dBASE today and get home for dinner tonight.

SPECIAL UPGRADE PRICE!

$99.95

(Suggested list price $795.)

Offer good for standalone or LAN upgrades



90-day, money-back guarantee!

See your dealer or call now, 1-800-336-6464, ext. 5074

In Canada, call 1-800-461-3327.

Borland

Power made easy

Circle 68 on Inquiry Card (RESELLERS: 69).

*Usability Sciences Corp. study, 1992. †*Software Digest* Ratings Report, multiuser database programs, May 1992. Copyright © 1993 Borland International, Inc. All rights reserved. All Borland product names are trademarks of Borland International, Inc. Prices good in the United States and Canada only. All prices are in U.S. dollars. Dealer prices may vary. BI 4383

World Radio History

"Why I

Patrick Pearce, Software Developer, Life Care Development Corp.

"Time is money."

The advantages of OS/2® are clear. "At Life Care Development Corp., we create applications for sale to physicians, psychiatrists and drug counselors for tracking patient and insurance information, and medicine and treatment goals. We make use of OS/2's inherent development capabilities like the REXX language as well as WorkFrame/2 (IBM's development environment), C Set/2 compiler and Borland ObjectVision®. For us, OS/2 has meant heightened productivity, shortened development time and improved quality of product."

Work in a customizable object-oriented environment without constraints. Enjoy true preemptive multitasking, unlike what you get with Windows™ and other DOS extenders. "With OS/2, I can reliably run several development applications at the same time: edit in one window, compile in another, link in a third and test in a fourth. I'm amazed how quickly I can compile a program while printing a copy of the source code." OS/2 gives you the capability to have multiple configurable sessions in which to build and test your applications.

ObjectVision

"OS/2 is easier to get into."

OS/2 Crash Protection™ helps you lose your fear of crashing and rebooting. If one app goes down due to a bug, the rest you're working on won't. OS/2 isolates the failure, letting you fix it and restart it without affecting other apps. Dynamic Link Libraries allow applications to share common functions, making them smaller and easier to maintain.

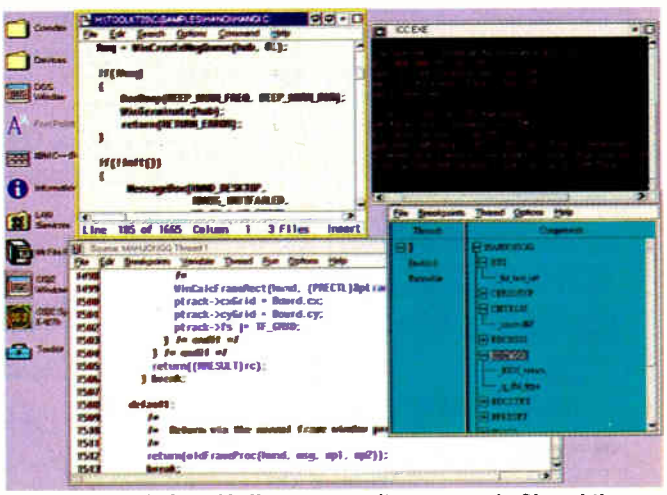
1992
– WINNER –
PC Magazine Award
for Technical Excellence

TECHNICAL EXCELLENCE
PC MAGAZINE

OPERATING SYSTEMS AND SOFTWARE STANDARDS
OS/2, Version 2.0
IBM Corporation

"I'll never go back."

"I may be a small ISV, but IBM has always treated me like a big fish." IBM's valuable technical service and marketing support includes OS/2 Support Line, IBMLink, the IBM OS/2 bulletin board system and several OS/2 developer forums on



In the Workplace Shell,™ you can edit source code files while compiling and debugging in the background.

World Radio History

don't do Windows anymore."

The no-comparison comparison chart.

	Windows 3.1	OS/2
Virtual memory limit	4 x physical	512MB (disk space)
Memory model	Segmented (64KB)	Flat memory objects
APIs	16 bit	Full 32 bit
Multitasking—DOS apps	Time slicing	Pre-emptive time slicing
Multitasking—Windows/PM apps	Cooperative	Pre-emptive
Priority	Static (set by user)	Dynamic
Dispatchability	Process	Thread
System services	Serial	Parallel
Protection between apps	Unprotected	Protected
Kernal protection—DOS/Win/PM apps	Unprotected	Protected
File system	FAT	Enhanced FAT and installable file systems (HPFS, CD-ROM)
User interface	Windowed	Object oriented

IBM and OS/2 are registered trademarks and Workplace Shell and OS/2 Crash Protection are trademarks of International Business Machines Corporation. All other products are trademarks or registered trademarks of their respective companies. ©1993 IBM Corp.

CompuServe®. "If I run into a problem, the OS/2 Developer Assistance Program is there to help."

The 32-bit operating system lets you break through the 64K code segment barrier and convert to a flat memory model with up to 512MB of memory per session for writing code. "Writing is easier and faster than ever—and bugs have never been easier to uncover and zap."

"I'm actually having fun again."

But the best reason for leaving Windows and other DOS extenders is the opportunity to develop truly revolutionary OS/2 applications. You could say OS/2 has closed the door on Windows. For the free white paper on why OS/2 is the developer's platform of choice, or for more information, call **1 407 982-6408.**

IBM®

Circle 87 on Inquiry Card.

World Radio History

BYTE

EDITOR IN CHIEF
Dennis Allen

PUBLISHER
Ronald W. Evans

EXECUTIVE EDITORS
New York: Rich Malloy
Peterborough: Rich Friedman

MANAGING EDITOR
D. Barker

ASSISTANT MANAGING EDITOR
Lauren Stickler Thompson

NEWS
Peterborough:
Senior Editor: Dan Muse
News Editors, What's New: Martha Hicks, Carol Swartz
Microbytes: David L. Andrews
News Assistant: June Sheldon
San Mateo/West Coast:
Bureau Chief: Andrew Reinhardt
Senior Editor: Tom Halfhill
News Editor: Patrick Waurzyniak
Editorial Assistant: Barbara J. Caravello
Los Angeles:
Senior Editor: Gene Smarte
New York:
News Editor: Ed Perratore

BYTE LAB
Director: Stephen Apiki
(also: *systems, networking*)
Technical Director: Rick Grehan
Senior Editor: Alan Joch
Technical Editor:
Stanford Diehl: *software, add-ins, peripherals, multimedia*
Testing Editors/Engineers: Howard Eglowstein, Ben Smith, Stanley Wszola
Lab Assistant: Selinda Chiquoine

STATE OF THE ART/FEATURES
Senior Editor: Michael Nadeau
Technical Editors: Janet J. Barron, Anthony J. Lockwood, Robert M. Ryan

SENIOR TECHNICAL EDITORS
At Large: Tom Thompson, Jon Udell
Columns: Rob Mitchell

ASSOCIATE TECHNICAL EDITORS
Ellen Bingham, Susan Colwell, Jeff Edmonds, Tom Kevan, Cathy Kingery, Margaret A. Richard, Warren Williamson

SENIOR CONTRIBUTING EDITOR
Jerry Pournelle

CONTRIBUTING EDITORS
Hugh Kenner, Barry Nance

CONSULTING EDITORS
Roger C. Alford, Jonathan Amsterdam, Nicholas Baran, Raymond GA Côté, Don Crabb, Anne Fischer Lent, Laurence H. Loeb, Trevor Marshall, Dick Pountain, Roberta Pournelle, Wayne Rash Jr., Kenneth M. Sheldon, Jane Morrill Tazelaar, Ellen Ullman, Peter Wayner

EDITORIAL ASSISTANTS
Office Manager: Peggy Dunham
Assistants: Linda C. Ryan, Janet A. Young

DESIGN
Director: Nancy Rice
Associate Director: Joseph A. Gallagher
Designers: Jan Muller, Sharon Price
Graphics Manager: Roger Goode

PRODUCTION AND FINANCE
Director: Claudia Flowers

PRODUCTION
Director: David M. Cohen
Production Manager: David R. Anderson
Advertising Graphics Manager:
Susan Kingsbury
Editorial Graphics Manager:
Virginia Reardon
Graphics Production Coordinators:
Barbara Busenbark, Christa Patterson, Donna Sweeney, Lillian J. Wise
Advertising Services Manager: Linda Fluhr
Senior Advertising Services Representative: Lyda Clark
Advertising Services Representatives:
Dale J. Christensen, Karen Cilley, Rod Holden
Scheduling Manager: Wai-Chiu Li
Operations Assistant: Lisa Jo Steiner

FINANCE
Senior Financial Analyst: Kenneth A. King
Financial Analyst: Kathleen Deguise
Data Processing Coordinator: Diane Henry
Billings Coordinator: JoAnn Walter
Production Assistant/Purchaser:
Agnes Perry

MARKETING AND PLANNING
Director: L. Bradley Browne
Administrative Assistant: Carol Cochran
Marketing Communications Manager:
Pamela Petrakos
Marketing Art Director:
Stephanie Warnesky
Market Research Manager: Julie Perron
Copyrights Manager: Faith Kluntz
Reader Service: Cynthia Sands
Marketing Events Coordinator:
Carol Sanchioni

CIRCULATION
Director: Glyn Standen
Subscriptions Manager: Paul Ruess
Assistant Manager: Pam Wilder
Subscriptions Assistant: Christine Tourgee
Newsstand Manager: Vicki Weston
Assistant Manager: Karen Desroches
Back Issues: Louise Menegus
Direct Accounts Coordinator: Ellen Dunbar

Publisher's Assistant: Donna Nordlund

ADVERTISING SALES
NEW ENGLAND
Patricia Payne (603) 924-2654

EAST COAST
Kim Norris (212) 512-2645
Jonathan Sawyer (603) 924-2665

SOUTHEAST
Mary Ann Goulding (404) 843-4782
Barry Echavarria (603) 924-2574

MIDWEST
Kurt Kelley (312) 616-3328
Ed Ware (603) 924-2664

SOUTHWEST, ROCKY MOUNTAIN
Jennifer Walker (214) 701-8496
Larry Levine (603) 924-2637

SOUTH PACIFIC
Beth Dudas (714) 753-8140
Joseph Mabe (603) 924-2662
Alan El Faye (213) 480-5243
Larry Levine (603) 924-2637

NORTH PACIFIC
Bill McAfee (415) 513-6862
Jonathan Sawyer (603) 924-2665
Roy J. Kops (415) 513-6861
Joseph Mabe (603) 924-2662
Barbara Holmes (415) 513-6945
Barry Echavarria (603) 924-2574

INSIDE ADVERTISING SALES
Director: Liz Coyman (603) 924-2518
Assistants: Susan Monkton, Vivian Bernier

THE BUYER'S MART (1 × 2)
Margot Gnade (603) 924-2656

HARDWARE/SOFTWARE SHOWCASE
Ellen Perham (603) 924-2598
Mark Stone (603) 924-2695

REGIONAL & BUYER'S GUIDE
Brian Higgins (603) 924-2651

BYTE DECK
Brad Dixon (603) 924-2596

EURO-DECK
James Bail (603) 924-2533

INTERNATIONAL ADVERTISING SALES STAFF
See listing on page 259.

PERSONNEL
Human Resources Administrator:
Patricia Burke
Assistant: Fran Wozniak
Receptionist: Beverly Goss

HOW TO CONTACT THE EDITORS

We welcome your questions, comments, complaints, kudos, and submissions.
MAIN OFFICE: One Phoenix Mill Lane, Peterborough, NH 03458, (603) 924-9281.
San Mateo: 1900 O'Farrell St. #200, San Mateo, CA 94403, (415) 513-6912.
Los Angeles: 15635 Alton Pkwy., Suite 290, Irvine, CA 92718, (714) 753-8140.
New York: 1221 Avenue of the Americas, New York, NY 10020, (212) 512-3175.
U.K./EUROPE: Wimbledon Bridge House, One Hartfield Rd., Wimbledon, London SW19 3RU, England, +44 81 543 1234.
ELECTRONIC MAIL: On BIX, send to "editors." All BYTE editors and columnists also have individual mailboxes on BIX for easy access.
MCI: 250-0135 BYTE Magazine. Many editors also have individual MCI addresses in their own name.
OTHERS: Many editors also are reachable through uunet, AppleLink, CompuServe, and numerous other services.
U.S. fax: Editorial: (603) 924-2550
Advertising: (603) 924-7507
U.K. fax: +44 81 540 3833

SUBMISSIONS:
Authors: We welcome article proposals and submissions. Unacceptable manuscripts will be returned if accompanied by sufficient return postage. Not responsible for lost manuscripts or photos.
Vendors: We welcome news of your new products; please call the News department or the BYTE Lab at the earliest possible date. We cannot be responsible for unsolicited product samples.

ARTICLE REPRINTS:
For price quotations on customized reprints of BYTE articles, contact Faith Kluntz, Reprints Manager, at (603) 924-2525. (Minimum quantity: 500.)

SUBSCRIPTION CUSTOMER SERVICE

Inside U.S. (800) 232-BYTE; outside U.S. +1 609 426 7676. For a new subscription, (800) 257-9402 U.S. only, or write to BYTE Subscription Dept., P.O. Box 555, Hightstown, NJ 08520. Subscriptions are $29.95 for one year, $54.95 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, $87.95 for three years. In Europe, £29 (U.S. $50) for fast surface delivery, £41 (U.S. $70) for air delivery. Non-European countries U.S. $50 for surface mail, or U.S. $75 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.

PHOTOCOPY PERMISSION:
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 $1.50 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. Specify ISSN 0360-5280, $1.50. Copying done for other than personal or internal reference use without the permission of McGraw-Hill, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to Faith Kluntz, Copyrights Manager, (603) 924-2525. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London, WC1R 4EJ, U.K.

Copyright © 1993 by McGraw-Hill, Inc. All rights reserved. BYTE and BYTE are registered trademarks of McGraw-Hill, Inc. Trademark registered in the United States Patent and Trademark Office.

Member Audit Bureau of Circulation

BIX INTERACTIVE ON-LINE SERVICE

PRODUCT MANAGER
Kip Bryan

DIRECTOR OF COMPUTER-RELATED SERVICES
Stephen M. Laliberte

MEMBER SERVICES MANAGER
Kevin Plankey

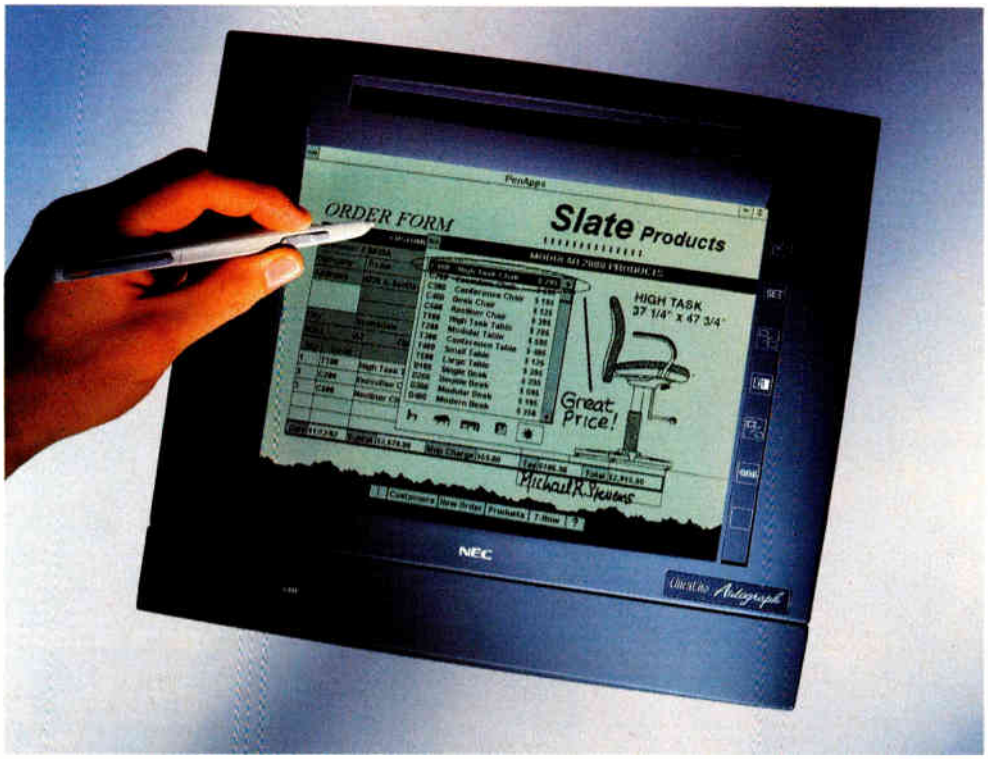
EXCHANGE EDITORS
Amiga Exchange: Joanne Dow
Entertainment and Leisure Exchange: Rich Taylor
IBM Exchange: Barry Nance
Programmers Exchange: Bill Nicholls
Professionals Exchange: David Reed
Tojerry Exchange: Jerry Pournelle
WIX Exchange: Karen Kenworthy
Writers Exchange: Wayne Rash Jr.

BIX, owned and operated by General Videotex Corporation, is a worldwide, low-cost, on-line information service featuring industry news, downloadable software, powerful electronic mail, previews of upcoming BYTE articles, the full text of published issues of BYTE, and source and/or executable code for BYTE benchmarks and noncommercial software mentioned in feature articles. BIX also offers unmatched "conferences" on virtually every computer-related topic imaginable, where you can share information with thousands of other computer pros. To subscribe via modem, set your communications software to full duplex, 7 bits, even parity, 1 stop bit, and then call (800) 695-4882 or (617) 491-5410, or make a data call to our Tymnet address: 310690157800. Then hit the Enter/Return key and enter "BIX" when asked to log in; then enter "BIX.VILLE" when asked for a name. For current fees and more information, call (800) 695-4775 or (617) 354-4137 on voice phone; fax: (617) 491-6642; Internet: bix@genvid.com.

OFFICERS OF MCGRAW-HILL, INC.:
Chairman, President, and Chief Executive Officer: Joseph L. Dionne; *Executive Vice President, General Counsel, and Secretary:* Robert N. Landes; *Executive Vice President:* Harold W. McGraw III; *Executive Vice President and Chief Financial Officer:* Robert J. Bahash; *Senior Vice President, Treasury Operations:* Frank D. Penglase; *Executive Vice President, Publication Services:* Norbert Schumacher. *Founder:* James H. McGraw (1860–1948).

World Radio History

After you see our performance



The UltraLite Autograph is just one of the many innovations NEC has brought to portable computing. Others include the first active-matrix color notebook, the first color laptop and the first portable Docking Station™

you'll want our Autograph.

Applause and standing ovations. That's how people are reacting to NEC's new UltraLite® Autograph.™ The UltraLite Autograph is a tablet computer that's designed to provide uncompromising performance anytime, anywhere. At just 3.9 lbs., and a mere 1.2" thin, this lightweight delivers heavyweight performance. The Autograph is loaded with advanced features like a powerful i486™SL processor. 40 or 80MB* hard disk drive. A full complement of standard ports. Local bus video for dazzling video performance. A high-quality VGA transflective screen display for clear viewing indoors and outdoors. Two PCMCIA slots for easy installation of peripherals like fax modems and local area network cards. And programmable HotZone™ icons that work like function keys to allow quick, easy access to frequently used functions. And there's an optional keyboard that has been customized for portable use. It comes with plenty of battery life, thanks to its 3.3-volt design that gives users significant battery life improvement depending on usage (3-5 hours with a standard NiMH battery and 6-10 hours with a double-capacity battery pack). And the Autograph can run either Windows™ for Pen Computing™ or PenPoint™ software. NEC's UltraLite Autograph. You'll give its performance rave reviews. To find out where you can see the Autograph, call us at 1-800-NEC-INFO (in Canada, 1-800-343-4418) and we'll tell you where you can sign on the bottom line for one.

intel inside

Because ⬆ is the way you want to go. NEC

*80MB available 1st quarter 1993.

UltraLite is a registered trademark and UltraLite Autograph and HotZone are trademarks of NEC Corporation. Docking Station is a trademark of NEC Home Electronics, Inc. The Intel Inside Logo is a registered trademark of Intel Corporation. All other trademarks and registered marks are property of their respective owners. © 1993 NEC Technologies, Inc.

Circle 111 on Inquiry Card.

World Radio History

The New Generation 17" Monitor

Advancing into the future is the powerful, new generation ViewSonic 17... with crispness and clarity unheard of before now. So, if a high-contrast, extremely bright, sharply focused screen is important to you, this is the answer! Plus, this remarkable monitor runs at 76Hz refresh at an astonishingly high 1,280 x 1,024 and beyond, which will give you a flicker-free image.

Our unique ViewMatch™ color control is an easy-to-use system that takes the guess work out of printing by adjusting colors to closely match printer output. Brighten the red. Lighten the blue. No problem; it works. And the ViewSonic 17 even has an ergonomically designed drop-down control panel that's as simple to use as a typewriter. More great features include digital controls and advanced anti-reflection coating ...all adding up to make this everything a 17" monitor should be. With its big screen display and edge-to-edge image, this is the monitor of choice for Windows, desktop publishing and CAD/CAM applications.

For safety and vision protection, the monitor meets strict MPR-II and ISO 9241-3 standards.

Call **800-888-8583** for more information on our products, including our new line of 15" through 21" monitors.

Welcome to the New Generation.

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

ViewSonic®

20480 Business Pkwy Walnut, CA 91789
Tel. (909) 869-7976 Fax (909) 869-7958

Circle 149 on Inquiry Card (RESELLERS: 150).

World Radio History

LETTERS

REVIEWS

Commodore Gets Tough

Amiga Excellence

I would like to commend Tom Yager for the "Commodore Gets Tough" review (January). He pointed out some of the best features of the Amiga 3000T-040/200 and 4000-040/120. Yager was fair, but he neglected to mention the AGA (Advanced Graphics Architecture), a standard chip set in the latest Amigas. A HAM8 mode lets you display 256,000 colors in high resolution on any AGA-equipped Amiga. These new images come close to 24-bit color, and the Amiga can easily animate them for top-notch multimedia capabilities.

Despite predictions of an early death for the Amiga, it is alive and well in the 1990s.

Randy Payment
No address given

My compliments to you on the articles "Grab Your Audience with Audio" (December 1992) and the "Commodore Gets Tough" (January). It was heartening to see the inclusive and balanced coverage of Amiga audio and MIDI in December. The review of the Amiga 3000T-040/200 and 4000-040/120 was also fair and enlightened.

Thank you for expanding BYTE beyond another Mac-clone magazine. It has the unique position of being potentially platform-independent. Keep up the good work.

Jeff Johnson
Cincinnati, OH

OS/2 Gets No Respect

Your omission of OS/2 2.0 from "The 1992 BYTE Awards" (January) is puzzling. There are not yet many 32-bit programs available to take full advantage of OS/2, but the operating system is technically superior. OS/2 is a huge advance in PC operating systems. Please give OS/2 the attention it deserves.

Steven Hoagland
Asheville, NC

One of the biggest technological successes of 1992 and OS/2 2.0 is not even mentioned? I just hope that the page that OS/2 2.0 was on fell out before the January issue reached me.

Robert Mahoney
Babylon, NY

Braincel Defense

Maureen Caudill's review of Braincel ("Neural Net Adds Smarts to Spreadsheets, Slowly," January) made allegations to which I feel compelled to respond.

Caudill's most exasperating allegation was that Braincel is "inappropriate for large-scale or difficult problems." We have many Fortune 500 customers who have solved large-scale problems using Braincel.

Also, Caudill's comparative evaluation of Braincel was hardly unbiased. She selected one pet problem to test and erroneously concluded that Braincel's proprietary algorithm, back percolation, performs worse than back propagation. This conclusion was due to several avoidable errors.

First, Caudill was familiar with the optimal architecture and parameter settings of Ansim for this problem. Although these settings were in all likelihood not appropriate for Braincel, she used them on both products. Second, although suboptimal architecture and parameter settings hampered Braincel's performance on the training set, Caudill unwittingly exacerbated Braincel's testing error by letting both products train for the same number of cycles. One of the first tenets in the neural-network field is to never overtrain the network, or it will perform poorly on test data. Because back percolation is a more effective training algorithm, training it for the same number of cycles as back propagation predisposed it to overtraining.

Braincel has solved many real-world problems defined with hundreds of inputs and thousands of rows of data. Many of our customers have switched to Braincel from other stand-alone neural-network products, due to both its convenience and the efficiency with which back percolation trains. Considering the number of customers we have, I am sure I would have heard other similar complaints if Caudill's criticisms were representative.

Murray A. Ruggiero Jr.
Vice President
Promised Land Technologies, Inc.
New Haven, CT

The parameters I used in the comparison test were not optimized for Ansim. I used that product because it uses a plain vanilla version of back propagation. When Braincel's heuristics determined the parameters, it could not solve the problem at all. Since Promised Land does not give details of back percolation and since its heuristics did not work, my only option was to use reasonable parameters based on my experience with other networks.

I have seen many new networks that contain improvements that are frequently optimized for a single type of problem. When tested on other applications, they often fail. Only open scientific review of the algorithm resolves such issues—an impossibility with a proprietary algorithm. As a user, my only recourse is to buy the product first and then try it on my network to see if it actually works.—Maureen Caudill

Adapter Flap

As a manufacturer of network adapters, we read with great interest Wayne Rash Jr.'s review of laptop LAN adapters ("Making Connections," BYTE's *Essential Guide*

WE WANT TO HEAR FROM YOU. *Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458, send BIXmail c/o "editors," or send Internet Mail to letters@bytepb.byte.com. Letters may be edited.*

World Radio History

Microsoft BallPoint is the first laptop mouse that locks into place at four different angles.

BallPoint® mouse raises your comfort level several degrees. And its easy-to-see cursor lowers your frustration level just as much. The point being, if you use the Windows™ operating system on a laptop, BallPoint makes your work even easier. So call us at (800) 426-9400 to find out how to get one. Because next to this mouse, others are hard to handle.

Microsoft
Making it easier

© 1992 Microsoft Corporation. All rights reserved. Printed in the USA. In the 50 United States, call (800) 426-9400. Outside the 50 United States, call (206) 936-8661. Customers in Canada, call (800) 563-9048. Microsoft and BallPoint are registered trademarks and Windows is a trademark of Microsoft Corporation.

World Radio History

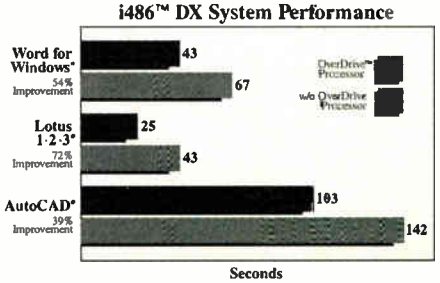
Give your i486™ PC nitro-fueled

Introducing Intel OverDrive™ Processors for your i486™ DX PC.

Want to really soup up your i486 system? Then it's time you install a new Intel OverDrive Processor under the hood.

A single-chip upgrade, an Intel OverDrive Processor will boost the overall performance of your i486 DX or SX system up to 70%.

By using Intel's ingenious "speed doubling" technology, OverDrive Processors give you added power to run all of your software like greased lightning—from AutoCAD® to



©1992 Intel Corporation. *All products are trademarks of their respective companies.
†In cases where there is no OverDrive Processor socket, Intel recommends installation by a qualified technician.

World Radio History

ground-pounding performance.

WordPerfect® and over 50,000 applications in between.

Plus, it doesn't take long to install an OverDrive Processor. Simply plug it into the vacant OverDrive Processor socket† and you're off and running. Faster.

So to rev up your whole system and keep up to speed with all the latest software developments, you need the future of PC upgradability: Intel OverDrive Processors.

To find out which OverDrive Processor is right for your system or to locate your nearest dealer, call 1-800-538-3373, ext. 295. And turn your PC into a street-legal racing machine.

WE MAKE COMPUTERS WORK HARDER.
Find out more. Ask for ext. 295
1-800-538-3373

intel®

Circle 89 on Inquiry Card.

World Radio History

Circle 172 on Inquiry Card.

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.

Security Continuum

Button Type	Unique Serial #	Read/Write Memory	Password Protection	Expiration Timer	Decoy Responses
DS1420 ID Button	X				
DS1427 Time Button	X	4K bits		X	
DS1425 Multi Button	X	2K bits	X		X

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 notebooks, 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

LETTERS

to Portable Computing, 1992). We question the validity of Rash's test environment and criteria. He never shares the results of his test with readers, so it's impossible to make a fair assessment of them. We also question his dismissal of Novell's Perform3 as a valid test methodology. Perform3 is one of the most widely recognized and used test packages available. If speed is going to be presented as a primary test criterion, then it's important to use a widely recognized benchmark and provide all the test results.

Most important, we challenge Rash's supposition that the EPP (Enhanced Parallel Port) specification will emerge as a new standard. Although more than 60 percent of all laptops are expected to be connected to LANs through the parallel port, only Zenith and Dell have adapted the EPP approach. Most laptop vendors seem to be leaning toward the PCMCIA approach for high-speed parallel ports.

Marshall Behling
Director of Marketing
Accton Technology Corp.
Fremont, CA

Perform3 is widely recognized and produces valid results for installations with a traditional network-interface arrangement. But my tests with Perform3 on parallel-port Ethernet cards produced inconsistent results, so I did not use it. Instead, I just measured the time required to perform a 10-MB file transfer between computers. Whether PCMCIA or EPP will be the standard for high-speed parallel ports is a matter of opinion.—Wayne Rash Jr.

Computerized Cinema

I found Roger Ebert's Stop Bit "Cinema by Computer" (January) to be curiously distorted by a preoccupation with trying to fit computerization into the traditional pattern of movie-making. This blinds him to its real potentialities.

The uses he proposed are irrelevant, even from the standpoint of technique. If you want to recreate Humphrey Bogart and place him in a commercial, simply go out and hire one of the numerous skilled Bogart impersonators.

When hardware prices fall a bit more, computer animations can be good for making extremely low-budget movies with decent production values. Today, movies cost too much to make. This means that big businesses produce them rather than free artists.

Movies are a debased art form, crippled by a corruption inherent in the way they are financed. Computer animation can end that corruption and make movies into a great art.

Andrew D. Todd
Philadelphia, PA

FIX

In Hugh Kenner's review of The New Grolier Multimedia Encyclopedia CD-ROM (Book and CD-ROM Reviews, March), prices were omitted. The Windows and Mac versions both sell for $395. ■

World Radio History

4 Gigabytes. Under $2,000.

POWERTAPE

When you consider the value of all the data on a network, any backup system is a wise investment. But now you have a choice. Introducing PowerTape from Colorado Memory Systems. With a native capacity of 2 GB and 4 GB using data compression, PowerTape can handle virtually any backup task.

The PowerTape system includes a backup tape drive, SCSI controller, Colorado Backup™ software, data cartridge, and more. At $1,995 why pay more and get less? And, if 4 GB is more than you need, a 2.4 GB model is available with the same high peformance features at only $1,295.

With PowerTape, you get safe and easy restores and backups, plus the reliability of QIC Industry Standard Format. PowerTape is compatible with Novell NetWare® 2.2 and 3.11, NetWare Lite™, LANtastic®, 3COM® and IBM® PC-NET. It supports Novell-specific files, including bindery and trustee rights.

Call **1-800-451-0897** ext. 317 today for a FREE 76-page catalog.

POWERTAPE™

SERIES 4000

COLORADO™ MEMORY SYSTEMS INC.

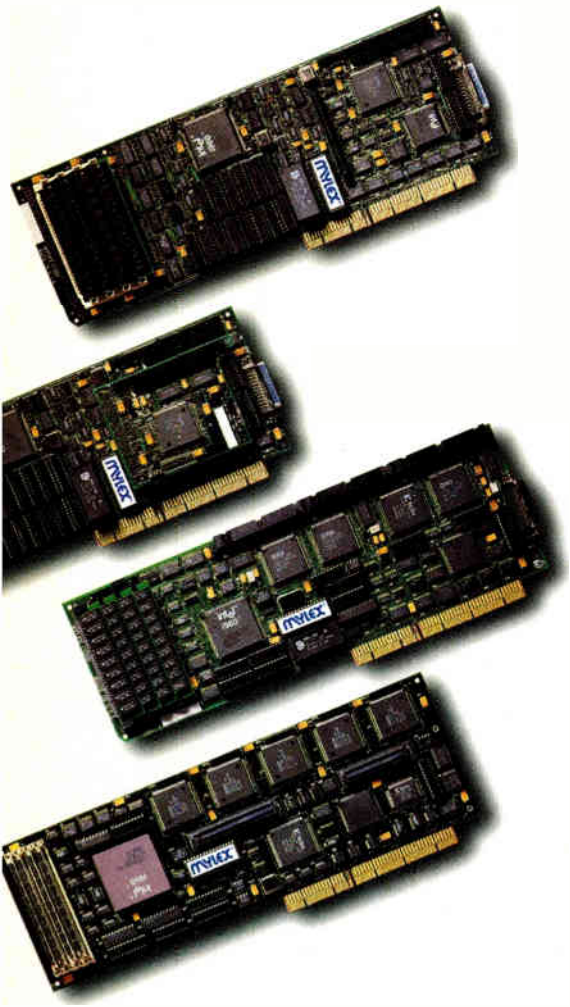
© 1992 Colorado Memory Systems Inc. All rights reserved. PowerTape, Colorado Backup and Colorado are trademarks of Colorado Memory Systems, Inc. All other trademarks are property of their respective companies. PTA-BYT010893

Circle 74 on Inquiry Card (RESELLERS: 75).

World Radio History

The Widest Arra

Fault Tolerant Disk Array Controllers, Subsystems and Servers supporting NetWare, SCO UNIX and OS/2.



Powerful 1, 2, 3, and 5-Channel Disk Array SCSI Controllers

Mylex now offers a range of disk array controllers, all based on the powerful Intel i960CA™ RISC processor. The controllers feature 4/16/64-Mbytes of cache, an EISA host interface and extensive software support.

RAID levels 0, 1, and 5 are supported, with hot swapping, on-the-fly reconstruction, background rebuild, hot standby, multi-threading, and scatter/gather features.

NetWare 3.11, SCO UNIX 3.2.4 and IBM OS/2 2.0 operating environments are supported. All controllers are offered with user-friendly software utilities.

- **DAC960-1/2:** Single fast and wide SCSI-II channel, which can be upgraded to two channels. Each channel has both 8-bit and 16-bit SCSI-II connectors.
- **DAC960-3:** Three fast SCSI-II channels, which can support up to 21 SCSI drives.
- **DAC960-5:** Five fast and wide SCSI-II channels, with the option to drive 8-bit or 16-bit fast SCSI drives.

NetWare, UNIX, OS/2
All Mylex disk array products support Novell NetWare 3.11, with optional support for SCO UNIX 3.2.4 and IBM OS/2 2.0.

Disk Array Subsystem

The disk array subsystem (DAS) features a DAC960 five-channel disk array controller and a flexible enclosure which houses up to five 5.25" or 3.5" SCSI drives. Each drive is powered by its own power supply for improved system reliability. Disk drives are offered as an option. Up to four of these enclosures can be powered by a single DAC960-5 controller, allowing up to 20 drives for each controller.

The DAS can be used in conjunction with any EISA-based computer to build a powerful file server. Up to four controllers can be configured into the system to offer virtually unlimited disk capacity.

Novell Labs Tested & Approved

World Radio History

y of Disk Arrays.

Integrated Disk Array Server: IDAS2000

The Mylex IDAS2000 is a high-performance integrated disk array server, utilizing state-of-the-art disk array technology.

▶ **CPU Subsystem:** Intel 486™ DX2-66MHz EISA system with 256-Kbytes of cache, 8-Mbytes of system memory upgradable to 256-Mbytes, six bus master EISA slots, built-in I/O, flash BIOS and future CPU upgrades with the ZIF socket.

▶ **Disk Subsystem:** Features a one-channel disk array controller that is upgradable to two channels for increased performance. The controller utilizes the powerful Intel i960CA RISC processor and includes a standard cache of 4-Mbytes that's upgradable to 64-Mbytes. RAID levels 0, 1, and 5 are supported with fault tolerance, hot replacement, hot sparing and background rebuild capabilities. Both 8- and 16-bit fast and wide SCSI-II drives are supported. Software support for NetWare 3.11 (Novell certified). Optional support for SCO 3.2.4 and IBM OS/2 2.0 operating environments. Extensive user-friendly software utilities included.

▶ **Enclosure:** Includes three redundant power supplies, five cooling fans, 10 drive bays for 3.5" SCSI drives, and four additional drive bays for tape drives, floppy, etc.

The system includes an EISA LAN adapter and super VGA graphics. Disk drives are optional.

We've Benched the Competition

When Mylex conducted benchmark tests to compare our disk array system's performance to our competitors', we outperformed the competition's RAID 3 and 5 systems, as well as duplexed and spanned systems, by a wide margin.

Benchmarks: Disk Array Subsystems

	CIPRICO NetArray RAID 3	CORE IAS RAID 3	MICROPOLIS RAIDion RAID 5	ULTRASTOR U124 RAID 5	MYLEX DAC960 RAID 5
NCOPY all drives enabled	13:19	15:00	13:30	10:06	4:25
NCOPY one drive down	14:05	15:00	15:30	10:36	4:30
NCOPY during rebuild	26:32	–	20:49	18:30	10:17

▶ LAN Technology's performance tests for Ciprico, Core and Micropolis consisted of copying 2400 files—totaling about 80-Mbytes—from one directory to another using NetWare's NCOPY. The Mylex and UltraStor test configuration included a 486 DX2-50MHz CPU-based EISA system using five HP 97556-30 796-Mbyte drives. Times are shown in minutes.

Flexible Purchase Options

Controllers only, a complete system without disk drives, or a complete system with the drives are offered.

For more information on Mylex disk array systems and controllers, call 1-800-77-MYLEX or 1-510-796-6100. Or, fax us at 1-510-745-8016.

© 1993, Mylex Corporation. Specifications subject to change without notice. All trademarks are the property of their respective holders. © 1992, M&T Publishing, reprinted with the permission of LAN TECHNOLOGY, August, 1992. Novell certification applies to 5-channel disk array products only. The Intel Inside Logo is a trademark of Intel Corporation.

MYLEX

Circle 107 on Inquiry Card.

World Radio History

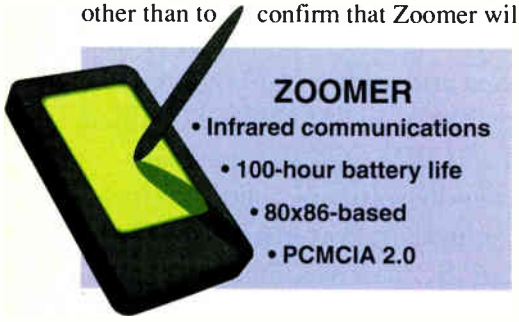
NEWS

MICROBYTES

Zoomer Could Beat Newton to the Punch

Casio Computer and Tandy's first hand-held personal information device will be a pen-based system with an LCD screen and infrared communications. It will also have the ability to run for up to 100 hours on regular alkaline batteries. Code-named Zoomer, the VCR cassette–size system is expected to ship late this summer, which is the same time frame in which Apple says it will release its Newton PDA (Personal Digital Assistant). Bruce Mendel, director of marketing at Casio's personal communications division, told BYTE that Zoomer's price, although not yet finalized, will be closer to $600 than $1000 (Apple officials recently hinted that the initial price of the Newton may hover near $1000).

Casio and Tandy still aren't saying what processor they will use in the system, other than to confirm that Zoomer will be based on a low-powered, 80x86-architecture processor running the Pen/GEOS operating environment from GeoWorks (Berkeley, CA). Zoomer will feature a top that you can flip up, much like the Star Trek communicator Captain Kirk uses. In addition, Zoomer will be PCMCIA 2.0–compatible, although company officials aren't saying how many PCMCIA slots the unit will have. Peripherals for a PCMCIA slot may include a Motorola pager and data communications devices, such as fax modems. Most of the internal components of Zoomer will be custom developed: Zoomer's bus or video architecture is not based on standards such as ISA or VGA.



Casio officials have demonstrated a working Zoomer prototype weighing less than a pound and capable of handwriting recognition, but to date, BYTE has not been able to test it. As an alternative to handwritten pen input, Zoomer will have a pop-up keyboard that you can tap with the pen. You'll also be able to undo digital ink strokes.

Several personal productivity applications will be available when Zoomer ships, including software from Intuit (Menlo Park, CA), the market leader in personal finance software, Casio says. Other companies developing programs for Zoomer include America On-Line (Vienna, VA, interactive, on-line service) and Palm Computing (Los Altos, CA, applications software and handwriting recognition). Reference tools (e.g., an electronic dictionary) will be bundled with Zoomer.

An open API will make Zoomer accessible to software publishers who want to develop applications for the hand-held system. This could be a major distinction between Zoomer and Apple's Newton, according to Casio.

—Andy Reinhardt and Dave Andrews

Chicago Brings DOS Closer to Windows

Microsoft is developing a 32-bit version of MS-DOS to carry Windows into the future. Sources say the combined DOS/Windows operating system, code-named Chicago, will be released next year. The idea is to tightly integrate MS-DOS and Windows so that, rather than sitting on top of MS-DOS, Windows will be threaded tightly into the 32-bit DOS. Along with the new operating system will be yet another API, called Win32c, another source said. Combining the two systems will help Microsoft progress in the direction it has already taken with MS-DOS 6 (see "Easy Does It with MS-DOS 6.0" on page 44) in integrating MS-DOS with Windows.

Microsoft's strategy is to evolve DOS into Windows by default. Another source said that Microsoft's Chicago will be an

NANOBYTES

Stac Electronics (Carlsbad, CA), developer and publisher of the Stacker data compression utility, has filed a lawsuit against Microsoft that asserts a prerelease version of MS-DOS 6 infringes two Stac patents. In announcing the lawsuit, Stac president **Gary Clow** provided a detailed version of discussions that he said took place between his company and top Microsoft officials before the lawsuit was filed, regarding Microsoft possibly licensing Stac's data compression for use in MS-DOS 6.

"From the very outset, Microsoft steadfastly refused to pay any royalties," Clow said. "Their position essentially was that 'we will bless Stac technology with the holy water of Microsoft and anoint you as an industry standard.' " Regarding Clow's version of what went on during these negotiations, Microsoft spokesman Collins Hemingway said, "We do not assume, and we would ask the public not to assume, that their version of the events is necessarily an accurate one." □

The FTC, apparently deadlocked in a vote on how to proceed in its investigation into possible antitrust violations by Microsoft, said in a terse statement that it "did not come to a final decision and will reconvene in the near future." The failure to take action means that, for now, the FTC is not likely to take punitive measures against Microsoft following a two-and-a-half-year investigation into the company's DOS licensing and other business practices. □

World Radio History

Windows™ NT Development Tools from WATCOM
Featuring powerful new GUI debugger
NOW available in Beta
Call 1-800-265-4555
to enroll.

Delivering the Power: WATCOM C9.0/386

- **The Widest Range of 32-bit Intel x86 Platforms**
  32-bit DOS, 32-bit Windows, OS/2 2.0, AutoCAC ADS
- **The Industry's Leading Code Optimizer**
  Advanced global optimizer with new 486 optimizations
- **The Most Comprehensive Toolset**
  Debugger, profiler, protected-mode compiler and linker, 32-bit DOS extender with royalty-free run-time, licensed components from Microsoft SDK, and more
- **The Best Value in 32-Bit Tools: $895***

Unleash 32-bit Power!

WATCOM C9.0/386 lets you exploit the two key 32-bit performance benefits. 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 at least a 2x speedup.

You Get:

- **100% ANSI and SAA compatible compiler and libraries** C9.0/386 passes all Plum Hall Validation Suite tests
- **Extensive Microsoft compatibility** simplifies porting of 16-bit code
- **Royalty-free** run-time for 32-bit DOS, Windows and OS/2 apps
- **Comprehensive toolset** includes debugger, linker, profiler and more
- **DOS extender** support for Rational, Phar Lap and Ergo
- **Run-time compatible with WATCOM FORTRAN 77/386**

32-bit DOS support includes the DOS/4GW 32-bit DOS extender by Rational Systems with royalty-free runtime license
- Virtual Memory support up to 32Mb

32-bit Windows support enables development and debugging of true 32-bit GUI applications and DLL's.
- Includes licensed Microsoft SDK components

32-bit OS/2 2.0 support includes development for multiple target environments including OS/2 2.0, 32-bit DOS and 32-bit Windows
- Access to full OS/2 2.0 API including Presentation Manager
- Integrated with IBM Workframe/2 Environment

AutoCAD ADS and **ADI** Development: Everything you need to develop and debug ADS and ADI applications for AutoCAD Release 11

Novell's *Network C for NLM's SDK* includes C/386

The Industry's Choice.

Autodesk, *Robert Wenig, Manager, AutoCAD for Windows:* "At Autodesk, we're using WATCOM C/386 in the development of strategic new products since it gives us a competitive edge through early access to new technologies. We also highly recommend WATCOM C/386 to third party AutoCAD add-on (ADS and ADI) developers."

Fox Software, *David Fulton, President:* "FoxPro 2.0 itself is written in WATCOM C, and takes advantage of its many superior features. Optimizing for either speed or compactness is not uncommon, but to accomplish both was quite remarkable."

GO, *Robert Carr, Vice President of Software:* "After looking at the 32-bit Intel 80x86 tools available in the industry, WATCOM C was the best choice. Key factors in our decision were performance, functionality, reliability and technical support."

IBM, *John Soyring, Director of OS/2 Software Developer Programs:* "IBM and WATCOM are working together closely to integrate these compilers with the OS/2 2.0 Programmer's Workbench."

Lotus, *David Reed, Chief Scientist and Vice President, Pen-Based Applications:* "In new product development we're working with WATCOM C because of superior code optimization, responsive support, and timely delivery of technologies important to us like p-code and support for GO Corp's. PenPoint."

Novell, *Nancy Woodward, V.P. and G.M., Development Products:* "We searched the industry for the best 386 C compiler technology to incorporate with our developer toolkits. Our choice was WATCOM."

MICROSOFT WINDOWS. Version 3.0-Compatible Product

PC MAGAZINE EDITORS' CHOICE September 13, 1988 Watcom C, Version 6.5

INFO WORLD BEST IN ITS CLASS WATCOM C7.0 1989

COMPUTER LANGUAGE PRODUCTIVITY AWARD 1990

COMPUTER LANGUAGE PRODUCT EXCELLENCE AWARD 1990 COLA

WATCOM **1-800-265-4555**

The Leader in 32-bit Development Tools

415 Phillip Street, Waterloo, Ontario, Canada. Telephone: (519) 886-3700, Fax: (519) 747-4971. *Price does not include freight and taxes where applicable. Authorized dealers may sell for less. WATCOM C and Lightning Device are trademarks of WATCOM International Corp. DOS/4G and DOS/16M are trademarks of Rational Systems Inc. Other trademarks are the properties of their respective owners. Copyright 1992 WATCOM International Corp.

Circle 151 on Inquiry Card.

World Radio History

Exactly how fast is graphics performan Image™ Series PCs?

Let's just say we developed Image Video™ technology expressly for all you high-performance speed demons. Fact is, we've engineered our Image™ Series PCs with a powerful combination of our second-generation local bus and graphics accelerator, allowing graphics information to travel directly between the CPU and video memory, so Windows™ is a breeze and you can sprint through today's most demanding graphics applications.

NEC has the ultimate system for graphics applications: lightning-quick Image Series PCs with integrated SCSI II interface, legendary MultiSync FG monitors, and our pioneering CD-ROM readers with MultiSpin™ technology.

Based on Intel's powerful 486 chip, each Image Series PC has OverDrive™ capability for easy processor upgradability. An on-board SCSI II interface means you can quickly connect to a wide variety of peripherals. And with our new OptiBus™ technology, your peripheral performance is up to 30% faster than ordinary systems. We've even made it easier for you to network your PCs with an optional factory-integrated, high-performance 10BaseT Ethernet® adapter.

Plus, every Image Series PC is designed with True Color support of up to 16.8 million colors for photo-realistic images, as well as our exclusive ImageSync™ technology for flawless performance when connected to our award-winning MultiSync® FG™ series monitors. The result? Clear, flicker-free images without any adjusting.

So call 1-800-NEC-INFO (in Canada, 1-800-343-4418), or NEC FastFacts™ at 1-800-366-0476 (# IMAGE). Then hold on to your spots.

Because ⬆ is the way you want to go.

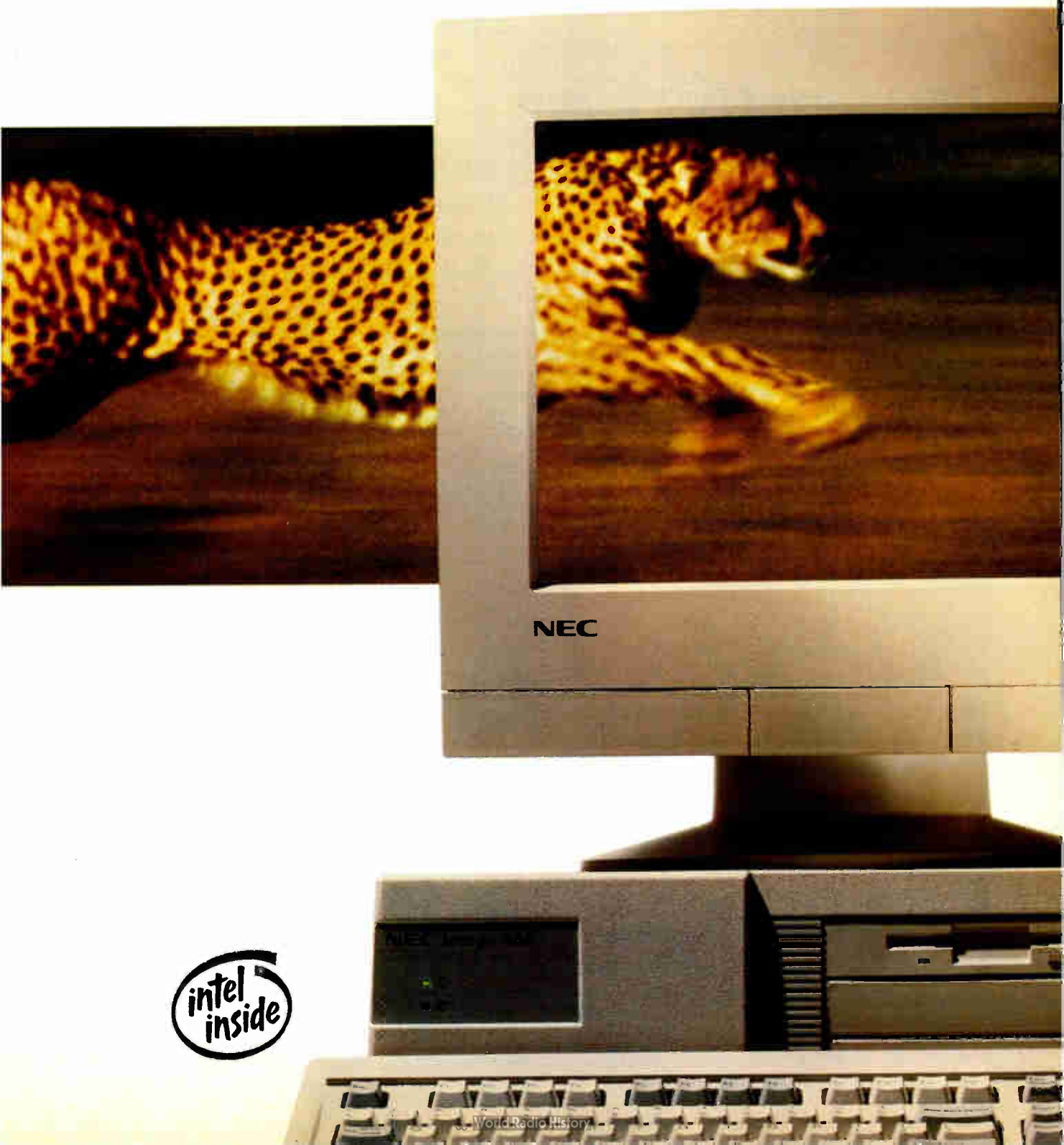
NEC

MultiSync is a registered trademark and FG, Image, Image Video, ImageSync, OptiBus, MultiSpin and FastFacts are trademarks of NEC Technologies, Inc. The Intel Inside logo is a registered trademark of Intel Corp. All other trademarks or registered trademarks are the property of their respective holders. NEC GSA #GS00K91AGS5241 © 1993 NEC Technologies, Inc.

Circle 112 on Inquiry Card.

World Radio History

the
ce of NEC's



intel inside

World Radio History

OS/2 killer, while still another said it represented Microsoft's hedging its bets in case Windows NT is not wildly successful in its first couple of years on the market. Mike Nash, Windows NT product manager at Microsoft, said Microsoft is always working on the next versions of its applications and operating systems, and Chicago is the "gradual logical extension" to Windows. "It is certainly not a Windows NT Lite," Nash said. However, one source at Microsoft said the Win32c API will support all the features of Windows NT's Win32 API—including multithreading—except for security and functions related to Windows NT's Hardware Abstraction Layer.

—Dom Pancucci and Dave Andrews

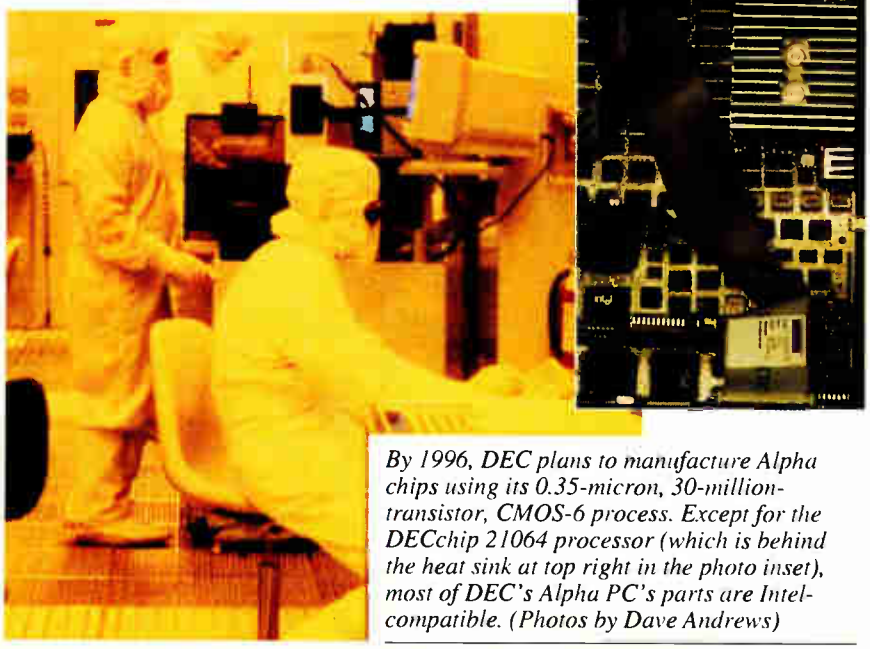
DEC's Alpha PCs: A Fast Chip Talking to Intel Parts

HUDSON, Mass.—DEC's first Alpha "PC" system will be a tower system with six EISA slots and five bays running on the DECchip 21064 at 150 MHz. The system will be in the $7000 to $10,000 price range, officials said. Expected to ship this spring, the so-called Alpha AXP PS will offer one-and-a-half to two times better performance than Intel Pentium-based systems and about four times better performance than an i486 system, says DEC. DEC also says the Alpha family of PCs will eventually support Intel's PCI (Peripheral Component Interconnect) bus and EISA.

Later this year, desktop systems supporting the EISA and PCI bus architectures will follow the AXP PS and will range in price from $4000 to $6000. A "future" desktop system, based on a low-cost implementation of an Alpha chip, will likely be available in 1994. DEC says the system will offer about two to three times the performance of systems based on the i486 and could bring Alpha technology under the $3000 mark.

Of the market that DEC will pursue with these systems, John Foesch, marketing manager for the Personal Computer group, said, "Clearly we're going to be a high-end PC." DEC expects to sell 70 percent of its Alpha PCs through indirect channels such as personal computer dealers and VARs. DEC will also sell the systems directly through its Desktop Direct unit.

David Conroy, senior consulting engineer for DEC's semiconductor engineering group, said that, other than the Alpha chip, very little Alpha-specific design was going into these Alpha PCs. In referring to the AXP PS, Conroy said, "there's buckets of parts there that believe they're only talking to Intel processors." The Alpha PCs are largely built of off-the-shelf Intel-compatible parts; glue logic interfaces the Alpha to either the



By 1996, DEC plans to manufacture Alpha chips using its 0.35-micron, 30-million-transistor, CMOS-6 process. Except for the DECchip 21064 processor (which is behind the heat sink at top right in the photo inset), most of DEC's Alpha PC's parts are Intel-compatible. (Photos by Dave Andrews)

NANOBYTES

Apple and subsidiary Claris say they will move product development of future versions of **HyperCard** into Apple's Developer Tools organization in the Apple Developer Group. Apple says it plans to coordinate HyperCard development efforts with its AppleScript project to give Apple a competitive advantage in the emerging area of next-generation software developer tools. **AppleScript**, a scripting technology for automating routine tasks, is scheduled for release in the first half of this year, Apple says. Claris will continue to sell and support the current version of HyperCard until Apple ships the next version. □

In March, Microsoft (Redmond, WA, (206) 882-8080) planned to release **Visual C++**, a full-fledged professional development language with a Visual Basic–like front end. Later this year, Microsoft is expected to ship Visual Basic 3.0 and a new version of Visual Basic for Windows NT. Get ready for the first version of Visual Basic for the Mac in early 1994. □

Computer Associates (Islandia, NY, (516) 342-5224) says it is close to releasing versions of **Realizer**, its BASIC programming tool for Windows NT, OS/2 2.0, and Windows. Jack Kramer, product manager for Realizer, said that as of February, the Windows version was in "solid beta." The OS/2 version, which was still in internal testing, will be bundled with the Windows version. The Windows NT version will ship shortly after Windows NT is released. □

A select number of developers are now testing early versions of **Script X**, Kaleida Labs' cross-platform scripting language for multimedia, sources said. The company plans to release Script X first for the Mac and Sweet Pea, the joint Apple/Toshiba consumer device—possibly as early as this summer, although one source said that time frame was "ambitious." □

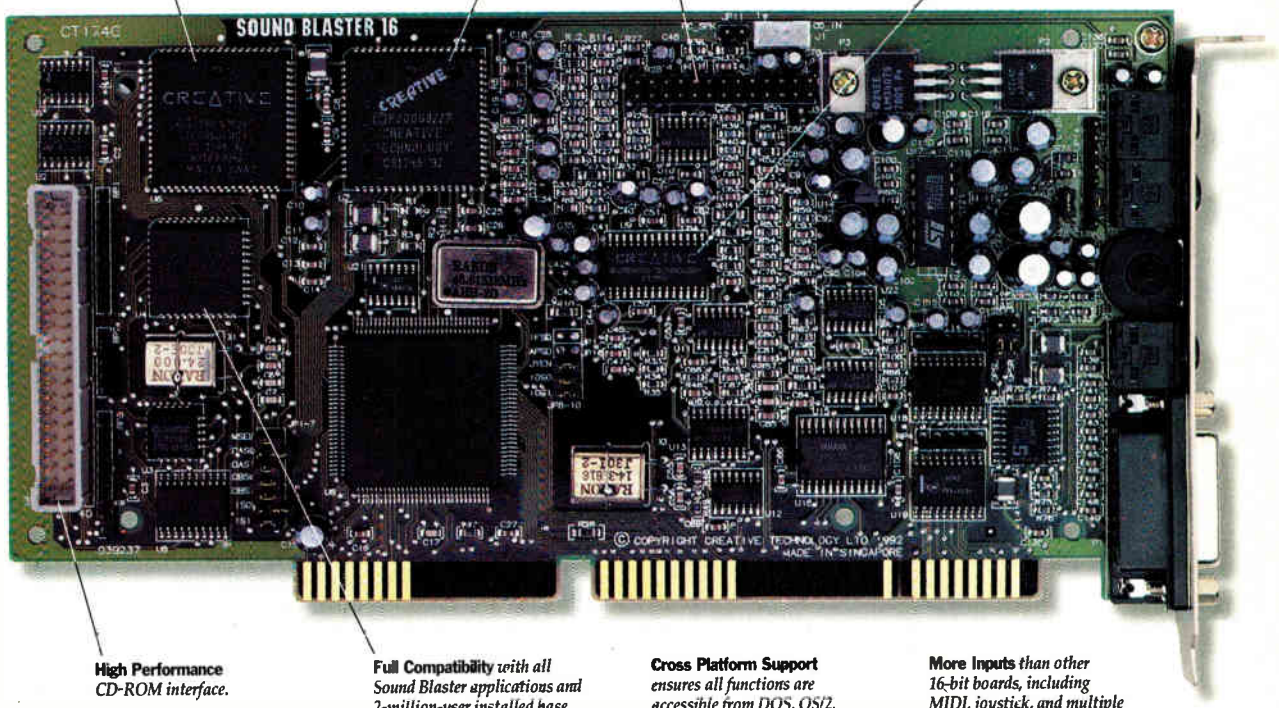
World Radio History

Advanced Signal Processing *(ASP) delivers 4:1 realtime hardware data compression and saves up to 65% of CPU processing time.*

Enhanced Features *include programmable mixing, multiple-source recording, treble and bass controls.*

Wave Blaster™ upgrade option *for next generation wave table music synthesis.*

State-of-the-Art *16-bit Codec with 90 dB signal-to-noise ratio.*



High Performance *CD-ROM interface.*

Full Compatibility *with all Sound Blaster applications and 2-million-user installed base.*

Cross Platform Support *ensures all functions are accessible from DOS, OS/2, Windows or MPC.*

More Inputs *than other 16-bit boards, including MIDI, joystick, and multiple audio sources.*

Sound Blaster 16 ASP. We're not playing games anymore.

Sure, games are great. But with new applications ranging from voice recognition to full-blown integrated multimedia, it's time to get serious about PC audio. With Sound Blaster™ 16 ASP.™

The 16 ASP comes with all the features you'd expect on a professional-quality sound board, plus more than $500 in bundled software...all for a suggested retail of just under $350.

But the real secret lies in Creative Labs' exclusive Advanced Signal Processing technology: realtime hardware data compression that delivers full CD-quality stereo at a fraction of the CPU power required by other 16-bit boards. And downloadable algorithms that enable future upgrades like voice recognition, time control and special effects.

So if you thought the original Sound Blaster set the standard for games, you're right. But the 16-bit PC Sound Barrier has now been broken. With Sound Blaster 16 ASP: the new Sound Standard for CD-quality PC Audio.

For more information call 1-800-998-LABS.

Sound BLASTER

CREATIVE
CREATIVE LABS, INC.

MICROSOFT® WINDOWS™ COMPATIBLE

© Copyright 1992 Creative Labs, Inc. All specifications subject to change without notice.
Sound Blaster, ASP, and Wave Blaster are trademarks of Creative Labs, Inc. All other software and trademarks are owned by their respective companies.
International inquiries: Creative Technology Ltd. Singapore, TEL 65-733-0233. FAX 65-773-0353.

Circle 157 on Inquiry Card (RESELLERS: 158).

World Radio History

THE KITCHEN SINK IS

If you're getting the feeling the T4500 series represents a new standard in business notebook computing, you're right.

Our T4500C features an LCD TFT active matrix color screen that can display a kaleidoscope of 256 simultaneous colors from a palette of 185,193. Our T4500 offers a large, bright, easy-to-read 9.5" VGA display with 640 x 480 resolution and 17:1 contrast ratio.

A 150-pin expansion port lets you attach a SCSI adapter to the notebook. Or lets you attach the notebook to our Desk Station IV, providing true desktop capabilities in your office.

System control hotkeys save time by allowing you to quickly change your display setting, power management, security status, etc., without having to call up menus.

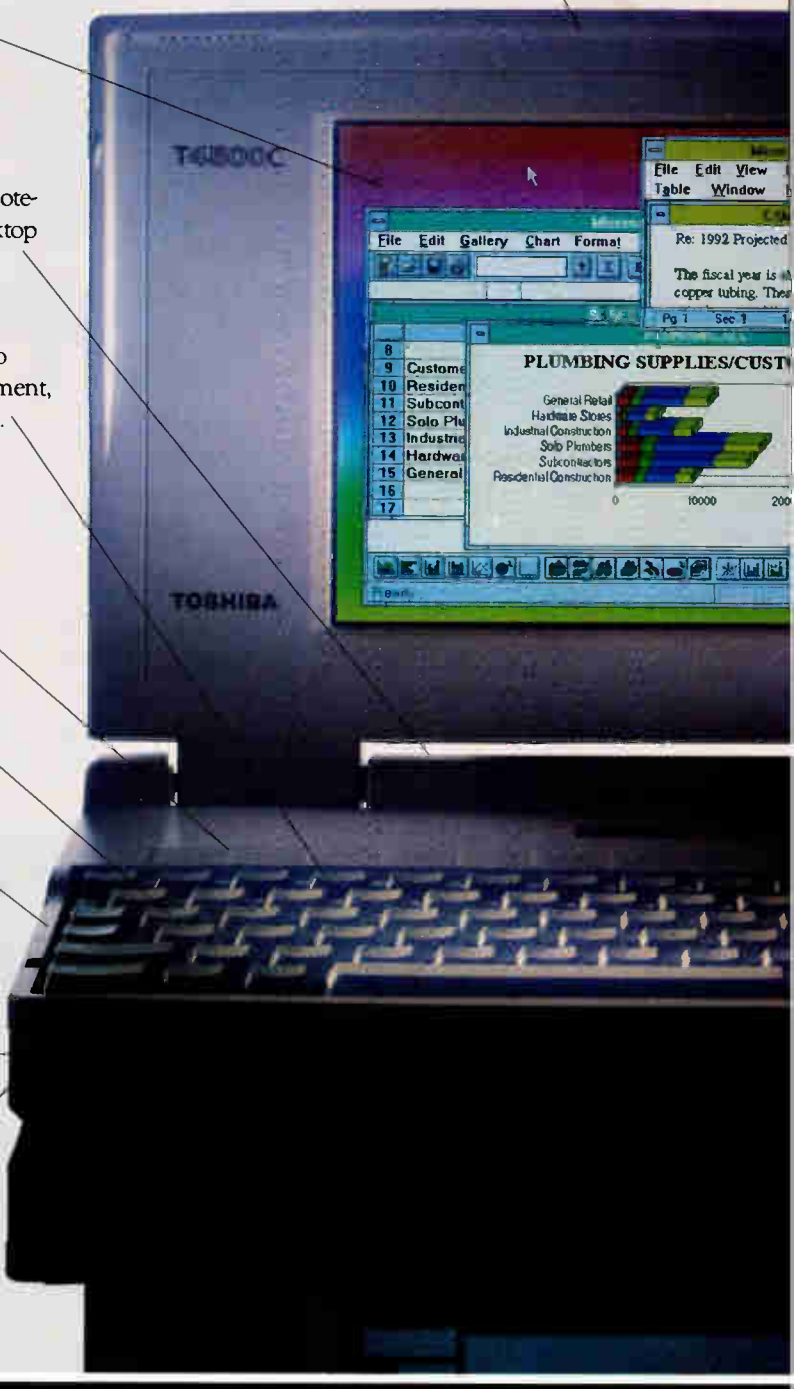
A generous 4MB RAM standard, expandable to 20MB.

Our award-winning keyboard features standard-sized keys and key spacing.

The T4500 series' advanced 20MHz i486™SX processor makes any 386 seem like a tortoise. In fact, tests reveal it's up to two and a half times faster than many 386-based notebooks.

The T4500C comes with a 120MB hard drive and our T4500 comes with a choice of an 80MB or 120MB hard drive.

3.3-volt chip technology decreases power drain by as much as 25%, while adding up to 27% more battery life.



INTRODUCING THE

© 1993 Toshiba America Information Systems, Inc. The Intel Inside logo and i486 are trademarks of Intel Corporation. All products indicated by trademark symbol are trademarked and/or registered by their respective

World Radio History

OPTIONAL.

The T4500C's dimensions: 11.7"W x 8.3"D x 2.0"H.
The T4500's dimensions: 11.7"W x 8.3"D x 1.8"H.
Both fit into half of a briefcase.

Windows® 3.1 and DOS® 5.0 with Ultrafont™ come pre-installed.

AutoResume lets you start where you left off without rebooting and automatically saves your material when you turn the power off.

Our Quick Charge capabilities allow you to charge the battery while you're working.

Featuring AutoResume, AutoSave, Advanced Power Management, and CPU Sleep Mode, our MaxTime™ power management system helps you get the maximum out of every battery charge.

Quickread LCD status icons allow you to check a host of functions (including remaining battery time, keyboard status, and power-saving mode) at a glance.

An industry-standard PCMCIA 2.0 slot accepts removable hard drives, data/fax modems, network adapters, and other expansion options.

The BallPoint™ mouse connects directly to the computer through a unique "one touch" QuickPort,™ so there's no cord to get in your way.

A front-loading floppy drive provides easy access.

Both the T4500 and the T4500C weigh in at about 6.5 lbs.

TOSHIBA T4500 SERIES

The T4500 features a large, easy-to-read 9.5" monochrome screen.

Tests reveal that the 3.3-volt 20MHz i486™SX processor is up to two and a half times faster than many 386-based notebooks.

You can call real-live Toshiba technicians toll-free for complete product support.

intel inside

In Touch with Tomorrow
TOSHIBA
1-800-457-7777

manufacturers.

Circle 142 on Inquiry Card.

World Radio History

PCI or the EISA buses.

By supporting Intel's future PCI bus, DEC will be able to take advantage of the wide variety of low-cost PCI peripherals, graphics, and I/O chips, according to Linley Gwennap, senior editor of the *Microprocessor Report* (Sebastopol, CA, (707) 823-4004). This will provide strong competition, at least on the Windows NT platform, for Intel's Pentium processor and the Mips R4000 family of processors.

—Dave Andrews

High Cost of Chip R&D Sparks New Friendships

The high cost of R&D in creating the next wave of CPUs and memory chips has prompted a new round of collaborations among high-technology firms. Last summer, IBM, Toshiba, and Siemens Nixdorf announced they had agreed to co-develop 256-Mb chips. Currently, Texas Instruments and Hitachi say that they, too, will share research efforts in developing 256-Mb memory chips. And in another alliance, AMD has hooked up with Hewlett-Packard to share development costs and expertise in developing the technology for a new generation of 0.35-micron chips that could range from RAM chips to RISC processors.

AMD and HP are working on a process technology capable of cramming as many as 10 million transistors on a single chip. To reach that goal, they must shrink the minimum feature size to 0.35 micron. (In contrast, the first versions of the Pentium have about 3.1 million transistors and a feature size of 0.8 micron.)

While the two companies have agreed to share technology to develop the smaller submicron process, each company will use the new chip technology individually. AMD and HP hope their collaboration will result in 0.35-micron chips by late 1994, with volume shipments beginning in 1995. That's about the same time industry observers think Intel will introduce the P6.

Although HP and AMD aren't releasing financial details of their alliance, the cost of developing the new submicron technology is estimated at $800 million to $1 billion, according to Charles Boucher, a senior industry analyst at Dataquest. IBM, Siemens Nixdorf, and Toshiba estimate that their development cost on the 256-Mb chip will reach about $1 billion. "The cost is enormous," Boucher said of the HP/AMD effort. "This partnership is very strategic for AMD because it will give them the means to compete with their primary competitor, which is Intel. I think it's a positive move." HP also benefits, as it can apply the submicron technology to its line of Precision Architecture RISC processors and ASICs (application-specific ICs).

—Tom Halfhill

Digital Cellular Radio Spreads Out

PARIS—Vodafone (Newbury, U.K.), one of the U.K.'s two licensed operators of GSM (Global System for Mobile), a pan-European digital cellular-radio network, claims to have completed the world's first simultaneous text and speech transmission over the GSM. The transmission took place entirely within the U.K. between equipment from Vodafone and a digital mobile telephone that Helsinki, Finland–based Nokia manufactures. Messages of up to 160 alphanumeric characters were transmitted to and displayed on the mobile terminal. Vodafone's CEO Chris Gent said, "This first example of simultaneous speech and text transmission in mobile telephony opens the door to a whole series of value-added services, some of which will become available later this year."

Digital GSM offers the potential of better voice transmission than analog cellular phones provide, as well as security through encryption and support for international roaming, although the implementation of cross-border GSM links is still in its early stages.

Another advanced feature promised by GSM is ISDN in cars. Despite teething troubles that delayed GSM implementation by about a year, several networks with restricted geographical coverage went live last summer.

Hong Kong and Australia have already adopted GSM. Two digital formats known as TDMA (time division multiple access) and CDMA (code division multiple access) are vying for acceptance as digital cellular standards in North America for a digital Advanced Mobile Phone Service (AMPS). (For more information on the two formats, see "Stretching the Ether,"

NANOBYTES

Microsoft has big plans for Modular Windows, the simplified version of the GUI for consumer entertainment and information devices. **Rob Glaser**, vice president of multimedia and consumer products at Microsoft, said that one benefit of Modular Windows is that it uses many of the same API calls as Windows 3.1. However, the ease in porting a Windows program to Modular Windows will vary from program to program, he said. For one thing, Modular Windows doesn't have pull-down menus. Glaser advises programmers to "think about what kind of display hardware you want your program to run on. Your next Windows application could be running on more than just an Intel processor. It could also be running on an interactive TV or stand-alone PDA or electronic books." Glaser said Microsoft plans to eventually release a Modular Windows version of its Multimedia Viewer development tool. □

The value of all **X Window System–specific** products and services sold worldwide increased more than 60 percent during 1992, according to the X Business Group (Fremont, CA), a market-research company. The total value of the X industry was $820 million for 1992, up from $510 million in 1991. The software PC X server category grew 217 percent. □

Canon says it has reached a basic agreement to acquire the hardware development and production departments of newly refocused Next. Dr. Keizo Yamaji, president of Canon, said Next originally set out to build great hardware and software. Now it will focus on building great software for Motorola, Intel, and possibly other architectures. □

World Radio History

For Xbase All Roads Lead To CA.

It's been a very difficult and confusing couple of years for Xbase developers. Filled with uncertainty and doubt about the future. At times, some questioned whether Xbase even had a future.

But those days are over.

With the resources, experience and support of the world's leading database company behind it, and with the combined technological wealth of CA-Clipper,® CA-dBFast™ and Computer Associates, the future of Xbase has never looked brighter.

Attention All dBASE IV Developers: Your CA-Clipper/Compiler Kit Has Arrived.

After four years, the compiler kit you've been waiting for has arrived. Introducing new CA-Clipper/Compiler Kit For dBASE IV. The easiest, quickest way in the world to compile a dBASE IV application. All it takes is three easy steps. And in just minutes, you can turn most dBASE IV programs into faster running, higher performance programs.

The new CA-Clipper/Compiler Kit For dBASE IV provides compatibility and database interoperability with most dBASE IV applications. The Kit is implemented using the open architecture of CA-Clipper, including the preprocessor, the Extend System and the RDDs.

Computerworld says CA-dBFast offers top price/performance.

Millions Of Clipper, dBASE, Fox And CA-dBFast Developers Head For The Next Generation Xbase System.

To build the Xbase system of the future, we've added CA's visual tool and client-server technology to Nantucket's next generation Xbase project. This new system will provide a fully object-oriented Xbase language, native code compiler, an IDE (Integrated Development Environment) and both DBF-style and client-server database support.

It will support Windows, Windows NT, OS/2 and UNIX. The complete product will be demonstrated at Fall Comdex and available for beta testing in the fourth quarter of 1992.

Readers of Data Based Advisor compiled first place in CA-Clipper 5.01 for Best Xbase Compiler, Best Development Language and Best Application Development Product.

Secure Your Future When You Team Up With The World's Leading Database Software Company.

Much more than just a PC software company, CA is the world's leading database software company. CA software is used in over 70 countries around the world by more than 10 million users including over 90% of the Fortune 500. From mainframe to midrange to microcomputers, CA database software runs on more platforms, more operating systems, and handles more mission-critical applications than any other software in the world.

Go GUI Today With CA-dBFast Or Go The DOS Route With OOP Via Clipper 5.0.

There are two migration paths to this ultimate Xbase system: The OOP (Object-Oriented Programming) path of CA-Clipper and the GUI (Graphical User Interface) path of CA-dBFast with Windows support.

Both paths will provide immediate benefits and will protect and leverage the substantial investments you've made in Xbase.

For Information On CA-Clipper, CA-dBFast And A Statement of Direction: Call 1-800 CALL CAI.

To get the complete story on The Future Of Xbase, call for this special 30-page statement of direction. It contains an Executive Summary as well as an in-depth discussion of Xbase in the 90s, CA's Open and Client-Server Architectures, Integrated Development Environment, Xbase migration plans and end-user tools.

Call for your copy today. And find out why the future of Xbase will lead you right to CA.

CA-dBFast for Windows and CA-Clipper 5.01 for DOS received honorable mentions for Best Database Manager.

COMPUTER ASSOCIATES®
Software superior by design.

© Computer Associates International, Inc., One Computer Associates Plaza, Islandia, NY 11788-7000. 1-800 CALL CAI. dBASE and dBASE IV are registered trademarks of Borland International, Inc. All product names referenced herein are trademarks of their respective companies.

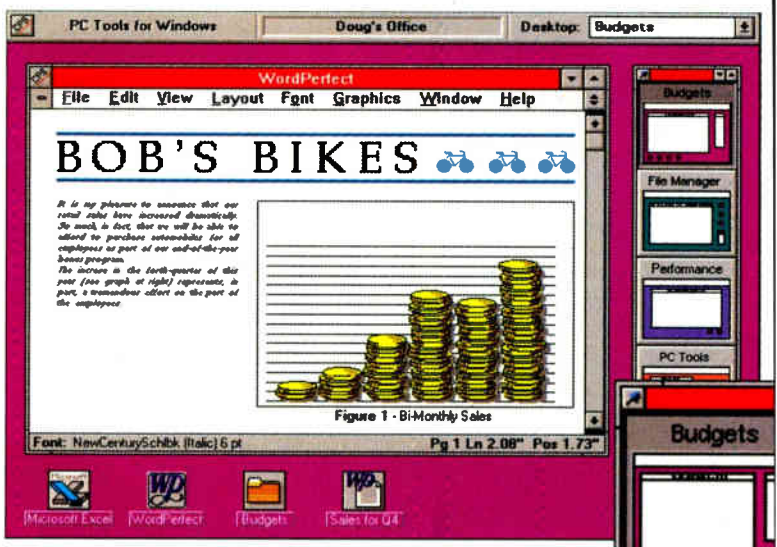
Circle 79 on Inquiry Card.

World Radio History

Introducing PC To
Just think of it

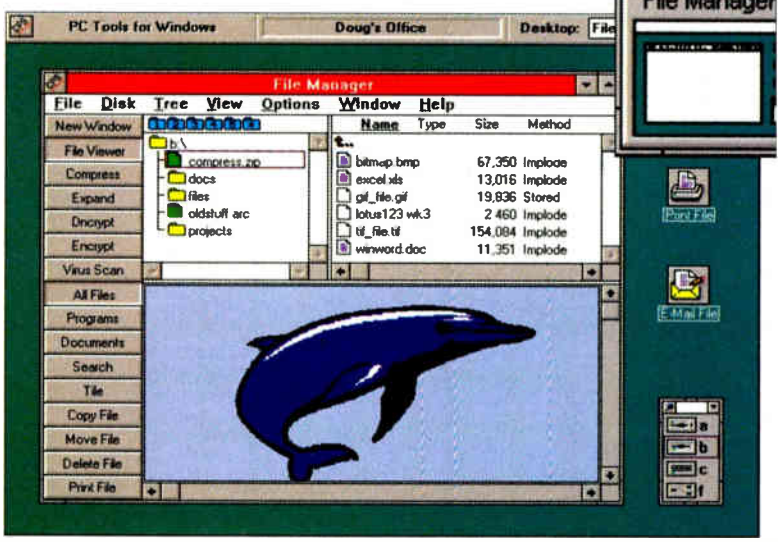
[1]
Organize and simplify your work.

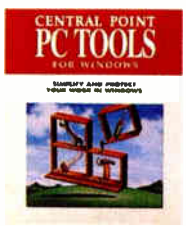
Our unique MultiDesk desktop manager lets you put related applications, folders and files into their own separate desktops. Set up as many desktops as you like, then switch between them instantly. It all adds up to a less cluttered, more productive Windows environment that works like you do.



[2]
Improve the speed and efficiency of common tasks.

Our integrated File Manager has advanced drag-and-drop capabilities that let you quickly locate, view, copy and print files. With over 75 viewers, you can scan files (including compressed PKZIP data) without having to open their applications first. Hate to turn off your PC because you don't want to set everything up again? Our DeskSaver feature solves that problem too.





Windows® is a great product. And someday, it'll be even better. But why wait?

New PC Tools™ for Windows® is here right now. It saves you time, reduces clutter and gives you easy access to all the functions and files you use most often. In fact, PC Tools for Windows is so innovative that after reviewing it, the editors of PC/Computing asked, "Who needs Macs?"

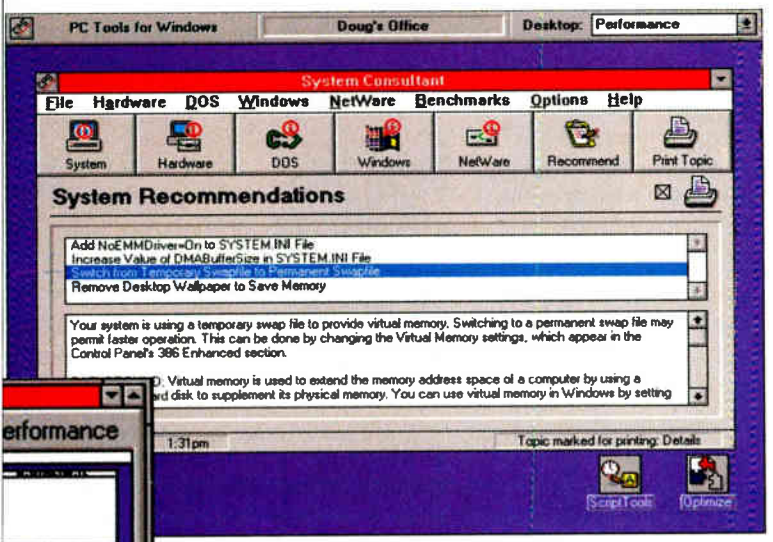
For starters, there's our unique MultiDesk™ desktop. MultiDesk is an intuitive desktop manager that lets you organize your work by creating as many desktops as you need for your projects, tasks, or clients. So, if you spend the day switching between many different projects, you won't lose anything in the clutter.

Ever misplaced a file or couldn't remember its

**Our lawyers said we could run this headline if we make the following absolutely clear: Windows is a trademark of Microsoft Corporation. PC Tools for Windows is the sole product of Central Point Software, Inc. Microsoft and Central Point,® PC Tools,™ MultiDesk,™ WinShield,™ Speed Keys,™ System Consultant™ and DiskFix® are trademarks of Central Point Software.*

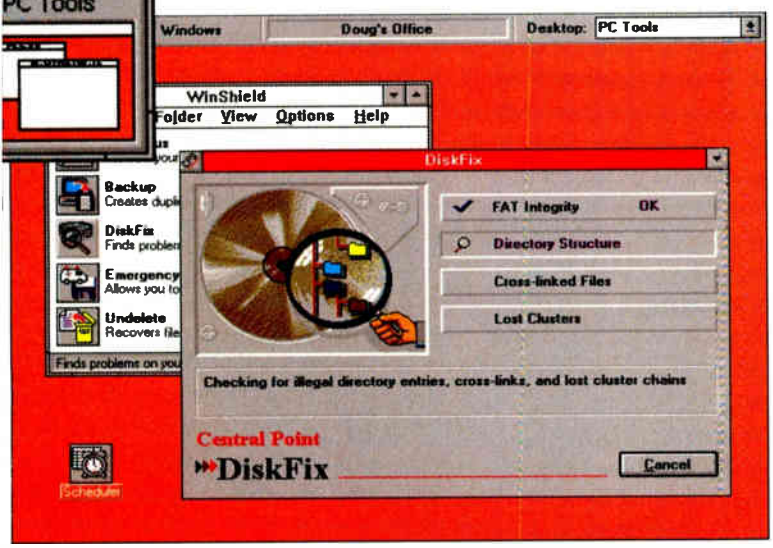
World Radio History

ols™ for Windows.®
as Windows 4.0.*



[3]
Enhance your system's performance.

System Consultant™ performs over 400 system checks and provides recommendations for improving your PC's performance. Our Disk Optimizer can automatically defragment your hard disk at prescheduled intervals, or on command.



[4]
Automatically protect your data.

We've included new Windows versions of Backup, Undelete, Anti-Virus and DiskFix.® They're all integrated in WinShield,™ an automatic data-protection system that results in worry-free computing. Our Emergency Disk builds a bootable recovery disk to help get a crashed system up and running fast.

name? Our File Manager lets you quickly view files without having to load the program first. Tired of cryptic, abbreviated file names? Now you can attach long file names to your data to keep things clear and simple.

We also created Speed Keys™ so you can take shortcuts through Windows, and System Consultant that gives you specific tips for improving system performance.

PC Tools for Windows is at your nearest dealer.

For more information, a free demo disk, or to upgrade from PC Tools for DOS, call us at **1-800-967-9251**. Your purchase is backed by our 60-day guarantee.

Find out for yourself why the editors are already heralding PC Tools for Windows as "The ultimate desktop." It may just be the best thing since, well...Windows.

Central Point Software INC.®

Central Point Software did not collaborate on this product, and this ad is not in any way sponsored by Microsoft. PC Tools for Windows does not replace Microsoft Windows or any future version thereof; it simply complements it. Names of other products mentioned herein are used for identification purposes only and may be trademarks of their respective companies.

Circle 73 on Inquiry Card.

World Radio History

February BYTE.) Minoru Kuramoto, executive manager of R&D for the Mobile Communications Sector at NTT (Japan), said that in Japan, standardized digital systems are also being developed.

Although the Japanese TDMA-based standard is not compatible with Europe's GSM, its use may soon extend into other Asian countries.

—Raymond Boult

Next Abandons the Hardware Business

Next is out of the hardware business. Next chairman and CEO Steve Jobs says the imminent (late May) shipment of NextStep for Intel Processors, the "commoditization" of the hardware industry, and the need to capitalize on its lead in the object-oriented operating-system market forced the company to sell its hardware operations.

The announcement marks the closing of a major chapter in computer history. Despite the Next cube's brilliant design, the company's decision to focus early on the education market, the halfhearted attempt by reseller BusinessLand to sell Next systems, and the machine's design flaws (e.g., the lack of a floppy drive in the original Next cube) doomed the machine. The Next cube may go down in history as a great machine that never found a market.

—Nicholas Baran

General Magic: Come Together with Telescript

General Magic, a company founded in 1990 by former Apple employees, wants to reinvent the telephone, but it may take a decade. Now that the company has announced its formidable partners, it intends to release further details this summer on its Magic Cap operating system and Telescript protocol.

Apple, AT&T, Matsushita, Motorola, Philips, Sony, and others expect the Telescript communications language to form the basis of a new wave of hand-held devices with ubiquitous communications capabilities. EO (Mountain View, CA), an affiliate of AT&T, will use General Magic software in its Hobbit processor-based communicator. But General Magic's president and CEO Marc Porat warned that it will be many years before users can electronically access a train schedule, pay bills, or call up a favorite restaurant's menu.

—Ed Perratore

First Simultaneous-Translation Telephone Call Demonstration

Do you need to negotiate a business deal with the CEO of a German company, but all you can remember from German 101 is how to count to five? Then check out Janus, an experimental continuous-speech translation system with a 400-word speaker-independent vocabulary that translates spoken communication back and forth between languages in close to real time.

The Consortium for Speech Translation Research, a group of scientists from Carnegie Mellon University (Pittsburgh, PA), the University of Karlsruhe and Siemens Nixdorf (Munich, Germany), and the Advanced Telecommunications Research Institute International (Kyoto, Japan) demonstrated Janus in a first-of-a-kind video conference held in January. People in Japan, the U.S., and Germany spoke to one another live in their respective languages while the system simultaneously translated each person's phone conversation.

In Janus, as each person speaks into the system, the speech signal is digitized and preprocessed. Using front-end signal analysis, a recognizer detects the sounds in the input stream by applying neural-network-based classification strategies. The system reviews the top 50 sentence hypotheses so the translation module can select the most plausible sentence to output. Further processing occurs downstream from this point.

Alexander Waibel, senior computer scientist at Carnegie Mellon's School of Computer Science, said that within five years, new learning algorithms should allow for voice-activated dictionaries and phrase books that translate business phrases, travel information, and directions. Waibel said that in five to 10 years, we should see spontaneous domain-specific speech-translation devices for planning trips, reserving hotel rooms, and ordering food. ■

—Janet J. Barron

NANOBYTES

Ross Systems (Redwood City, CA), a company with experience in developing commercial accounting software programs in the minicomputer market, is releasing a suite of financial accounting products for client/server computing on a variety of platforms, including Windows NT, HP-UX, and OSF-1. **Larry Smart**, president of Ross Systems, on the process of rewriting its time-sharing application for the client/server model, said, "The biggest hurdle was rethinking the applications into event driven from time sharing. The interface is different, the old way was sequential, but in an event-driven world, we never know what the user will do next." □

Santa Monica, California–based **Quarterdeck** has reduced its workforce by about 45 people, or about 15 percent. One of the challenges facing the company is to educate the public on its Desqview/X product (see "Was Desqview/X Worth the Wait?" August 1992 BYTE). Stephen Auditore, president of the X Business Group, called Desqview/X a good product from a technical point of view. "They [Quarterdeck] are to be applauded for their efforts, but their [technical accomplishment] doesn't necessarily translate into market success." Quarterdeck plans on releasing version 7.0 of its QEMM memory manager shortly after the release of MS-DOS 6. □

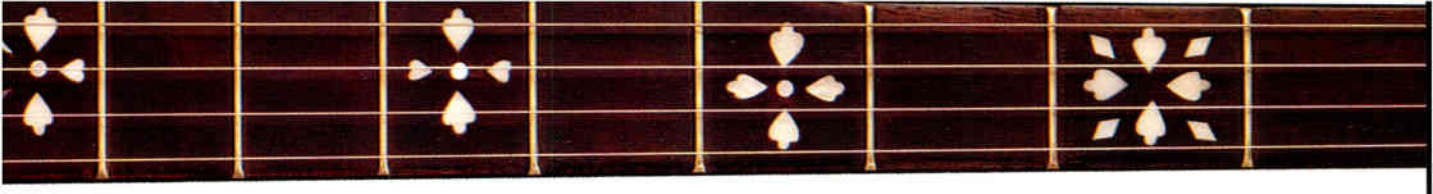
A report from the City University Business School (London) says that 80 percent of companies using groupware apply the technology for tactical work, such as increasing efficiency. The other 20 percent are changing core business practices through computer-based teamwork. ■

World Radio History

We're Playing Your Song!

World Radio History

World Radio History



If Gateway 2000 was a record, what would we sound like? Music to your ears!

Those Old-Time Country Values

by The Low Overheads

Our album would kick off with some great Country tunes because, after all, we're the original country PC company with the low-overhead prices. We're located

in the heartland of America where our factory is bordered by corn and bean fields. KSUX country radio, the Super Pig, is the number one station in these parts (no fooling). Gateway folks are mostly midwest born and raised, and it shows in our quality workmanship and in the friendly, down-home way we treat our customers. We'll bend over backwards to please you. When you buy from Gateway, you get the best price, quality and service. That's a value nobody can beat.

Gimme the Good Stuff –

by Hammer and the Boys

This song is dedicated to everybody who's tired of new technology becoming affordable only after it's upstaged by something better. At Gateway, we offer the latest, newfangled technology at homespun prices.

Baby, Let Me Baby You

by The Support Group

Every Gateway 2000 system comes with excellent after-the-sale support. You get a **30-day money-back guarantee**. If you don't like your system, send it back within 30 days for a refund. All systems come with a **one-year limited warranty** and telephone **technical support** for the life of the system from our award-winning tech department. We received *PC World's* World Class Award in 1992 for best service and support in the hardware category. And in a February 1993 survey, *PC Magazine* readers once again gave Gateway an excellent rating for service and reliability. You also get a **lifetime BBS membership** for additional technical support and online forums.

We offer **on-site service** to most locations in the country (factory service only for notebooks). **Replacement parts** leave our factory as quickly as possible; we pay overnight shipping. Plus we now have **interactive documentation** on desktop systems with pictures and text right on your hard drive (in addition to comprehensive hardware and software manuals).

We make it easy for you to buy a Gateway PC, too, with convenient payment options including major credit cards and C.O.D. terms. Net 30-day terms and leasing options are also available to qualified commercial customers. All this *and* your great-looking Gateway PC comes in our distinctive, country cow-spotted box!

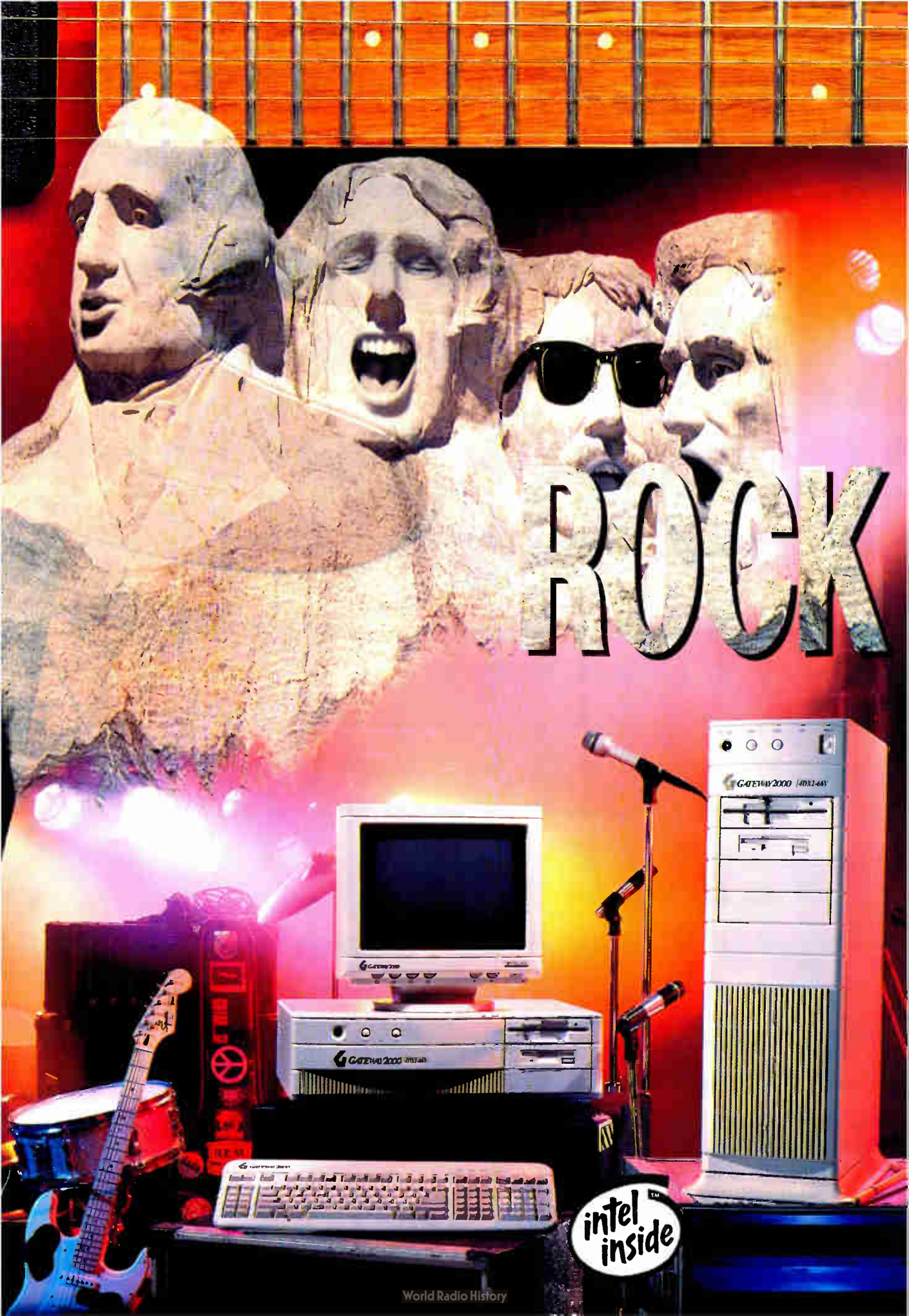
To serve you better, we've hired and trained over 500 new people for customer service, technical support, sales and manufacturing in the past five months, bringing our total number of employees to over 1,900.

GATEWAY2000

800-846-2058

◀ *Gateway's 4SX-33 makes a mighty-fine Windows machine!*

World Radio History



World Radio History

We Got the Goods – *by The Systematics*

Gateway's album would continue with some heart-pounding rock 'n roll cuts because our systems are definitely pure rock. They're cool-looking, hot-performing, high-energy machines – at some sweet prices. There's a model that's perfect for you.

Megahertz So Good – *by Pup and the Cells*

Gateway's mini-desktop systems – 3SX-33, 4SX-33 and 4DX-33 – are petite but plenty powerful, based on a integrated design that incorporates many subsystems on the motherboard for the best price-performance ratio All mini desktop systems include: 4 to 8MB RAM; a large and fast hard drive, operating on the local bus in 486 models for even faster drive performance; a fast video chipset with 1MB; a brilliant, crisp display from the standard 14-inch CrystalScan non-interlaced color monitor; and more available expansion slots than you find in most small-footprint PCs. The combination of these features makes a cool Windows machine for an unbeatable price.

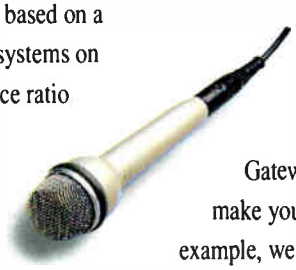
So You Wanta Fly? – *by The Screamin' Vs*

Power users, pick up the phone and order a Gateway 2000 VESA local bus 486 machine right now. You'll never regret it. With our 4DX2-50V or 4DX2-66V models, you get screaming PC performance. We put ATI's Graphics Ultra Pro video card with 1MB VRAM on our VESA local bus for results that are simply awesome! Plus these systems have a hefty 8MB RAM with cache, and hard-rockin' hard drives running on the local bus. Extra VESA local bus expansion slots, too. You get a 15-inch flat, square CrystalScan color monitor – our top-of-the-line – and more choices of cool application software than you'll find anywhere else.

We custom-build each Gateway 2000 computer to your order. We'll gladly provide you with a quote on a special configuration. Call our sales department!

Big Bandwidth Boogie – *by The Gates*

If you're looking for the 32-bit power of an EISA system, we offer three models – 4DX-33E, 4DX2-50E and 4DX2-66E. All models include: 8MB RAM with 256K cache; a very large, very fast SCSI hard drive; 32-bit EISA SCSI controller; and a standard tower case. Please call for details and prices on models not listed on our price page.



Workin' Up Some New Riffs – *by The Harmonics*

This one's our theme song. At Gateway, we're always looking for ways to make your PC easier and more fun to use. For example, we now install a Mach 32 video driver icon in your Windows control panel so you can change your video resolution quickly and easily.

All Gateway systems go through extensive compatibility testing to ensure flawless performance with all products from major software developers and peripherals manufacturers.

◀ *According to* PC World, *"(Gateway 2000's 4DX2-66V is) by far the fastest machine we've ever tested!"*

GATEWAY2000

800-846-2058

World Radio History

World Radio History

Windows to the Other Side – *by Tommy Gee*

Gateway's album would also include jazz favorites because we offer a complete line of software and peripherals to make your system extra cool.

JAZZ

Software Improv – *by Good Vibes*

All Gateway systems come with some very hip software, all pre-installed and ready to run the moment your PC arrives. With mini desktop, desktop and tower systems that include "choice of application software," you get to pick one of the following applications, all latest versions:

- Microsoft® Excel for Windows™
- Microsoft Word for Windows™
- Microsoft Word and Bookshelf 92® CD
- Microsoft PowerPoint for Windows™
- Microsoft Project for Windows™
- The MS Entrepreneur Pack (Works,™ Publisher,™ Money,™ and games)
- Borland Paradox® for Windows™
- The Windows Programmer Pack (MS Quick C,™ Visual Basic and more)
- Upgrade to Microsoft Office™ for $175

All Gateway desktop systems also come with Cool Tools for DOS, a diagnostic and utilities package including QA Plus™ from Diagsoft, Central Point® Anti-Virus and more.

Connectivity – *by The Local Area Group*

TelePath™ Fax/Modem. A 14,400bps modem, V.32bis, with 9,600bps fax capability. Includes WinFax Pro, Crosstalk for Windows, Qmodem. $195

Network Cards. Call for a selection of Ethernet cards and Token Ring adapters, installed and configured.

Microsoft Windows™ for Workgroups. Networking made easy! Price includes an Ethernet adapter and software. Hardware and software factory-installed. $159

WOW – *by Talking Pictures in Motion*

CD-ROM Kit. Includes CD-ROM, interface card and everything you need to add MPC-compliant CD-ROM to your PC. $225

Microsoft Windows Sound System.™ Package includes sound board, microphone, headset and software. $149

Multimedia Accessories. Call for details on other multimedia hardware and software.

Accessorize – *by The Wizbangs*

We offer many other system options and upgrades, including:

- 17" and 20" Monitors
- Tape Backup Units
- Texas Instruments Laser Printers
- Panasonic Dot-Matrix Printers
- Bigger Hard Drives
- Other Software

Call today!

The software and peripherals listed here are sold only with the purchase of a system. For details on our complete line of extras for Gateway customers, call direct to our special add-on components division: ***800-846-2080.***

◀ *Gateway's 4DX-33V is shown here with Windows Sound System components, the CD-ROM kit and optional speakers. Call for details on this system.*

GATEWAY2000

800-846-2058

World Radio History

Gateway 2000's Hit Parade

Desktop Systems

3SX-33

- 33MHz 386SX Intel® Processor
- 4MB RAM
- 5.25" & 3.5" Diskette Drives
- 80MB 17ms IDE Hard Drive
- Windows Accelerated Video w/ 1MB DRAM
- 14" Color CrystalScan™ 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 124-Key AnyKey™ Keyboard
- MS-DOS,® Windows™ & Mouse
- Cool Tools for DOS
- MS Works for Windows™ 2.0

$1295

4SX-33

- 33MHz 486SX Intel Processor
- 4MB RAM
- 5.25" & 3.5" Diskette Drives
- 170MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Intel OverDrive Socket
- Windows Accelerated Video w/ 1MB DRAM
- 14" Color CrystalScan 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 124-Key AnyKey Keyboard
- MS-DOS, Windows & Mouse
- Cool Tools for DOS
- MS Works for Windows 2.0

$1495

4DX-33

- 33MHz 486DX Intel Processor
- 8MB RAM, 64K Cache
- 5.25" & 3.5" Diskette Drives
- 250MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Intel OverDrive Socket
- Windows Accelerated Video w/ 1MB DRAM
- 14" Color CrystalScan 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 124-Key AnyKey Keyboard
- MS-DOS, Windows & Mouse
- Cool Tools for DOS
- MS Works for Windows 2.0

$1995

4SX-33V

- 33MHz 486SX Intel Processor
- 8MB RAM, 64K Cache
- 5.25" & 3.5" Diskette Drives
- 250MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Intel OverDrive Socket
- VLB ATI Ultra Pro with 1MB VRAM
- 15" Color CrystalScan 1572FS
- Desktop Case (Tower Upgrade)
- 8 16-Bit ISA Slots, 2 with 32-Bit VLB
- 124-Key AnyKey Keyboard
- MS-DOS, Windows & Mouse
- Cool Tools for DOS
- Choice of Application Software

$2195

4DX2-50V

- 50MHz 486DX2 Intel Processor
- 8MB RAM, 64K Cache
- 5.25" & 3.5" Diskette Drives
- 250MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Intel OverDrive Socket
- VLB ATI Ultra Pro with 1MB VRAM
- 15" Color CrystalScan 1572FS
- Desktop Case (Tower Upgrade)
- 8 16-Bit ISA Slots, 2 with 32-Bit VLB
- 124-Key AnyKey Keyboard
- MS-DOS, Windows & Mouse
- Cool Tools for DOS
- Choice of Application Software

$2495

4DX2-66V

- 66MHz 486DX2 Intel Processor
- 8MB RAM, 256K Cache
- 3.5" Diskette Drive **AND CD-ROM Drive** ◀
- 340MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Intel OverDrive Socket
- VLB ATI Ultra Pro with 1MB VRAM
- 15" Color CrystalScan 1572FS
- Desktop Case (Tower Upgrade)
- 8 16-Bit ISA Slots, 2 with 32-Bit VLB
- 124-Key AnyKey Keyboard
- MS-DOS, Windows & Mouse
- Cool Tools for DOS
- Choice of Application Software

$2995

4DX2-66E

- 66MHz 486DX2 Intel Processor
- 8MB RAM, 256K Cache
- 5.25" & 3.5" Diskette Drives
- 500MB 11ms SCSI Hard Drive
- 32-Bit EISA SCSI Controller
- Intel OverDrive Socket
- Windows Accelerated Video w/ 1MB DRAM
- 14" Color CrystalScan 1024NI
- Tower Case
- 8 32-Bit EISA Slots
- 124-Key AnyKey Keyboard
- MS-DOS, Windows & Mouse
- Cool Tools for DOS
- Choice of Application Software

$3495

Software Options

With systems that include "choice of application software," pick one from this selection:

- Microsoft Excel for Windows
- Microsoft Word for Windows
- Microsoft Word and Bookshelf 92 CD
- Microsoft PowerPoint for Windows
- Microsoft Project for Windows
- The MS Entrepreneur Pack (Works, Publisher, Money and games)
- Borland Paradox for Windows
- The Windows Programmer Pack (MS Quick C, Visual Basic and more)

You can also upgrade from MS Works to a choice of software for $100, or upgrade from these choices to MS Office for $175.

Service

Every Gateway 2000 system is backed by:

- 30-Day Money-Back Guarantee
- One-Year Limited Warranty
- Lifetime Toll-Free Technical Support
- On-Site Service Available to Most Locations
- Lifetime BBS Membership

Printed on recycled paper with soy inks

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 • 605-232-2000 • Fax 605-232-2023

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

©1993 Gateway 2000, Inc. All prices and configurations are subject to change without notice. AnyKey, FieldMouse, CrystalScan and TelePath are trademarks of Gateway 2000, Inc. The Intel Inside Logo is a trademark and Intel is a registered trademark of Intel Corporation. All other brands and product names are trademarks or registered trademarks of their respective companies.

World Radio History

NEVEN PRASNIKAR

RECOVERY THROUGH TECHNOLOGY

ZAGREB—Only months ago, we were spending most of our time in bomb shelters. That terrible experience is behind us, but we still have to repair the damage that was done to our newly formed nation. One can feel the winds of change, however. Exhausted as we are, Croatians are awakening—lethargy is behind us.

Now it is imperative that Croatians act as quickly and as effectively as we can. And one of the ways to achieve maximum efficiency is through the use of sophisticated computers and communications, from personal computers to large systems. That is probably why the personal computer market is one of the fastest recovering markets in the country. Proof of that recovery was seen quite clearly last October at the Fair Interbiro-Informatika (Interoffice-Information Fair) here in Zagreb. The fair—which is the largest computer and communications exposition in this part of the world—had to be canceled in 1991 because of the war. But the show bounced back in 1992 with about 30,000 attendees—more than it ever had before.

Despite the recent hard times, the shape of Croatian personal computing is not drastically different from that in most Western European countries. The personal computer has invaded both our professional lives and our private lives. It is part of everyday life, just like a car or TV set. Our children are flying spacecraft or driving race cars, destroying joysticks almost on a daily basis. Parents, on the other hand, are more conservative and mostly Tetris fans.

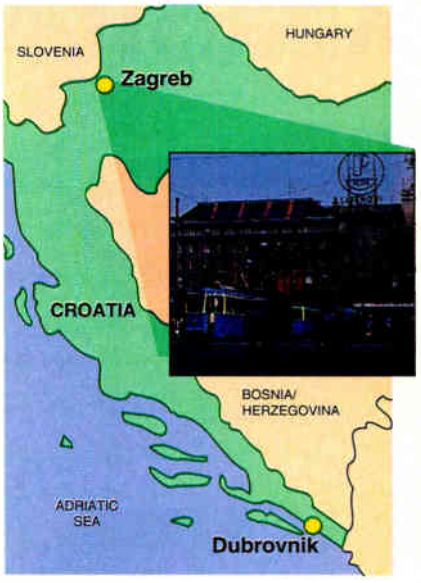
Compared to Western countries, it is true that we have slightly fewer of the more powerful systems, such as those based on 386, 486, 68030, and 68040 processors, or Unix, VMS, or VM operating systems. Also, our distribution network is not completely in place. Many of us—including some local dealers—buy our systems directly from dealers in other countries, especially Germany, the U.K., and Italy. When you look at the number of personal computers imported in this way, you could argue that Croatia is already a member of the European Community.

Unfortunately, so far we are mostly computer buyers. But we do have the potential to produce and export. This would probably not be supercomputers or microchips, but surely it is possible to manufacture some type of peripheral or accessory. The truth is, with a population of only 5 million, Croatia is too small a nation to change the world computer market. However, we can certainly try to make some contribution.

We do have some interesting specialized software products to offer to the world. Croatian programmers are working on all platforms and have already sold many of their products, such as Clipper applications and terminal-emulation programs, to U.S. and Western European software firms.

At the moment, a great deal of attention is being given to changing the educational and legal regulations affecting the computer software market. For example, two years ago, Croatia had poor regulations on software ownership. New regulations, however, are expected to give a boost to software production. With copyright laws in place to help in combating piracy, domestic and foreign software vendors will have a greater incentive to market products in Croatia. Also, new regulations concerning foreign investment should help reassure potential investors from other countries. These changes are now in progress, so more specific information is not yet available.

As Croatia rebuilds, the computer industry is rebounding quickly



One important change for Croatia's future is a greater openness to the rest of the world. Last October, my company, Art Plus Publishing, signed an agreement with McGraw-Hill to publish a Croatian version of BYTE. It's the first agreement by a Croatian firm to publish a magazine in cooperation with a foreign publisher.

As tension continues in the former Yugoslavia, Croatians face many challenges that technology can't solve. However, as this young country looks to a more peaceful future, it hopes for a greater role in the world computer market. ■

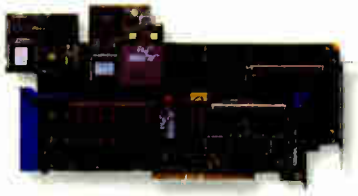
Neven Prasnikar is the president of Art Plus Publishing and the publisher of a Croatian version of BYTE. You can contact him at Art Plus d.d., 41040 Zagreb, Kapelska 5, Croatia, or you can fax him at +38 41 259 201.

PHOTOGRAPHY: PATTI MCCONVILLE / THE IMAGE BANK © 1993

World Radio History

$3,280

KINGSTON PROCESSOR UPGRADES.



Significant Savings, Equivalent Performance.
Kingston's SX/Now!, 486/Now!, MCMaster, ATMaster and the IBM designed SLC/Now! processor upgrades make existing systems perform like new 386SX, 486SX or 486DX models. They provide the power needed for today's software, perform comparably to new systems and cost at least 50% less.

SX/Now!	IBM-AT	With SX/Now! 25	PS/2 Model 57SX-045
Landmark Speed 2.0:	8 MHz	35 MHz	22 MHz
Recount:	5:44 Min.	1:51 Min.	1:54 Min.
Retail Price:		$215	$1,545
SLC/Now!	PS/2 Model 50	With SLC/Now! 25	PS/2 Model 57SX-045
Landmark Speed 2.0:	13 MHz	33 MHz	22 MHz
Recount:	3:34 Min.	1:08 Min.	1:54 Min.
Retail Price:		$245	$1,545
486/Now!	PS/2 Model 70-25MHz	With 486/Now! SX 25	PS/2 Model 90-0H9 SX 25
Landmark Speed 2.0:	39 MHz	84 MHz	84 MHz
Recount:	:55 Sec.	:39 Sec.	:38 Sec.
Retail Price:		$495	$3,280
MCMaster	PS/2 Model 55SX	With MCM SX 25	PS/2 Model 90-0H9 SX 25
Landmark Speed 2.0:	16 MHz	84 MHz	84 MHz
Recount:	2:47 Min.	:36 Sec.	:38 Sec.
Retail Price:		$795	$3,280
ATMaster	PS/2 Model 40	With ATM SX 25	PS/2 Model 90-0H9 SX 25
Landmark Speed 2.0:	21 MHz	84 MHz	84 MHz
Recount:	1:48 Min.	:45 Sec.	:38 Sec.
Retail Price:		$875	$3,280

All systems tested with 16MB installed except ATMaster, tested with 8MB, and MCMaster, tested with 8MB on-board and 8MB on mother board. All system prices are MSRP at standard configuration as of 2/1/93. Processor upgrade prices are MSRP as of 3/1/93. Recount conducted on 3MB Excel for Windows spreadsheet generated by Kingston Technology.

Eliminate Peripheral Replacement and Software Reinstallation.
When upgrading with Kingston, existing peripherals will remain fully compatible with host systems. Re-installation of operating system and application software is eliminated.

Systems Supported.
Kingston's SLC/Now! supports IBM's 286-based systems while SX/Now! supports 286-based systems from AST, Compaq, Epson, Hewlett-Packard, Toshiba and Zenith. 486/Now! upgrades 386DX systems from IBM and Compaq. MCMaster supports all IBM PS/2 Micro Channel systems while ATMaster supports 386SX systems from IBM and Compaq.

1992 BYTE AWARD OF MERIT

Leadership in Processor Upgrades.
Kingston is the industry leader in performance and reliability. Byte Magazine's 1992 Award of Merit *was presented to MicroMaster, the forerunner of the MCMaster.*

World Radio History

$495

SAVE YOUR SYSTEM AND A BUNDLE.

Compatibility is Assured.
Testing with the original manufacturer's diagnostics guarantees 100% hardware and software compatibility. The National Software Testing Laboratory certifies that Kingston's upgrade products are fully compatible.

Both SXNow! and 486Now! are currently certified by The National Software Testing Laboratory. Certification for recent introductions, MCMaster, ATMaster and SLCNOW! is pending.

Easy Installation.
MCMaster and ATMaster upgrades install in any available expansion slot. SLCNow!, SXNow! and 486Now! plug directly into the existing processor socket on the mother board. With Kingston's product manuals that detail the simple, step by step installation, it only takes about 10 minutes to complete the process.

Individual Product Testing.
Every product is bench tested in the system for which it was designed. Testing with original equipment manufacturer system diagnostics assures absolute compatibility. This rare commitment to quality control leads to many years of reliable service.

Kingston Reliability.
Processor upgrade users enjoy the same reliability customers have come to expect from Kingston memory products. Every product is individually tested prior to shipping, supported by free comprehensive technical assistance and backed by a five-year warranty. Thanks to this relentless scrutiny, we have over 5,832,717 products hard at work in the world today.

More Information.
To find out which processor upgrade is best for you, contact your nearby Kingston dealer or give us a call at (800) 835-6575. We'll be happy to answer your questions about processor upgrades or any of our other 615 upgrade products.

[800]

Kingston TECHNOLOGY CORPORATION

THE INSIDE NAME IN UPGRADES

17600 Newhope Street, Fountain Valley, California 92708 (714) 435-2600 Fax (714) 435-2699

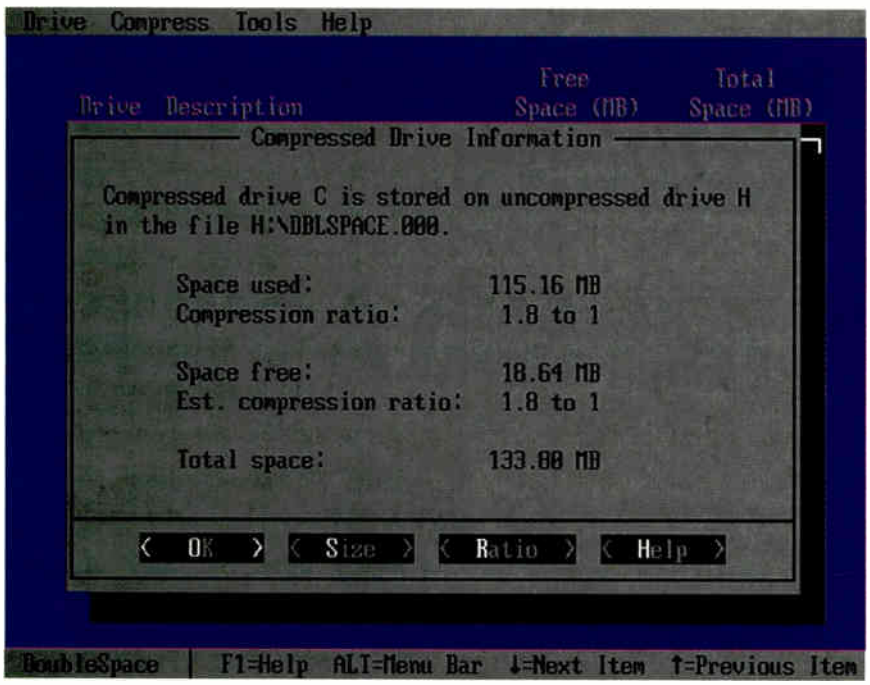
All Trademarks, Registered Trademarks and Logos are of their respective holders. Kingston and Kingston Technology are Registered Trademarks of Kingston Technology Corporation. MCMaster & ATMaster are Trademarks of Aox, Inc.

Circle 94 on Inquiry Card (RESELLERS: 95).

World Radio History

Easy Does It with MS-DOS 6.0

JON UDELL



Screen 1: *MS-DOS 6.0's file compression utility, DoubleSpace, typically expands your hard disk space by a factor of 1.8.*

Compression and memory management take center stage in version 6.0 of Microsoft's venerable operating system

MS-DOS 6.0 aims to make file compression and upper-memory-block management safe for the masses. "I wanted to be sure that my own mother wouldn't have any trouble using it," says Microsoft's Eric Straub, program manager for MS-DOS 6.0, of the new automatic memory management utility, MEMMAKER.

That's the MS-DOS 6.0 upgrade story in a nutshell. The two headline features—compression and memory management—are robust, automatic, and fault-tolerant. I'd hesitate to ask my mother to install Stacker and QEMM, but I'm pretty sure she could install an MS-DOS 6.0 upgrade and achieve essentially the same benefits.

Like other compression utilities, the MS-DOS 6.0 DoubleSpace utility will typically boost your disk space by a factor of 1.8 (see screen 1). My laptop's hard disk, for example, "grew" from 84 MB to 151 MB thanks to DoubleSpace. Multiplied by the 50 PCs in the BYTE editorial department, that effect would translate into more than a gigabyte of space created essentially out of thin air. Multiplied by the 50 million PCs in use worldwide, it would translate into a million-gigabyte ocean of new storage. That much storage will not materialize, of course, but a good chunk of it likely will. Bundled and tightly integrated with MS-DOS 6.0, DoubleSpace tears down barriers of inertia and intimidation that have prevented more widespread use of other compression tools.

Version 6.0 comes with a number of additional tools that you've previously had to buy separately. The package includes a disk defragger, a serial/parallel file transfer tool, an antivirus tool, and client-only NetBIOS LAN software, as well as greatly enhanced backup and undelete tools. Three of these—the antivirus, backup, and undelete tools—offer to install for MS-DOS, Windows, or both.

Truthfully, with the exception of the disk defragger, which is intimately connected to the compression system, I don't expect to use any of these tools much. I've long since settled happily on the likes of LapLink, NetWare, and Network Archivist, and the new MS-DOS 6.0 tools don't begin to compete with these. Still, I'm pleased to see that MS-DOS finally provides a reasonably complete basic toolkit.

Wide Open Spaces

When you finish installing MS-DOS 6.0, you're invited to type ...DBLSPACE to begin the compression process. A great deal of activity ensues, all of it automatic. Like Stacker, DoubleSpace creates a CVF (compressed volume file) in place, so there is no need to reformat your disk. The CVF is a huge MS-DOS file (78 MB of the 84 MB on my laptop's hard disk) that contains an alternative file system used to store compressed files.

To convert an uncompressed disk, DoubleSpace compresses each file (using the Lempel-Ziv-Welch technique) and stores it in the CVF. Space reclaimed from the uncompressed disk enables the CVF to grow. DoubleSpace checkpoints its progress continuously. It is extremely fault-tolerant and will recover without a hiccup even if someone kicks the plug in the middle of a conversion. Files that should not be

World Radio History

compressed, like the Windows permanent swap file, won't be.

The next trick is to get the CVF to show up as drive C. It's here that DoubleSpace differs most noticeably from Stacker and other add-on utilities. MS-DOS 6.0 adds a third kernel file, DBLSPACE.BIN, to the venerable pair of IO.SYS and MSDOS.SYS. Because DBLSPACE.BIN loads early in the boot-up process and maps the CVF as drive C before CONFIG.SYS processing begins, there is no need to manage one version of CONFIG.SYS on the uncompressed disk and another in the CVF.

If you've never used compression, it may take a while to get used to the fact that the free space reported by DIR and CHKDSK is, necessarily, an estimate based on the current average compression ratio. In other words, with 1 MB of actual space left on your disk, the system might report 1.8 MB free. If you try to copy a 1.5-MB text file onto the disk, it will probably fit, because most text files will shrink by at least half when compressed. But if you try to copy a 1.5-MB .ZIP file onto the disk, it won't fit, because the .ZIP file is already compressed and can't get any smaller.

The compression system performs quite well in most cases, thanks partly to the enhanced MS-DOS 6.0 disk cache. SmartDrive now stores compressed data, so it uses the memory allocated to it more effectively. There are times, though, when compression will just get in the way. If you're recording compressed sound samples, for example, you'll probably want to use an uncompressed disk. DoubleSpace doesn't "know" that data won't squash any further, and it will waste time trying to compress it anyway. Fortunately, DoubleSpace makes it easy to slide the boundary between the CVF and the uncompressed disk up or down, so you can put whatever free space you have available where you need it most.

The MS-DOS 6.0 Toolkit

MS-DOS 6.0 provides two disk defraggers. One, based on Norton's Speed Disk, performs a traditional disk reorganization. The other, internal to DoubleSpace, compacts the CVF. They're linked, so when you type DEFRAG, the first defragger invokes the second. (Similarly, CHKDSK spawns a CVF-aware helper when run on a compressed disk.) In the beta version of MS-DOS 6.0 that I tested, defragmentation was an overnight, not a lunchtime, affair. Even so, CVF defragmentation only compacts sectors. It doesn't ensure that all sectors of a compressed file are contiguous. That job will be left to the third-party tool vendors.

MEMMAKER provides much-needed automation for those who use EMM386.EXE and the LOADHIGH and DEVICEHIGH commands. When you run MEMMAKER, it prepends the SIZER command to every device driver and program named in CONFIG.SYS and AUTOEXEC.BAT and reboots your machine. SIZER enables MEMMAKER to figure out how much space these programs really use when loaded. Then MEMMAKER computes and writes out the optimal LOADHIGH and DEVICEHIGH commands, exploiting their new ability to specify particular regions of upper memory, and reboots the machine.

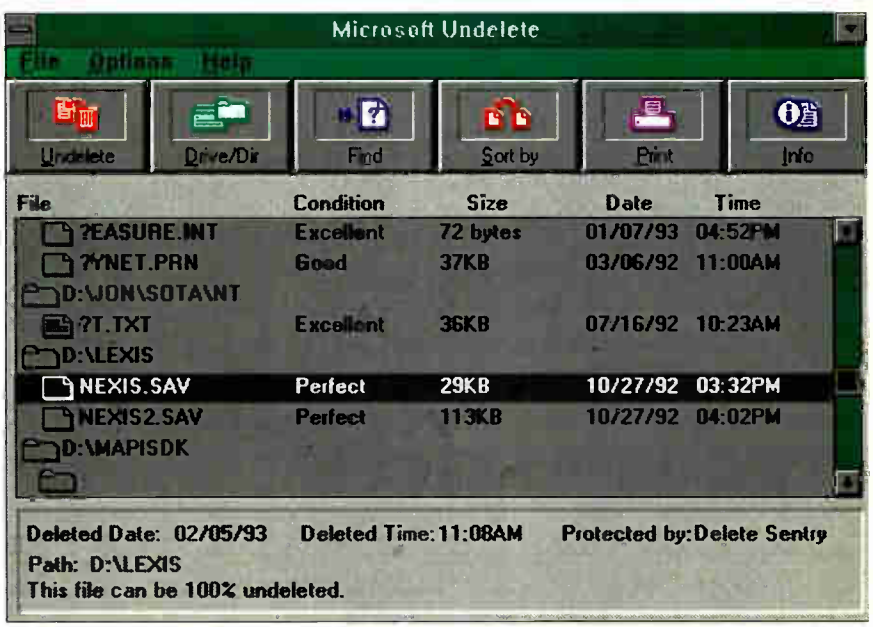
Like DoubleSpace, MEMMAKER is designed to be restartable in case of failure. Some uses of high memory that it attempts are bound to result in a hung machine. Anticipating the possibility of an unscheduled reboot, MEMMAKER always records enough data to pick up where it left off.

The antivirus tools, licensed from Central Point Software, include a monitor that watches for suspicious disk or memory access and MS-DOS and Windows versions of a scanner that checks for (and can expunge) known viruses. The scanners also record file checksums used to detect changes to executable files that may signal viral infiltration. Of course, you've got to take all this with a grain of salt. Many legitimate programs do sneaky things—Windows itself, for example, patches COMMAND.COM when installing. So be prepared for some false alarms.

The undelete tool adds a new level of protection, Delete Sentry, which uses a shadow directory to retain deleted files (see screen 2). With MS-DOS 6.0, you can now undelete directories. However, you can't recover a whole subtree with a single undelete; you've got to reconstruct one level at a time.

With the new backup tools, you can define archive sets and store them on floppy disks or network drives using the same compression technology that's in DoubleSpace. Unfortunately, though, there's no support for tape drives, so if you're not connected to a network, you'll have to trundle a whole bunch of floppy disks to back up your newly enlarged hard drive.

MS-DOS 6.0 will support networking



Screen 2: *DOS 6.0's undelete tool, Delete Sentry, puts deleted files in a shadow directory. You can now undelete directories.*

World Radio History

Circle 88 on Inquiry Card.

Rack & Desk Chassis FOR XT/AT/286/386/486

Integrand's unique packaging design uses modular construction. We have 3 basic models for ISA/EISA bus computers. Over 90 interchangable modules allow you to customize them to nearly any requirement. We make drive enclosures and rackmount keyboards too. Integrand offers high quality, advanced design hardware and strong support. Why settle for less?

Rack & Desk Models
Accepts Most Motherboards and Passive Backplanes
Doesn't Look Like IBM
Rugged, Modular Construction
Excellent Air Flow & Cooling
Designed to meet FCC
204 Watt Supply, UL Recognized
200 & 300 Watt Supplies, UL, CSA, TUV
Reasonably Priced

NOW AVAILABLE Rackmount Keyboards

Three Models: Drawer, Shelf, and Panel
Reasonably Priced

Call or write for descriptive brochures, prices or applications assistance:

INTEGRAND RESEARCH CORP

8620 Roosevelt Ave. • Visalia, CA 93291
209/651-1203
FAX 209/651-1353
We accept VISA and MasterCard

IBM/XT/AT TM IBM • 286/386/486 TM INTEL. Drives and computer boards not included.

and E-mail through a separate Workgroup Connection module ($79.99), which Microsoft had considered incorporating into MS-DOS 6.0. The network support, comprising MS-NET and Microsoft Mail clients, originally debuted as a Windows for Workgroups option, and it's in that context that it would be most useful. Lacking server capability and the protected-mode protocol support of Windows for Workgroups, MS-DOS 6.0 networking in no way competes with the many excellent DOS peer-to-peer LAN products.

The file transfer system has client and server components. INTERSVR runs full-screen on a host, waiting for clients to connect to its local drives (or printers). INTERLNK runs on the client and establishes connections. Unfortunately, you have to load INTERLNK by way of CONFIG.SYS, so you must either pay its 9-KB price all the time or reboot to use it.

Assorted Goodies

If you press F5 while booting up, MS-DOS 6.0 boots clean; that is, it skips your CONFIG.SYS and AUTOEXEC.BAT files. Because I'm constantly reconfiguring my machines and then trying to sort out what went wrong, this little feature is a major convenience for me. There's an even better way to zero in on specific CONFIG.SYS troubles. If you press F8 while booting up, the system prompts for permission to execute each line of CONFIG.SYS. Have you ever been frustrated trying to read the message printed by a problematic device driver as it flashed by on the screen? Now you can freeze the action and take a good look at those messages.

MS-DOS 6.0 also provides a set of handy tools for organizing the boot-up process. Using a new CONFIG.SYS command, MENUITEM, you can create multiple paths through CONFIG.SYS. When I boot up my laptop, I get a menu of three choices: Standalone, NetLocal, and NetRemote. All configurations share a common block of commands. Standalone loads no network support, NetLocal connects me to NetWare and Windows for Workgroups through a Xircom adapter, and NetRemote connects me to Windows for Workgroups by way of an asynchronous connection to a Shiva NetModem.

Because the name of the chosen configuration shows up in the environment variable `config`, I can branch appropriately in AUTOEXEC.BAT as well (using `goto %config%`). I use at least two of these configurations almost every day, so I really appreciate the multiconfiguration support. There's one glitch, though. MEMMAKER isn't aware of multiple configurations, so for optimal results, you still have to maintain multiple CONFIG.SYS files and run MEMMAKER on each of them.

Another nice touch is the ability to slosh memory back and forth between EMS and XMS (Extended Memory Specification) memory as needed. In earlier versions of MS-DOS, the boundary between the two was fixed. As a FoxPro user, that caused me considerable grief. FoxPro 2.0 really wants a chunk of EMS, but it comes out of the same pool of extended memory that Windows as well as other MS-DOS applications (including the DOS-extended FoxPro 2.0) would prefer to treat as XMS. MS-DOS 6.0 solves the problem, enabling the EMS and XMS pools to adjust dynamically.

I'm also glad to note the belated arrival of three long-needed commands. DELTREE and MOVE are the MS-DOS equivalents of the Unix commands `rm` and `mv`. DELTREE lops off entire trees of directories and subdirectories, and it can also delete individual files marked hidden, system, or read-only. MOVE transplants files from one directory to another, and it can also rename a directory. The third command is CHOICE, which prompts for a single character of input and returns an ERRORLEVEL. It's crude, but it means you can finally write interactive batch files without resorting to an external utility.

MS-DOS 5.0 wasn't the long-rumored "high-tech" DOS with protected-mode capability, threads, and long filenames, and neither is MS-DOS 6.0. But I'm not complaining about version 6.0. It delivers enormous practical benefits and is by far the most compelling MS-DOS upgrade yet. ■

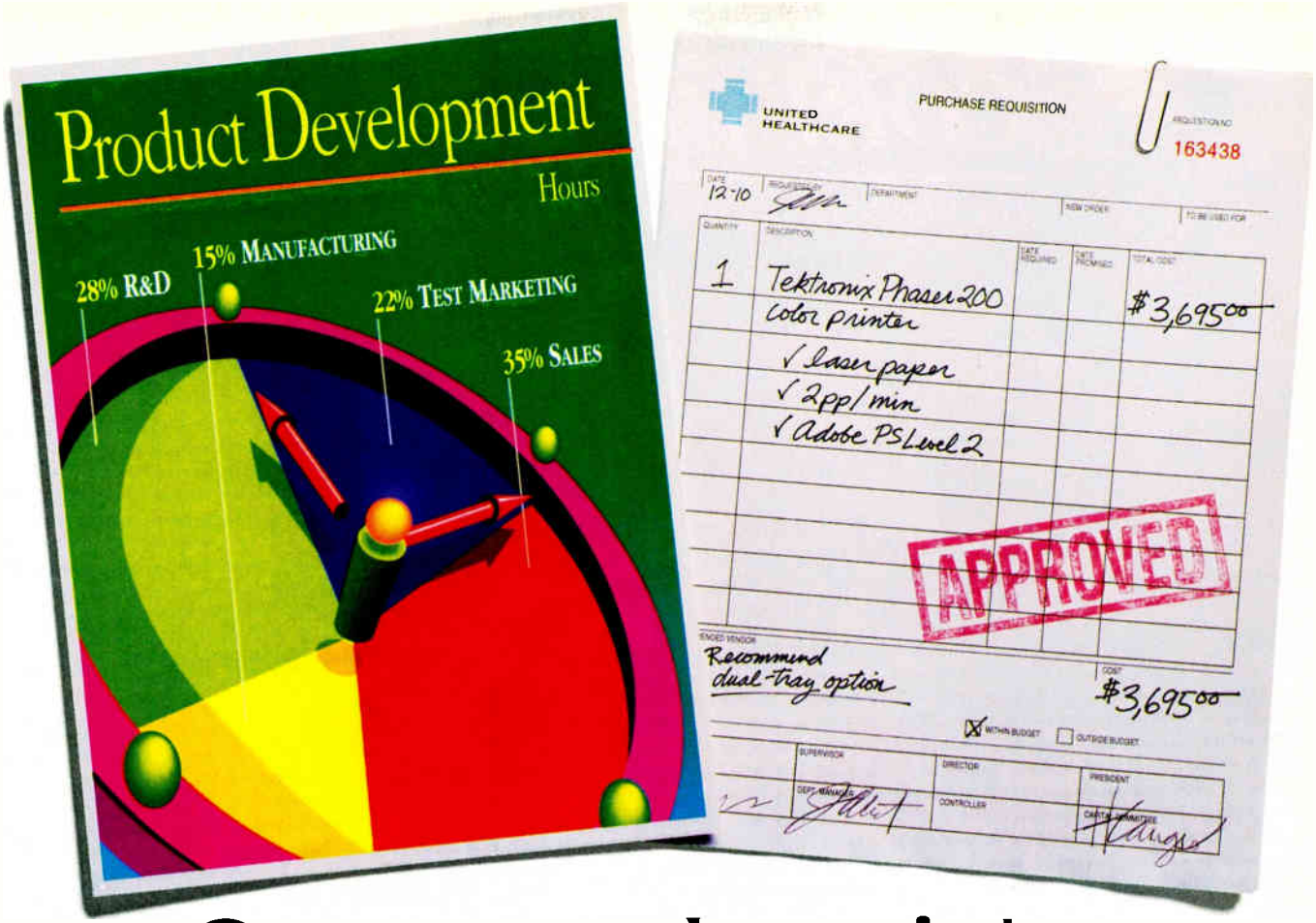
Jon Udell is a BYTE senior technical editor at large. You can contact him on BIX as "judell" or on the Internet at judell@bytepb.byte.com.

THE FACTS

MS-DOS 6.0
$129.99 ($49.99 for the first 60 days)

Microsoft Corp.
1 Microsoft Way
Redmond, WA 98052
(800) 426-9400
(206) 882-8080
fax: (206) 936-7329
Circle 1181 on Inquiry Card.

World Radio History



Our new color printer not only looks great on paper, it looks great on paper.

True, the brilliant color produced by the new Tektronix Phaser® 200 is captivating. But the price is equally attractive. And though we've become the award-winning leader in color printers by frequently outdoing the competition, this time we've even outdone ourselves. Introducing our newest business work group color printer.

The eye when it sees black and white.

The eye when it sees color.

The Phaser 200 is compatible with virtually any business software and can print two colorful pages per minute. No, not two minutes per page—two pages per minute. And even at a speed like that, it still manages to print eye-catching color on common laser paper or transparencies using a separate input tray for each. You select the medium you want at your computer keyboard. And it switches automatically from user to user just as easily, using its parallel, serial, AppleTalk,™ or optional EtherTalk™ and Ethernet™ ports.

It has all the advantages of a laser printer. True Adobe PostScript™ Level 2, networkability, Pantone® colors, speed and price. (Did you notice it's only $3695, slightly below unheard of?) And when you add to that extremely high materials capacity and sparkling TekColor™ output—not just any color, but the indisputably best color in the business—you've got something even better than our previous best. Which is quite a feat.

So stop by your nearest Tektronix dealer or call us at 800/835-6100, Dept. 28J for a free output sample. For faxed information call 503/682-7450, ask for document #1223. You won't find another business investment that looks this good on paper.

Tektronix

Phaser is a trademark of Tektronix, Inc. PostScript is a trademark of Adobe Systems, Inc. All other marks are trademarks or registered trademarks of their respective companies.

Circle 138 on Inquiry Card.

World Radio History

CorelSCSI!

The Best Software to Connect PC Peripherals

Connect up to Seven Peripherals!

It's easy! Add all the SCSI devices you need to your system. CorelSCSI makes it simple and inexpensive. CorelSCSI provides you with all the software you need to install and manage all your SCSI devices including: CD-ROM drives, rewritable and WORM optical drives, hard drives, jukeboxes, tape drives, and many more.

Unlimited Flexibility!

CorelSCSI software works with major SCSI host adapters including Adaptec, Always, BusLogic, D.P.T., and Future Domain. CorelSCSI will allow installation of SCSI devices on DOS, Windows or OS/2 systems. CorelSCSI software will even allow you to set up CD-ROMs, optical drives or jukeboxes on your NetWare* file server!

*Novell Netware 3.0 or higher

"With its low cost and vast array of device support, CorelSCSI provides a great new way for PC users to make easier peripheral connections."

M. Keith Thompson, PC Magazine, June 1992

Compatible host adapter companies:

adaptec — When you're serious about SCSI.
DPT
always technology
FUTURE DOMAIN
BUSLOGIC

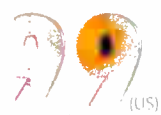
Value Packed!

CorelSCSI software includes bonus programs and utilities such as CD-Audio, Core Tape Backup software and complete diagnostic tools.

Quick Installation!

CorelSCSI software is quick and easy to install and will get you up and running immediately. CorelSCSI will ask what devices are connected and install the correct drivers automatically.

If you have CD-ROM drives, tape drives, or any other SCSI devices, you need Core SCSI!



Suggested Retail Price

Look for the CorelSCSI Approved Product logo

yes NetWare Tested and Approved

MICROSOFT® WINDOWS™ COMPATIBLE

1-800-836-SCSI

Circle 80 on Inquiry Card.

World Radio History

Photoshop Now Does Windows

TOM YAGER

The latest version of Adobe Photoshop extends its color-imaging techniques to Windows and revs up its image on the Mac

Adobe, whose graphics products have helped define the Macintosh, is extending its reach with the release of Photoshop for Windows. At the same time, the company is upgrading the Mac Photoshop to version 2.5, a release that matches its PC counterpart.

If you have never seen Photoshop, you've missed one of those glorious rare moments when software approaches perfection. Adobe is humble about Photoshop, calling it a "photo design and production tool," but no one who's used Photoshop is so reserved. In the time it spent running exclusively on the Mac, Photoshop established itself as the standard for desktop color-image processing. (More than a few Macs were bought expressly to run Photoshop.)

Photoshop's attraction is its scope: This one tool handles practically everything you'd want to do with a color image. Scanning, converting format, painting and retouching, correcting color, composing, cropping and resizing, separating color, printing, and creating special effects are but a few of the capabilities of this do-everything image-processing application.

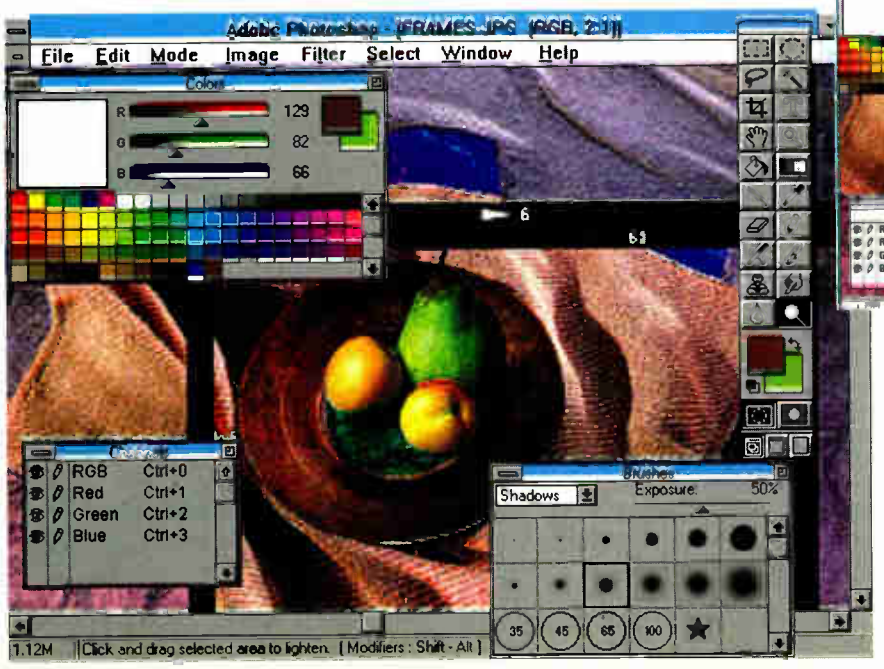
I worked with prerelease copies of both the Windows and Mac editions of Photoshop 2.5. The systems I used were a Mac IIci with 8 MB of memory and an 8•24 GC graphics card and a Uniq 486/50 EISA system with 8 MB of memory and a Matrox Illuminator Pro graphics card (part of my Matrox Studio setup). Both systems were set to run in 24-bit graphics mode.

Feature Heaven

Both versions of Photoshop 2.5 include some impressive features and usability enhancements. The most visible new stuff falls roughly into eight categories: quick mask mode, dodge and burn, brushes and channels palettes, a pen tool, duotones, a variations interface, and new special effects filters.

Quick mask mode causes Photoshop's tools to switch from image to mask modification. You see a mask as a semitransparent film (red by default) over your image. You can use selection and painting tools to build your mask and then switch out of quick mask mode to turn that mask into a selection. You can use a selected area to protect portions of your image from modification or as a target for filters and other selection-oriented tools.

The dodge and burn tool's purpose is



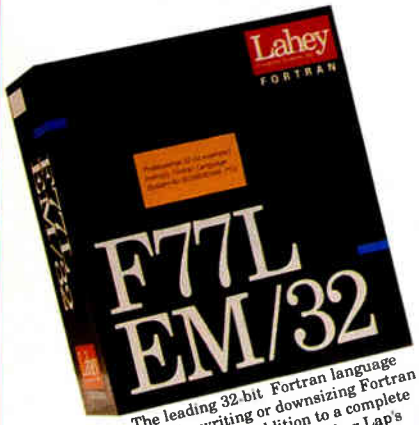
Screen 1: *Photoshop 2.5 for Windows (left), showing tools, brushes, channels, and colors palettes. Adobe designed the interface to offer rapid access to common functions and information.*

Screen 2: *Photoshop 2.5 for the Mac is almost identical to its Windows counterpart except for the Mac look and feel. System 7 Publish/Subscribe and QuickTime image manipulation are two features unique to the Mac version.*

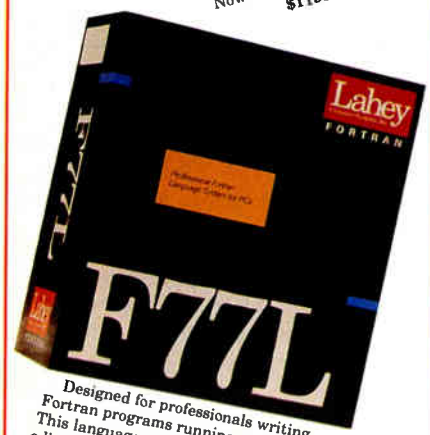
World Radio History

Circle 96 on Inquiry Card.

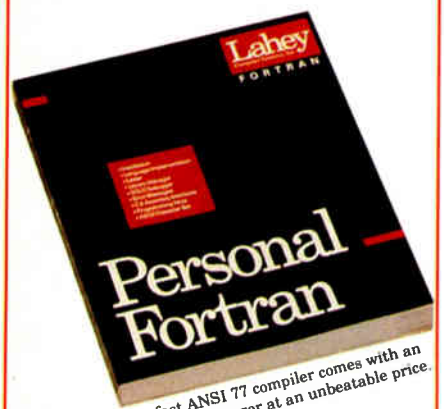
Just Add Code.



The leading 32-bit Fortran language system for writing or downsizing Fortran applications. In addition to a complete toolset, EM/32 includes Phar Lap's 386|DOS-Extender with virtual memory and free runtimes. Now shipping version 5.1
$1195



Designed for professionals writing Fortran programs running under DOS. This language system's tools include an editor, debugger, profiler, linker, library manager, and make utility.
$295



This fast ANSI 77 compiler comes with an editor and debugger at an unbeatable price.
$99

(800) 548-4778

Free, Unlimited Technical Support
30-Day Money-Back Guarantee
Same-Day Shipping

Lahey
Fortran is our forte

(702) 831-2500
Fax: (702) 831-8123
P.O. Box 6091
Incline Village NV 89450

similar to that of darkroom tools of the same name, which either block light from the enlarger to lighten parts of an image (i.e., dodge) or cause regions of the print to darken through additional exposure (i.e., burn). You can use this tool to enhance or soften shadows, make a background less distracting, or otherwise darken or lighten portions of an image.

The dodge and burn, paint, stamp, and other tools alter your image using shapes stored in Photoshop's brushes palette (see screens 1 and 2). A selection of circular brushes is standard, with both hard and feathered edges. In the new Photoshop, you can add any selected shape to the brushes palette. As you select tools, the top of the brushes palette window offers quick access to useful tool options. When the dodge and burn tool is in use, for example, the brushes palette lets you select the range of brightness values (i.e., shadows, midtones, or highlights) to affect your image and the percentage of exposure each sweep with the tool will apply.

One way to use the channels palette is to view and modify the components of your color image separately. A 24-bit RGB image, for example, starts with three channels: red, green, and blue. The channels palette lets you switch your view from the composite color image (i.e., the default) to one or more of the component channels. You can also add channels (up to a total of 16) for alpha-channel effects in other programs (e.g., Matrox Studio's Personal Producer), saving masks and selections, image overlays, and calculated operations such as subtracting one channel from another.

The new pen tool gives you more precise control over the shapes you create to define selection areas and masks. The tool builds Adobe Illustrator–style paths with straight lines and Bézier curves. A path the pen tool creates can, in addition to acting as a means of creating a selection, be filled or stroked. That is, the interior of the shape created with the path can be painted with a color or pattern.

Duotones refers to a process in which a gray-scale image is printed with two colored inks. Each of the inks is assigned to a range of gray tones, expanding the number of distinct gray levels a screened, printed image can represent. Photoshop supports monotones through quadtones, meaning you can manage up to four ink colors. You create a curve to set the range of grays covered by each ink. You can apply inks other than grays to the image to create attractive toning and colorization effects.

The new variations dialog box simplifies color correction by presenting multiple miniature views of your image (or a selected portion) and letting you see the effect changes would have before you apply them. You can modify hue, saturation, brightness, and contrast here through a commonsense interface. If you need to color-correct an image, for example, you can simply click on the icon that says "more magenta," and you see a preview of the effect the added magenta would have. You can continue to click on the preview icons until the "current pick" image reflects the effect you want. A comparison between the original and would-be modifications is always visible.

Finally, Photoshop 2.5 adds a host of special effects filters. Users of Adobe Premiere on the Mac will recognize many of them. Tile breaks an image into squares and slightly (and randomly) skews each segment to give the image the appearance of being printed on a matrix of cardboard shapes that weren't fitted together very well. Extrude, similar to Tile, turns the image into a matrix of square-capped tower shapes that convincingly simulate depth in a weird but appealing way.

A distortion filter warps the image, other filters build line-art-like drawings, and a host of others apply either purely artistic or functional changes. One functional filter prepares an image for display on a TV monitor by filtering out NTSC-illegal (oversaturated) colors and diminishing interlace jitter through scan-line duplication or interpolation.

Photoshop 2.5 is one of those grand tools that adapts itself to the shape of the work to be done. In bringing it to the PC, Adobe legitimizes the use of Windows systems for serious graphics work. ■

Tom Yager is a multimedia consultant and author of The Multimedia Production Handbook for the PC, Macintosh and Amiga *(Academic Press, forthcoming). He can be reached on BIX as "tyager" and on the Internet at tyager@bytepb.byte.com.*

THE FACTS

Adobe Photoshop 2.5 for Windows and the Macintosh
$895 each

Adobe Systems, Inc.
1585 Charleston Rd.
Mountain View, CA 94039
(415) 961-4400
fax: (415) 961-3769
Circle 1182 on Inquiry Card.

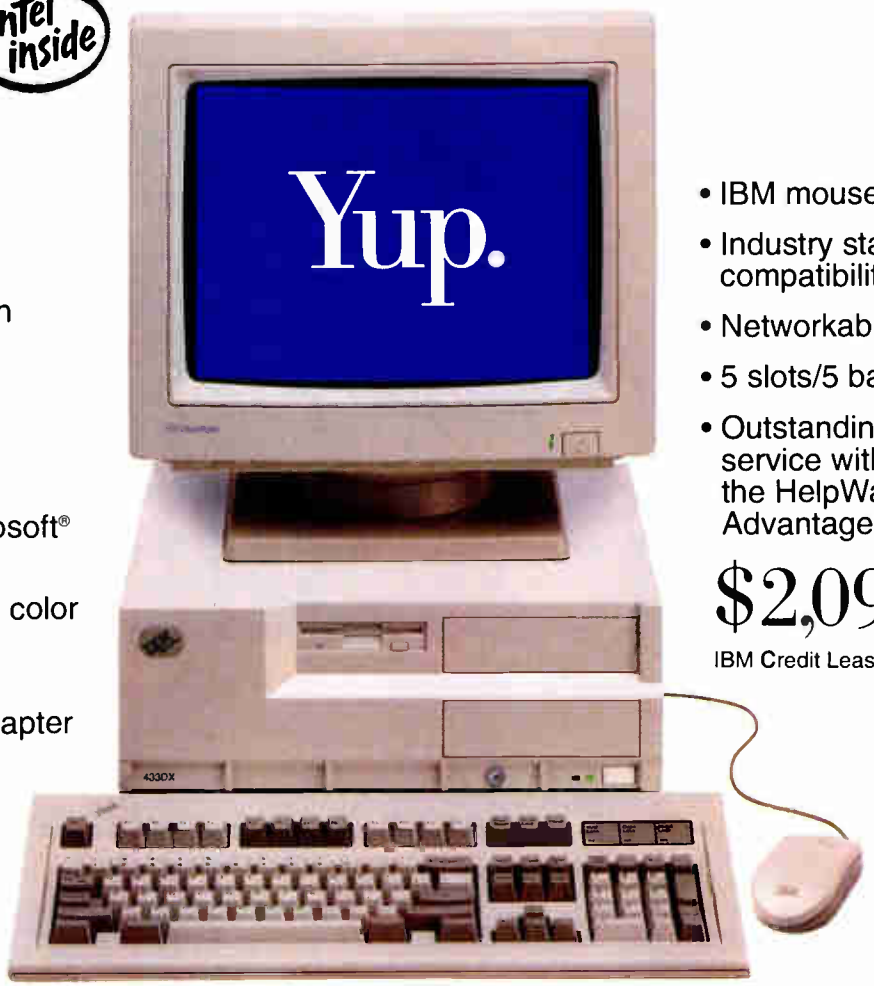
World Radio History

"You mean I can get all this from IBM Direct for just $2,099?"

intel inside

PS/ValuePoint™
433DX

- i486™ DX/33MHz processor
- Internal i487™ math coprocessor
- 4MB RAM
- 120MB hard drive
- Pre-installed IBM® DOS 5.0 and Microsoft® Windows™ 3.1
- 6312 SVGA NI 14" color display†
- PowerGraph X-24™ graphics adapter
- 1MB video DRAM
- 128KB L2 cache
- 8KB internal cache
- 3.5" 1.44MB diskette drive



- IBM mouse
- Industry standard compatibility
- Networkable
- 5 slots/5 bays
- Outstanding service with the HelpWare™ Advantage

$2,099*

IBM Credit Lease $76/mo.**

Order now from IBM Direct.
1 800 IBM-2YOU.

World Radio History

Get everything you expect. And more.

PS/ValuePoint **325T**

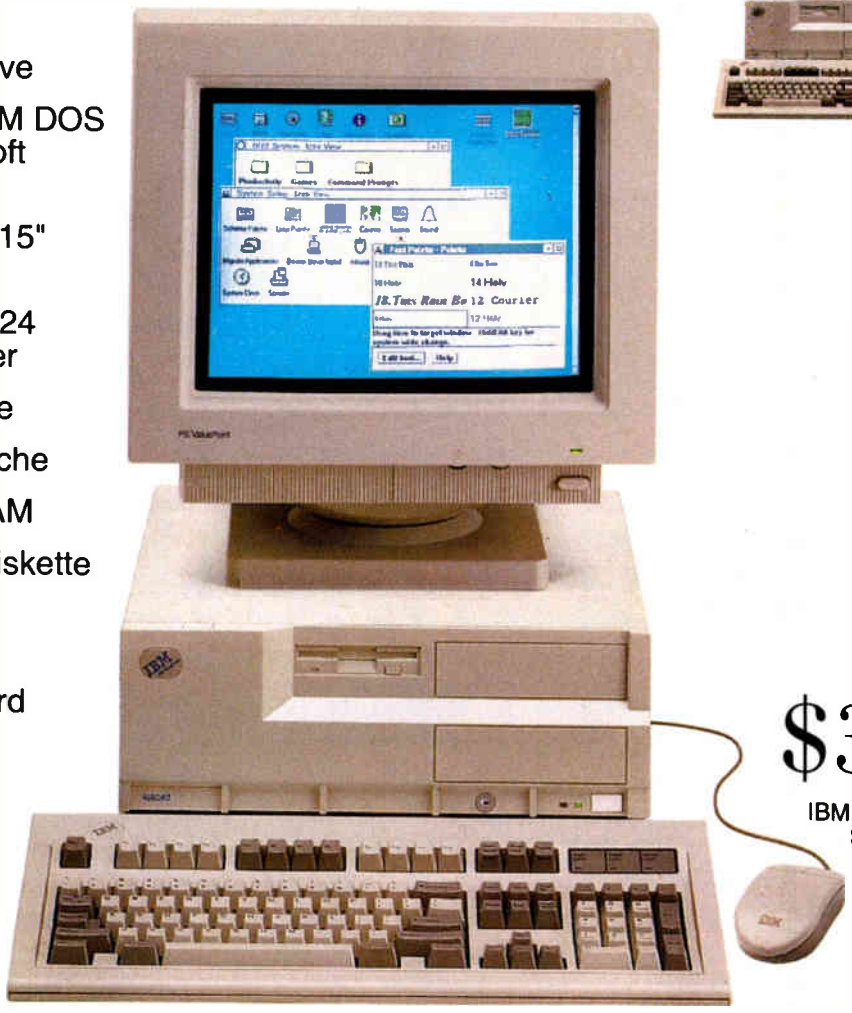
- 386SLC™/25MHz processor
- 2MB RAM
- 80MB hard drive
- Pre-installed DOS 5.0
- PS/2® 8511 VGA color display
- 3.5" diskette drive
- IBM mouse
- 5 slots/5 bays
- Industry standard compatibility
- Outstanding service with the HelpWare Advantage

$1,199* IBM Credit Lease $44/mo.**

PS/ValuePoint **466DX2**

Get mind-blowing, double-clocked speed and power.

- i486DX2/66MHz processor
- Internal i487 math coprocessor
- 4MB RAM
- 212MB hard drive
- Pre-installed IBM DOS 5.0 and Microsoft Windows 3.1***
- 6319 SVGA NI 15" color display†
- PowerGraph X-24 graphics adapter
- 128KB L2 cache
- 8KB internal cache
- 1MB video DRAM
- 3.5" 1.44MB diskette drive
- IBM mouse
- Industry standard compatibility
- Networkable
- 5 slots/5 bays
- Outstanding service with the HelpWare Advantage



$3,225*

IBM Credit Lease $116/mo.**

Get on the phone!

World Radio History

ThinkPad™ 700C†

PCComputing MVP

Get eye-popping, big-screen notebook color.

- 486SLC™ /25MHz processor
- Big, brilliant 10.4" active matrix color display
- DOS 5.0 and PRODIGY®†† pre-installed
- TrackPoint II™ keyboard-integrated pointing device
- 4MB RAM (up to 16MB maximum†††)
- 120MB hard drive (removable)
- 3.5" diskette drive
- Full-size keyboard
- NiMH rechargeable battery pack
- Slip-in IC DRAM memory cards
- Outstanding service with the HelpWare Advantage

$4,139*

IBM Credit Lease $149/mo.**

ThinkPad 300†

intel inside

- 386SL/25MHz
- 4MB RAM
- 80MB hard drive
- DOS 5.0 pre-installed
- Integrated STN LCD display
- 3.5" diskette drive
- Outstanding service with the HelpWare Advantage

$1,999* IBM Credit Lease $72/mo.**

IBM Direct

Quality, service, selection and price.
Just call IBM Direct. It's that easy to get IBM PC products delivered right to your door. Or for more information on IBM products, call our automated fax system at 1 800 426-3395.

Choose the best way to pay.
Easy payment methods: American Express, VISA, MasterCard, Discover card or personal check. Personal checks are subject to credit approval. Purchase order is available for qualifying customers.

Hundreds of IBM products
The 40-page IBM Direct Catalog features other IBM PS/ValuePoint and ThinkPad configurations. The catalog highlights a broad range of other products such as application software, storage devices, memory options, connectivity adapters and much more. And if you want a PS/ValuePoint system with OS/2® 2.0, that too is available on many configurations.

The HelpWare Advantage

- **One-year on-site warranty for PS/ValuePoint products and ThinkPad 300.**
- **Three-year international warranty for ThinkPad 700 and 700C (in U.S., first year on-site).**
- **24-hour 800# assistance, 7 days a week[1]**
- **4-hour service response time, on average[2]**
- **24-hour Bulletin Board and Automated Fax**
- **Hassle-free, 30-day money-back guarantee[3]**
- **Plus 10,000 IBM service representatives at 1,600 locations backed by a $1 billion parts inventory**

[1]At no additional charge during warranty.
[2]Available Monday through Friday 8 am–5 pm in your time zone, when serviced by IBM. If parts are required, this service is provided after receipt of parts overnight. Applies to IBM Direct sales only.
[3]Warranty and 30-day guarantee information available from IBM and IBM authorized dealers. Please call 1 800 426-2968 for details regarding IBM's money-back guarantee and limited warranty. Copies of the terms of IBM's money-back guarantee and limited warranty are available upon request.

*IBM prices only. The offerings, prices and products are subject to change or withdrawal without prior notice. Products you acquire may not be counted under any existing Volume Purchase Agreement. The same offerings and products may be available through IBM Authorized Remarketers. Remarketer prices may vary. Shipping and handling charges are extra.
**IBM Credit Lease prices quoted are for 36-month terms. Lease rates quoted are good through 4/30/93, after which time rates are subject to change without notice. Lease available to qualified commercial customers only.
***Screen at right depicts OS/2, also available pre-installed on this model.
†ThinkPad 300 and 700C systems and options are manufactured in Japan. PS/ValuePoint 6312, 6314, and 6319 Color Displays are manufactured in Korea. PowerGraph X-24 graphics adapter is manufactured in Mexico.
††PRODIGY will not run without a modem. A modem is not included with the ThinkPad 700C. A customer who acquires a ThinkPad 700C and a modem which operates at a speed below 9600bps may contact PRODIGY to obtain a One-Month Free Trial Membership.
†††Available at additional cost.

Call IBM Direct.

CALL TO ORDER TODAY
1 800 IBM 2YOU
1 800 426-2968, refer to: X413BYTE
8am-9pm M-F, 9am-5pm Sat., EST.

Circle 86 on Inquiry Card.

World Radio History

"And the IBM Direct Catalog has more?"

You bet. This page offers just a sampling of the more than 250 advanced technology products found in the 40-page IBM Direct Catalog. From IBM desktops, ThinkPads and displays to adapters, peripherals, software, network connectors, even multimedia options. When you call we'll be glad to guide you to the IBM products most appropriate for your needs. We can also provide you with accurate specifications and answer any questions you may have.

Call 1 800 IBM-2YOU

Call now for your copy of the IBM Direct Catalog—a comprehensive source for a broad range of products available through IBM Direct.

Free

IBM LaserPrinter

An IBM LaserPrinter 6 delivers up to 6-pages-per-minute performance, 300 dpi resolution for sharper images, and a variety of built-in type fonts

$1,510*

ThinkPad 700 and 700C Options	Price*
Data/Fax Modem (2400 bps/9600 bps)	$285
IBM PS/2 8MB IC DRAM Card	$905
ThinkPad 300 Options	
Data/Fax Modem (2400 bps/9600 bps)	$330
Port Replicator	$120
Operating Systems and Application Software	
DOS 5.0 Stacker V2.0 and 386MAX 6.0	$135**
OS/2 2.0 Upgrade from DOS	$99
WordPerfect® 5.1 for DOS	$355
Lotus® 1-2-3® for DOS	$355
Microsoft Excel™ 4.0 for Windows	$335
Lotus Freelance Graphics® for OS/2	$425
LAN Communications	
Token Ring Network 16/4 Adapter for AT Bus	$535
EtherCard PLUS Elite 16 Combo™	$195
PC LAN Program 1.3	$185
NetWare® V3.1 (5 User)	$720
IBM OS/2 LAN Server 3.0 Entry	$505
Printer and Printer Options	
IBM Personal Printer Series II, 2390	$385
IBM ExecJet® Printer, 4072	$775
500-Sheet Second Drawer for 4019 (E), 4029	$295
PostScript® Option for 4019 (E), 4029	$335
PS/ValuePoint Displays	
IBM 6312 Color Display	$405
IBM 6314 Color Display†	$530
IBM 6319 Color Display	$660

Non-IBM programs are licensed under the manufacturer's, supplier's or publisher's terms and conditions.
**Promotional price. Offer good until 3/31/93. Offer may be modified or withdrawn at any time.

Technical support for IBM printers is provided by Lexmark™ International, Inc.

Expansion Unit (Docking Station)

The 3550 Expansion Unit for ThinkPad 700 and 700C gives you two slots and one bay, and accommodates 5.25-inch or 3.5-inch SCSI devices.

$859*

IBM, OS/2, PS/2 and ExecJet are registered trademarks of International Business Machines Corporation. PS/ValuePoint, SLC, ThinkPad, TrackPoint II and HelpWare are trademarks of International Business Machines Corporation.

i486 and i487 are trademarks of Intel Corporation. Lexmark is a trademark of Lexmark International, Inc. Windows and Excel are trademarks of Microsoft Corporation. EtherCard PLUS Elite 16 Combo is a trademark of Standard Microsystems Corporation.

The Intel Inside logo is a registered trademark of Intel Corporation. NetWare is a registered trademark of the Novell Corporation. PRODIGY is a registered service mark and trademark of Prodigy Services Company. WordPerfect is a registered trademark of WordPerfect Corporation. Lotus, 1-2-3 and Freelance Graphics are registered trademarks of Lotus Development Corporation. Microsoft is a registered trademark of Microsoft Corporation. PostScript is a registered trademark of Adobe Systems Incorporated. PowerGraph X-24 is a trademark of STB Systems, Inc.

©1993 IBM Corp.

IBM Direct

CALL TO ORDER TODAY

1 800 IBM 2YOU

1 800 426-2968, refer to: X413BYTE,
8am-9pm M-F, 9am-5pm Sat., EST.

Circle 85 on Inquiry Card.

IBM®

Attractive Pricing and Attractive Printing

Epson America's 1985 foray into the ink-jet printer market was a brief one. By 1987, the company had quietly stopped selling its $2295 SQ-2000. Now Epson is returning to an ink-jet market dominated by Hewlett-Packard and Canon.

Epson hopes to challenge the leaders with the **Stylus 800**, a plain-paper ink-jet printer based on the MACH (Multilayer Actuator Head) technology that the company announced last November. The 360-dot-per-inch, 48-nozzle black-and-white model, list-priced at $499, is expected to sell in the $350 to $400 range to small-business and home users who want near-laser quality at dot-matrix prices.

Epson says its printer uses fewer disposable parts and has a lower cost per page than the competition. But when comparing competing models, be aware of statistical sleight of hand on the part of all vendors and their printer specifications. Using a 1000-character text page for reference, the Stylus, at 2.8 cents per page, does seem to win out against products such as the Canon BJ-200 (5 cents per page). It also appears that, on average, the Stylus's cost per page is lower than the HP DeskJet 550C's claimed cost of 3 cents per page in black-and-white mode and matches the per-page cost of Lexmark's IBM 4072 ExecJet (another product with a permanent print head). Epson's cartridges list at $19.99 apiece; Lexmark's list at $28.

The 10.6-pound, compact Stylus 800 is well suited for general-purpose jobs, with an ease of use that begins with plug-and-play installation and continues through all-control-panel configuration. Four of the seven resident fonts are scalable (through hardware or software) from 8 to 32 points. An economy mode uses half as many dots, to extend the life of the 700,000-character cartridge. Other adjustable settings include a character table, a toggle switch for mixed text and graphics (toggled off if your software integrates scalable fonts and graphics), and head cleaning.

Paper options are plentiful up to legal size. The feeder holds 100 sheets of letter-size or, for the European version, A4 paper. A manual feeder takes single sheets and number 6 or number 10 envelopes.

The beta model that I saw excelled in print quality, with a smooth, nearly satellite-free (i.e., no stray ink dots around the letters) letter-quality text. It falls short of, say, the HP LaserJet II under close scrutiny, but not noticeably enough to make a difference for routine use. Graphical images that I printed from Windows were attractive, although they betrayed a hairline banding that is sure to vary depending on the quality of plain paper you use.

It's ironic that the company that virtually defined the printer market now has much to prove. In spite of its name recognition, Epson is slipping behind Panasonic in the dot-matrix printer market, according to the market-research firm InfoCorp. In laser printers, Epson never made it out of the "Other" category. However, with its Stylus 800, Epson could have a big impact on the nonimpact printer market.

—Ed Perratore

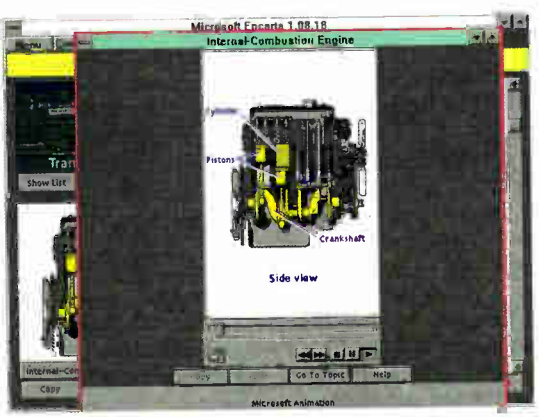
THE FACTS

Stylus 800
$499;
replacement ink cartridge, $19.99

Epson America, Inc.
20770 Madrona Ave.
Torrance, CA 90503
(800) 922-8911
(310) 782-0770
fax: (310) 782-5220
Circle 1083 on Inquiry Card.

Encarta: Explore New Worlds from the Desktop

Whether you're seeking answers to one of life's eternal questions, researching the intricacies of quantum theory, or just looking for a quick mental escape, browsing through **Encarta**, Microsoft's new Windows-based multimedia CD-ROM encyclopedia, makes for an excellent adventure. Encarta, under development at Microsoft for nearly two years, never ceased to intrigue during my examination of an alpha version. I was drawn both back in time and to faraway places by the encyclopedia's rich mixture of text, sound, photographs, and animation sequences.



Encarta encompasses some 21,000 articles in 94 categories, and it includes more than 7 hours of sound in its animations, music clips, and literature. Although Microsoft licensed the contents of Funk & Wagnall's *New Encyclopedia*, Encarta is largely a rewrite to meet the needs of a multimedia title, according to Craig Bartholomew, product group general manager for Microsoft's multimedia publishing business unit.

Part of Encarta's strength comes from the volume of original animations and photos added to the encyclopedia. The collection, which can display graphics in 256 colors at 1024 by 768 pixels, contains more than 7000 photographs, charts, and graphs. For example, I found an interesting short animated sound clip, detailing the inner workings of the internal combustion engine, accompanying an article on automobiles.

Among Encarta's more enjoyable features is the 20-foot historical time line of important events in history, dating from 15,000,000 B.C. to the present. Clicking on an event in the time line pops up a short synopsis or an even longer article on the subject. Encarta also makes it easy for

World Radio History

users of all ages to search for articles by using the program's category browser, which offers a graphical method of sorting through the entire encyclopedia by subject. In this way, you could, for example, quickly look up your favorite hockey, baseball, or basketball player by selecting the sports category.

You can access articles in Encarta directly by name by clicking on graphical images of a 26-volume encyclopedia set on a bookshelf. Encarta is also organized into nine major categories: physical science and technology; life science; geography; history; social science; religion and philosophy; art, language, and literature; performing arts; and sports, games, hobbies, and pets. Each category is further divided into subcategories that you can easily search via a category browser. Or you can research topics in a much more sophisticated manner through Encarta's Find feature, which allows powerful Boolean searches that can be narrowed to specific data types, such as photographs or animations. You also have access to an atlas with about 800 color maps, a word processor, and a Webster's dictionary and college thesaurus.

Microsoft also threw in a game called MindMaze as a fun way for younger users to build their knowledge. The MindMaze game asks youngsters questions as they try to navigate a maze by going through doors in a medieval castle. Although I was told that successful MindMaze players would get a Master of Knowledge certificate from Bill Gates, I never got that far (even though most of the questions were relatively easy).

Originally announced in October 1992, Encarta was expected to be available in late March or early April, according to Encarta product manager Sonja Gustavson. Microsoft, which has set Encarta's list price at $395, plans to sell the multimedia encyclopedia to students, educators, and school administrators for $249. If you order the initial edition by March 31, you will receive a free 1993 update. Microsoft plans to price future updates at less than $100.

—Patrick Waurzyniak

THE FACTS

Encarta
$395

System requirements:
A 386 or higher with Windows 3.1, 2 MB of RAM (4 MB is preferred), a CD-ROM drive, a VGA or Super VGA color monitor, a sound card, and speakers.

Microsoft Corp.
1 Microsoft Way
Redmond, WA 98052
(800) 227-4679
(206) 882-8080
fax: (206) 936-7329
Circle 1084 on Inquiry Card.

TI's microWriter Pricing Breaks New Ground

Plain-paper, laser-quality output for the lowest price on the planet: That's what Texas Instruments promises with the **microWriter**, a svelte little desktop printer that carries a starting list price of just $729. At that price, TI hopes to entice a lot of first-time printer buyers away from inkjet and dot-matrix printers.

The basic microWriter has an LED print engine rated at 5 pages per minute, Hewlett-Packard LaserJet compatibility (PCL 4), a parallel interface, and 512 KB of RAM (expandable to 4.5 MB in PCL mode). For $999, you can buy the PS 17, with an Adobe PostScript Level 1 interpreter with 17 fonts, 2 MB of RAM (expandable to 4 MB in PostScript mode), an Apple LocalTalk port, and automatic emulation switching between PostScript and PCL. For $1299, you can get the microWriter PS 35, with the full complement of 35 PostScript fonts.

Paper handling is one of the microWriter's strong points. The 250-sheet paper tray is contained entirely within the printer's footprint. Printed pages normally come out at the top of the printer, face-down, and go into a fold-out paper catcher. A manual feed slot accepts envelopes and other odd-size paper. The combination of the manual feed slot and a rear-panel-access door gives you a straight paper path for heavier paper or card stock. An optional universal paper feeder attaches underneath the printer.

I spent a week with a beta unit of the 35-font PostScript configuration, connected to a PC running Windows and a network of Macs. The microWriter holds its own quite nicely against most other printers in the 4- to 6-ppm class. On BYTE's PostScript tests (a slimmed-down version of Genoa Technology's PostScript suite), the microWriter ran faster than Apple's Personal LaserWriter NT, an HP IIIP with HP's PostScript cartridge, and TI's own microLaser. The print quality is typical of other LED printers.

For a beta-test unit, this printer was unusually reliable and well built. The PCL interpreter and automatic emulation sensing worked flawlessly. There was one hiccup when printing bit maps from a Mac running System 7 printer drivers; TI says this will be remedied by the time the unit ships. The microWriter-specific printer drivers weren't ready for testing, so I used the standard Apple LaserWriter drivers.

TI should make lots of friends by shipping a real Adobe PostScript printer that breaks the $1000 price barrier. The microWriter will present a serious challenge to many printers twice its price and make a welcome addition to almost anyone's desk.

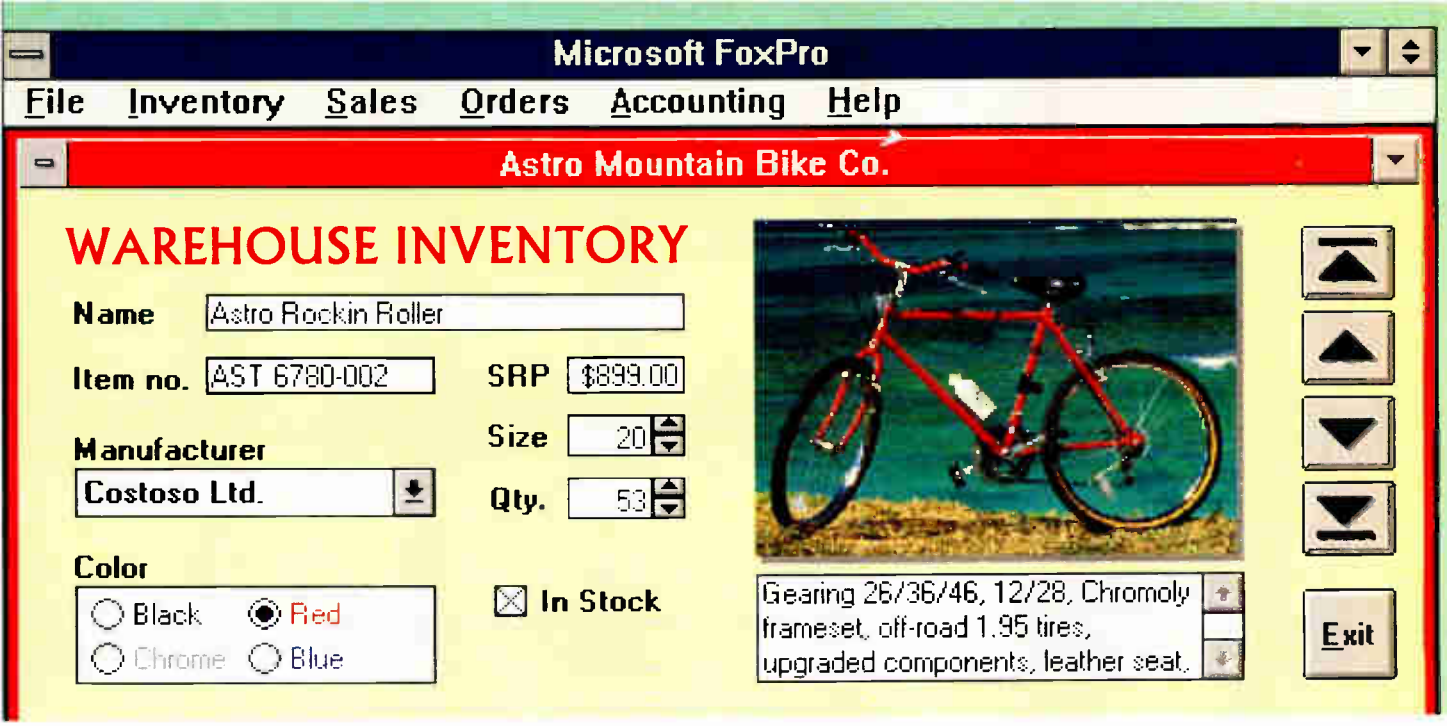
—Howard Eglowstein

THE FACTS

microWriter
$729; PS 17, $999; PS 35, $1299

Texas Instruments
P.O. Box 202230
Austin, TX 78720
(800) 527-3500
(817) 771-5856
Circle 1085 on Inquiry Card.

World Radio History



SUDDENLY dBASE USERS ARE LOOKING AT DATA IN A WHOLE NEW WAY.

dBASE® users everywhere are making the move to the FoxPro® database management system.

Now you can have all the power and graphics of a true Windows™ based database, without sacrificing your investment in dBASE. Because it's Xbase compatible, FoxPro lets you use your knowledge of dBASE, your existing data, and your applications.

And that's just the beginning. FoxPro unleashes the full power of Windows. Make your database solutions more informative and exciting by using colors, fonts, pictures, sound, even video! And share information with other applications, such as spreadsheets and word processors.

FoxPro also provides full mouse support at all levels, enables you to edit multiple files simultaneously, and features over 100 extensions to the dBASE language.

Available for both the Windows and MS-DOS® operating systems, FoxPro helps you create the most powerful, graphical applications across multiple platforms — leveraging your current investment in code and hardware.

How fast is FoxPro 2.5? In independent tests, FoxPro is over 30 times faster than dBASE IV® 1.5.*

But if speed, features and cross-platform compatibility don't move you, the price should. For a limited time, database users can get FoxPro 2.5 for Windows or MS-DOS for only $149 — with a 90-day money-back guarantee (excluding freight). This special upgrade price is offered only to users of other DBMS products.

$149 OFFER ENDS 6/30/93

FoxPro 2.5. We'll move you.

FoxPro version 2.5 for Windows or MS-DOS will open your eyes to a new world of database technology.

To upgrade to Microsoft FoxPro 2.5, rush to your reseller, or call (800) 882-2000, Dept. JY9.

Microsoft
Making it easier

*Performance tests performed by Micro Endeavors, a third-party consulting firm (November 1992). © 1993 Microsoft Corporation. All rights reserved. Printed in the USA. Offer good only in the 50 United States. Offer expires 6/30/93. In the 50 United States call (800) 882-2000, Dept. JY9. For information only. In Canada, call (800) 563-9048; outside the 50 United States and Canada, call (206) 936-8661. Microsoft, FoxPro, and MS-DOS are registered trademarks and Windows and the Windows logo are trademarks of Microsoft Corporation. dBASE and dBASE IV are registered trademarks of Borland International, Inc.

World Radio History

Circle 217 on Inquiry Card.

UPGRADE TO v6.5
$19.95 — 1-800-344-4323

Hard Drive Installation and Diagnostics

Made Easy.

Now, adding a hard drive to your system is as easy as typing "install." There's no need to know DOS or complicated commands. SpeedStor automatically performs all of the operations to make your drive "data ready." And to keep your drive "data safe," SpeedStor contains critical diagnostics not found in DOS — diagnostics that safeguard your valuable data and ensure your hard drive is trouble free.

Available at Best Buy, Egghead Software, Computer City Supercenter, CompUSA, Elek-Tek and Software Etc. Order today, call 1-800-344-4323.

STORAGE DIMENSIONS

SpeedStor
Storage Installation And Diagnostic Software

SpeedStor is a registered trademark of Storage Dimensions.
©1992 Storage Dimensions

Windows Sound in a Small Package

Adding sound to Windows applications is becoming de rigueur in some circles, but the cost of the equipment and the potential difficulty of adding it to the computer are stumbling blocks to many prospective sound users. And if you use a Windows notebook, sound hasn't been an option. A refreshing solution to this situation is Logitech's **AudioMan**.

A small, attractive, and inexpensive external device with a built-in microphone, speaker, and sound board, AudioMan eliminates the fuss of having to open your computer and install a sound board or attach external speakers that take up space on your desk. The device attaches to the parallel port of your computer and has a pass-through connector for uninterrupted printer availability. AudioMan's light weight and small footprint make it ideally suited to mobile computer users, who can choose to use the unit as a hand-held or desktop device.

AudioMan uses OLE to embed sound in any Windows document that supports OLE. The device is compatible with any Windows sound utility. AudioMan is not SoundBlaster compatible, so it won't play back sounds that were created by products that adhere to that standard. This means that you're limited to the 60-second recording limit imposed by Windows Sound Recorder, although you can link several 60-second lengths together to create a longer message. The 60-second limit may be a blessing, though: Since each second of sound takes 11 KB of disk space, a full minute would eat up 660 KB on your hard drive.

AudioMan is particularly geared toward the annotation of spreadsheets and text files. I used a beta version of the package to add a verbal annotation to a text file, to play when I go back into the document to make updates.

You can also connect AudioMan to an external sound source such as a CD player via the alternative recording audio jack and then insert that recorded sound into your document. You should note that AudioMan's sound quality (8-bit mono at 11 kHz for input and 22 kHz for output) is well below CD quality (16-bit at 44 kHz). However, its sound quality is perfectly suitable for its most likely application—adding personal comments to Windows documents. Two small buttons on the front of the unit let you control the volume for the current session; for a permanent change, you reset the default volume in AudioMan's dialog box.

You install the AudioMan software by using the Run command in the Windows Program Manager or via the Drivers icon in the Program Manager Control Panel. I chose to use the Run command, which was simple and straightforward.

To add sound to a Windows document, I positioned the insertion bar at the place in the document where I wanted the sound to go. After choosing Insert Object from my word processor's Edit menu and Sound from the subsequent Object Type list, I selected a .WAV file from the Sound Recorder file listing. I then clicked on Update in the Sound Recorder's File menu and closed the Sound Recorder. A Sound Recorder icon then appeared in my document at the place I had designated. To play the embedded sound, I simply double-clicked on the icon; AudioMan did the rest.

Despite the program's recording and compatibility limits and the less-than-specific instructions in the user's guide, AudioMan is a likable, low-cost way to add sound to Windows documents. And it's the easiest way I know to add sound to my files as I travel. ■

—Carol J. Swartz

THE FACTS

AudioMan
$179

System requirements:
A 286 or higher with 2 MB of RAM, DOS 3.1, Windows 3.1, and one parallel port.

Logitech, Inc.
6505 Kaiser Dr.
Fremont, CA 94555
(510) 795-8500
fax: (510) 792-8901
Circle 1086 on Inquiry Card.

World Radio History

Programmer's Paradise®

WATCOM SQL Developer's Edition
by WATCOM

Complete client/server development tool allows you to develop and deploy single-user standalone applications, and to develop applications for use with the Network Server Edition. Includes: Single-user database server: ACME application development system: Embedded SQL C/C++ preprocessor: SQL libraries for WATCOM C, C/386, MS/C ++ and BC/C++.

List: $395 Ours: $299
FAX*cetera* # 1683-0010

HUGE SELECTION AT THE RIGHT PRICE! CALL TODAY!

386MAX	$64	Label Master	$429
Baler	$399	Lahey EM/32 5.0	$1,015
Bar Code Library	$350	mini Ed Tools	CALL
Borland C++	$319	MKS Learning UNIX	$99
C Windows Tlkt. 386	$179	MKS Toolkit	$239
C++/Views	$449	MS Visual C++	CALL
C-DOC Professional	$269	MS FoxPro	CALL
CAD/CAM Products	CALL	Multi-Edit Professional	$139
CASE:W Corporate	CALL	Norton Desktop/Win	CALL
CA-Clipper	$499	object-Menu	$269
CodeWright	$225	Opt-Tech Sort/Merge	$119
dBASE IV	$499	Paradox 4.0	$569
dBFast Windows	$359	PGL	CALL
dGT-Unlimited Runtime	$499	.RTLink/Plus	$445
Dr. Switch-ASE	$159	SlickEdit	$149
ED for Windows	$199	SQA:Replay	$79
GX Products	CALL	Turbo C++ for Windows	$112
KPWin++	CALL	WATCOM FORTRAN 77/386	$719

Essential Graphics Chart™ for Windows
by South Mountain Software

Essential Graphics Chart for Windows lets you turn your data into charts and graphs that make an immediate visual impact. Features include: DLL-works with any Windows API compatible language. 2D bar, 3D bar, legends for all chart types, real-time charts, true perspective and rotational capability. No Royalties.

List: $399 Ours: $299
FAX*cetera* # 2089-0017

CA-dBFast Windows 2.0
by Computer Associates

The complete stand-alone dBASE/Xbase development language for MS Windows. Create fast, powerful, easy-to-use graphical applications. Over 200 extensions to the dBASE III PLUS language and 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: $550 Ours: $359
FAX*cetera* # 1004-0003

Dan Bricklin's Demo II
by Lifeboat Software

Experience for yourself why 30,000 people have made Demo II 3.0 the leading tool for producing program prototypes, demonstrations, and tutorials. Demonstrate commercial software to potential customers without shipping live software. Produce effective tutorials that interactively teach products. Create Computer Based Training for a fraction of the cost of dedicated CBT authoring software.

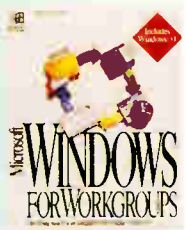
List: $249 Ours: $215
FAX*cetera* # 0233-0003

Q+E Database Library (QELIB) 1.1
by Pioneer Software

A set of Dynamic Link Libraries providing a common call level interface for developer tools such as Visual Basic, ToolBook, Actor, Smalltalk, C, C++, etc, and most macro language products to access data from Oracle, SQL Server, Sybase, EE Database Manager, DB2, Netware SQL, dBASE, Paradox, Excel, and text files.

List: $399 Ours: $359
FAX*cetera* # 2625-0003

Microsoft Windows for Workgroups



Considering how easy it is to use MS Windows™, imagine what MS Windows™ for Workgroups can do for an entire group. Such as information sharing among many PC users that can lead to even better, more collaborative work. Printer sharing that uses hardware resources more efficiently. And schedule management that improves efficiency.

	List: $249	Ours: $175
Add-On	List: $ 79	Ours: $ 61

FAX*cetera* # 1269-0042

MediaDeveloper
by Lenel Systems

Create multimedia-enabled applications with MediaDeveloper and ObjectVision. It is **THE** Multimedia Development Toolkit to integrate sound, images, animation and full-motion video into Windows applications. Includes media and device control for multimedia peripherals including CD-ROMs, VCRs and laserdisc players; support for major animation, video, audio and graphics formats; a multimedia database; OLE server; and many DLLs.

	List: $595	Ours: $449
w/MS VB Win. 2.0	List: $794	Ours: $569
w/MS VB Win. Pro 2.0	List: $1090	Ours: $739

FAX*cetera* # 1005-0302

800-445-7899

World Radio History

Software that Sizzles!

800 445-7899

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, Opus Make, Video Graphics, and Excellent Diagnostics. 386/486 users have the option of generating 32-bit instructions.

List: $295 Ours: $259
FAX*cetera* # 1476-0001

Visio
by ShapeWare

Now everyone can create professional-quality graphics! Straightforward stencils, designed for everyday business drawings and technical diagrams, provide all the shapes you need. Whether you're creating engineering schematics, network or block diagrams, org charts, programming flow charts, or your own custom drawings, Visio has a stencil of shapes that will make your job easier. GET A $79 VISIO PROGRAMMER'S STENCIL FREE WITH EACH COPY OF VISIO YOU ORDER!

List: $299 Ours: $225
FAX*cetera* # 1006-2801

WindowsMAKER Professional 4.0
by Blue Sky Software

Next generation of industry standard C/C++ development tool for Windows. The easiest fastest way to create Windows apps, just point and click. New architecture uses Switch-It™ Code Generation Modules for generating ANSI C, MFC++, or OWL C++ code among others. Award-winning Visual Prototyper lets you test the look & feel and make changes on the fly. TrueCode technology ensures the user code is preserved during code regeneration. Generates Windows .EXE w/fully commented C or C++ source.

List: $995 Ours: $695
FAX*cetera* # 2602-0003

PRODUCT OF THE MONTH

Microsoft Visual C++
by Microsoft Corporation

Microsoft Visual C++ combines the power of reusable, prebuilt code with a seamless, visual environment to shorten the development process. Design user interfaces, build, debug, and browse using a set of tightly integrated tools, while "wizards" assist you with fundamental tasks for maximum productivity. It's the fast, powerful way to program in C++!

Standard Edition (Comp. Upgrade) List: $99 Ours: $95
Professional Edition (Comp. Upgrade) List: $199 Ours: $189
FAX*cetera* # 1269-0040

ED–The Programmer's Editor for Windows
by Lifeboat Software

A full-featured Windows-based programmer's editor is here! ED is setting the standard with features like background compilation, automatic code indenting and completion, hypertext function/procedure lookups, "smart" language-specific editing, a fast "C" extension language, Windows Toolbar, unlimited undo and redo, keyboard macros and remapping, and emulation of popular DOS editors.

List: $269 Ours: $199
FAX*cetera* # 0233-0011

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 term 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!

List: $199 Ours: $149
FAX*cetera* # 5400-0001

MS Visual Basic for DOS

Draw forms and controls, write event-procedures, use and create custom controls–in DOS! Create all-new apps or combine with existing C/C++ or Pascal code. Highly compatible with VB/Win for multi-platform development. Even run existing MS Quick Basic/Basic PDS code! Includes a native 80 x 86 compiler that creates 100% stand-alone .EXE files, 386 code generation, MOVE overlays, an integrated ISAM and much more!

Standard Edition List: $199 Ours: $139
Professional Edition List: $495 Ours: $325
FAX*cetera* # 1269-0039

OS/2 2.0
by IBM

OS/2 2.0 increases your operating system choices by providing you with DOS, Windows and OS/2 support. Because OS/2 was created for use with 386SX and above processors, it offers full 32-bit addressability and true concurrent multitasking. OS/2 2.0 also features an object-based user interface, enhanced file system, advanced memory technology and the ability to complete many processes within a task simultaneously.

List: $195 Ours: $126
FAX*cetera* # 3142-0009

World Radio History

Programmer's Paradise®

MetaWare High C/C++
by MetaWare, Inc.

MetaWare, Inc. announces its newest product! The 32-bit High C/C++ compiler version 3.0 is a true compiler, not a C to C++ translator. "Incremental Strengths" let you specify the level of C++ compilation, allowing you to migrate from C to C++, one C/C++ block at a time. Included is a C++ tailored source-level debugger and a 32-bit Application Development Kit for Windows. MetaWare offers a full line of multi-language, multi-platform compilers for professional software developers.

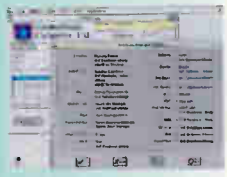
List: $795 Ours: $669
FAX*cetera* # 1590-0008

VM Data
by PocketSoft, Inc.

VMData for Windows is a DLL that manages up to 128 MB of dynamic data. Eliminates annoying slowdowns commonly seen in 386 Enhanced Mode when programs use large amounts of dynamic data, and eliminates out-of-memory problems in Standard Mode. Provides superior run-time performance and ensures that your program is a good citizen under the Windows environment.

List: $495 Ours: $359
FAX*cetera* # 1987-0005

WinGEN
by Buzzwords International



Converts ObjectVision .OVD to Source Code! Make the title bar disappear and run your application at compiled speed. WinGEN produces code for Windows versions of dBASE, C/C++, and Turbo Pascal. Supported engines include: Paradox Engine, Sequiter Codebase, POET, Raima, Faircom c-tree, Sybase, Novell Btrieve, Novell Btrieve with SQL/XQL Manager, OLE & DDE/DDEML, and Q & E.

List: $149 Ours: $79
FAX*cetera* # 1873-0002

DataBoss
by Kedwell Software

Relational database application generator. Use to develop complete applications with menus, forms, browse tables, memo fields, reports and more. Includes sophisticated screen painter; field definition template for defining field characteristics, indexes, data files and their relations; WYSIWYG report designer; generator engine and skeletal files. Generates structured C/C++ or Pascal source code. No license or runtime fees.

List: $695 Ours: $499
FAX*cetera* # 3758-0001

WATCOM C/386 9.0
by WATCOM

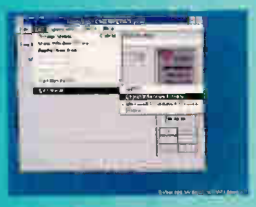
Develop and Debug 32-bit applications for extended DOS, Windows, and OS/2 2.0 with the most complete 32-bit C development package available. Includes the royalty-free DOS/4GW DOS extender by Rational Systems, components from MS Windows SDK, compiler, linker, debugger, profiler, plus numerous development tools. Supports other industry standard 32-bit DOS extenders. Create ADS Applications for AutoCAD or embedded systems development.

List: $895 Ours: $599
FAX*cetera* # 1683-0003

C++ Views 2.0
by Liant Software Corp.

NEW VERSION! An application development framework that provides a C++ class library and an interactive class browser for building portable GUIs for Windows, PM or Motif. It comes complete with over 100 classes including interface, graphics, event, dialog, data, windows, and persistent storage also available. Includes C++/Browse object class browser and source code at no additional charge.

List: $495 Ours: $399
FAX*cetera* # 1812-0001



PROTOGEN 3.0
by ProtoView Development

NEW VERSION! The industry standard for code generation and prototyping Windows applications. Develop the user interface of your application using Visual prototyping methods. ProtoGen generates expert level, commented code for ANSI C, Microsoft NT Win32. All generators included! User Code is preserved from one generation to the next. It's easy and fast.

List: $99 Ours: $95
FAX*cetera* # 2553-0002

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*cetera*®: 908 389-8173

Programmer's Paradise®

• All prices are subject to change without notice.

Circle 99 on Inquiry Card.

800-445-7899

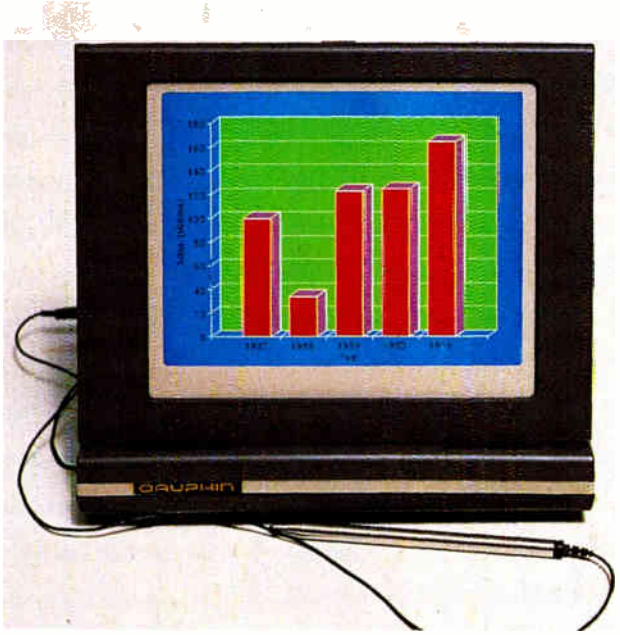
World Radio History

A Pentop to Flip Over

A flip-up, flip-down passive-matrix VGA color display is just one reason for considering the Dauphin 5500 Color Pentop. Other reasons are its 25-MHz 386SL processor with 64 KB of cache SRAM (static RAM), 4 MB of RAM (expandable to 20 MB), and an 80-, 130-, or 200-MB hard drive. A PCMCIA slot in place of the standard 3½-inch floppy drive is an option.

The backlit color display has a resolution of 640 by 480 pixels in 256 colors; you can simultaneously use an external Super VGA monitor with an 800- by 600-pixel resolution display in 256 colors. The unit includes a Centronics parallel port, an RS-232 serial port, and a port for an external floppy drive. Operating systems supported include Windows for Pen Computing, PenPoint, DR DOS, DOS, and OS/2.

Price: About $3495.
Contact: Dauphin Technology, Inc., Lombard, IL, (708) 627-4004; fax (708) 627-7618.
Circle 1131 on Inquiry Card.



Computing power on the Dauphin 5500 Color Pentop comes partly from the 87SLC math coprocessor.

Passive Color Can Turn Active

Based on a 25-MHz 386SL processor with a 64-KB cache, the DECpc 325SL notebook can be upgraded to a 486SL. The 4 MB of main memory is expandable to 20 MB, and the monochrome or passive-matrix color display can be upgraded to an active-matrix color display.

The DECpc 325SL's 80- or 120-MB hard drive is removable, and the unit has two sockets for attaching PCMCIA Type 2 peripheral cards. The power management system in the notebook provides up to 6½ hours of battery life. Other features include a cableless trackball that connects to a built-in hot shoe on the front of the unit.

Price: $2399 and up.
Contact: DEC, Maynard, MA, (800) 722-9332.
Circle 1133 on Inquiry Card.

The DECpc 325SL.

Designed for Windows

A notebook computer designed for Windows users, the WinBook features a built-in trackball and 4 MB of RAM (expandable to 8 MB). The basic unit has a 120-MB hard drive, a PCMCIA 2.0 slot, and a 2400-bps data/9600-bps fax modem. With 1 MB of ROM for the BIOS, 512 KB of VRAM (video RAM), a 25-MHz 486 SLC/E processor, and a 1-KB internal cache, the 5.4-pound WinBook packs a lot into its 11- by 9- by 2-inch frame.

The Winbook's 10-inch display is a 64-gray-scale supertwist transflective screen with a resolution of 640 by 480 pixels. You can simultaneously display on it and on an external CRT. Powered by a detachable nickel-metal-hydride battery pack, the unit runs for up to 4 hours.

Price: $1699.
Contact: Micro Electronics, Inc., Columbus, OH, (800) 468-2162 or (614) 481-8041.
Circle 1132 on Inquiry Card.

VL-Bus-Based Desktops

Insight's new 486-based computers have a VESA (Video Electronics Standards Association)-standard video controller as well as a VESA-standard IDE hard drive controller. The upgradable systems feature two VL-bus slots and a 238-pin ZIF (zero insertion force) OverDrive socket.

The computers have 4 MB of RAM, 128 KB of cache memory, and a 210-MB IDE hard drive with cache. Dual floppy drives, two serial ports, a parallel port, a mouse, and a 14-inch noninterlaced Super VGA color monitor are also standard equipment.

Price: $1699 and up.
Contact: Insight Distribution Network, Inc., Tempe, AZ, (800) 755-9628 or (602) 350-1128.
Circle 1134 on Inquiry Card.

Cache Tucked in a Subnotebook

Smaller than a notebook, the Bicom SL60 runs DR DOS 6.0 as its standard operating system. Based on a 25-MHz 386SL chip with a cache controller, the unit has 2 MB of RAM (expandable to 20 MB), 64 KB of cache memory, and a 25-MHz 387SX coprocessor socket. The 60-MB hard drive comes with power management.

The viewing area of the high-contrast, nonglare, reflective LCD is 6¼ by 4½ inches. The unit weighs about 2 pounds with the battery.

Price: About $1150 (HK$149).
Contact: ABC Computer Co., Ltd., Kwai Chung, New Territories, Hong Kong, +852 481 6118; fax +852 481 5836.
Circle 1135 on Inquiry Card.

World Radio History

Dedicated SCSI Caching

A dedicated SCSI-2 caching device that has a cache access time of less than 0.03 ms, Atto's SiliconCache connects to your computer through the SCSI bus. The device, designed for disk-intensive and time-critical applications, resides between the host computer's SCSI port and its disk storage devices.

The SiliconCache's basic capacity of 32 MB is expandable in 32-MB steps to 512 MB; its transfer rate is 6 MBps. The device has a write-through design to eliminate data loss and provide an extra level of system fault tolerance. Transparent to the host, the unit supports up to 49 SCSI devices.

Price: $7995.
Contact: Atto Technology, Inc., Amherst, NY, (716) 688-4259; fax (716) 636-3630.
Circle 1136 on Inquiry Card.

SiliconCache uses special caching hardware and adaptive software for access times under 0.03 ms. The device can manage up to 512 MB of cache memory.

More Power for the PowerBook

Portable storage for your PowerBook is now available in the form of the Powerbox and the MicroMD 200.

With the same footprint as the PowerBook, the 4-pound, 1.4-inch Powerbox fits under the notebook and connects through the SCSI port. The Model 200-T (with a 200-MB hard drive) and the Model 500-T (with a 500-MB hard drive) Powerboxes each have a 155-MB tape drive for microstreaming tape backup. Average seek time of the hard drive is 12 to 15 ms; the data buffer size is 64 KB.

A standard PowerBook battery in the Powerbox typically provides 2 hours of hard drive operation. The System 7.0–formatted Powerbox ships with Adambyte utilities and integrated backup software.

Price: $1990 and up.
Contact: Adambyte, Mountain View, CA, (415) 988-1415; fax (415) 988-1418.
Circle 1138 on Inquiry Card.

Procom Technology's MicroMD 200 incorporates the company's Atom 200 2½-inch hard drive, with an average access time of 12 ms. A miniature external AC power supply powers the unit.

Features include 132 KB of RAM cache, a 3.2-MBps sustained transfer rate, a 4000-rpm spindle rate, and a 100-g shock rating. The drive supports System 6.x, System 7.x, AppleShare, and A/UX.

Price: $1695.
Contact: Procom Technology, Irvine, CA, (714) 852-1000; fax (714) 852-1221.
Circle 1139 on Inquiry Card.

Stack Up Your Storage

SmartStack is Envisio's modular answer to SCSI expansion. Comprising three main components, SmartStack uses just one SCSI cable and one power cable to automatically connect multiple hard drives.

SmartSource, the base unit of the storage system, features a 120-W power supply, a quiet fan, a power switch that accesses all connecting drive modules, and a power cable. The unit's two 50-pin SCSI connectors let you add other peripherals.

Attached to the base unit via the snap-on/snap-off SmartStack cover unit, the SmartStack drive modules each include PTB (pass-through bus) connectors on the top and the bottom; a SCSI loop-back connector on the cover unit sends the SCSI signal throughout the system. The drive modules include a standard hard drive, an optical drive, and a DAT (digital audiotape) drive.

Price: SmartSource, $249; drive modules, $699 and up.
Contact: Envisio, Inc., St. Paul, MN, (612) 628-6288; fax (612) 633-1083.
Circle 1137 on Inquiry Card.

Sized to take up minimal desk space, the SmartStack modular storage system can run up to seven SCSI peripherals.

Color in Full Bleed

Seiko Instruments' Professional ColorPoint PSH dye-sublimation printer lets you create extra-large full-bleed prints that fill an 8½- by 11-inch area. Standard memory in the 300-dpi printer is 16 MB, expandable to 64 MB. The primary processor is a Weitek RISC XL8220 that runs at 25 MHz.

The PostScript-compatible PSH accepts incoming files at speeds as fast as 200 KBps via its Centronics parallel port. Additionally, the PSH has LocalTalk/AppleTalk and RS-232C interfaces, letting you connect Mac, PC, and Unix systems. Features include simultaneously active ports, multitasking capability, automatic input polling, and off-line printing.

Price: $9999.
Contact: Seiko Instruments USA, Inc., San Jose, CA, (800) 888-0817 or (408) 922-5800; fax (408) 922-5840.
Circle 1140 on Inquiry Card.

World Radio History

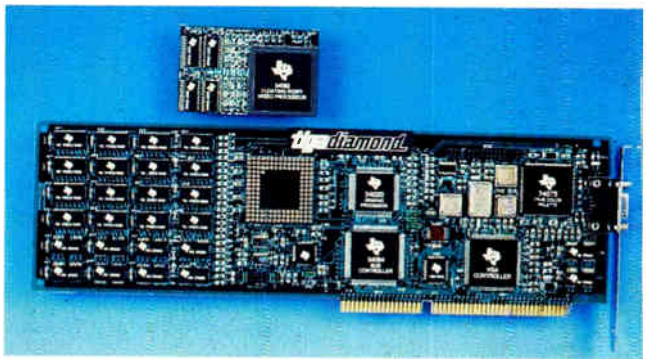
Render Graphics in AutoCAD

The 32-bit display list in the Diamond accelerator board from the Norwegian company Rasterex lets you take full advantage of the no-regen rendering feature in release 12 of AutoCAD. When you're drafting in AutoCAD at 8-bit color and you use Rasterex's rendering tool RxAutoIcon release 12 (built-in on the board), the Diamond will switch to 24-bit color (i.e., true color) without your having to reconfigure anything. In multimedia applications such as Animator Pro and 3D Studio, you can use RxAutoIcon for real-time capture at high resolution.

If you work in Windows, the Diamond, which is based on the TI-34020 processor and comes with 4 MB of video RAM, lets you run true-color applications. The board's 1280- by 1024-pixel resolution is reconfigurable to lower resolutions.
Price: $2495 and up.
Contact: Expert Graphics, Inc., Atlanta, GA, (800) 648-7249 or (404) 320-0800; fax (404) 315-7645.
Circle 1141 on Inquiry Card.

PCMCIA for Palmtops

Available with capacities of 256 and 512 KB and 1 and 2 MB, the SRAM Memory Card Family from Memorex is geared toward users of palmtop computers. The PCMCIA-standard, solid-state memory cards use an 8- or 16-bit data bus with an average access time of 200 ns. Each card ships in an antistatic envelope and with a lithium battery.
Price: From $199.95 to $749.95.
Contact: Memorex Computer Supplies, Santa Clara, CA, (408) 957-1000; fax (408) 957-1145.
Circle 1142 on Inquiry Card.



The Diamond 32-bit graphics accelerator board lets you do rendering in true color.

Orange You Closer to DOS, Mac?

Two boards use different methods to let you join your Macs and PCs. One puts DOS on the Mac; the other puts Mac applications on the PC.

The OrangePC is Orange Micro's latest solution to DOS/Mac incompatibility. With either a 25-MHz 386SX or a 25-MHz Cx486SLC processor, on-board VGA hardware, DOS 5.0, and 1 MB or more of RAM (up to 16 MB), the board lets you display VGA graphics on any Mac monitor or Mac-compatible monitor. You can also launch Windows 3.1 inside a Mac window and run your Windows applications simultaneously with Mac applications in another window.

The entry-level board is only RAM expandable. Expandability on the intermediate 25-MHz 386SX model consists of an AT bus slot for add-on PC cards and PC serial and parallel ports, so you can attach a modem, printer, pocket network adapter, or software key. The 2 MB of RAM is expandable to 16 MB via SIMMs. The top-of-the-line Cx486SLC board includes the same expandability features.
Price: From $1099 to $1799.
Contact: Orange Micro, Inc., Anaheim, CA, (714) 779-2772; fax (714) 779-9332.
Circle 1143 on Inquiry Card.

An expansion board that lets you run Macintosh applications on your PC in addition to all DOS and Windows applications, the 50/50 Dual Desktop displays DOS and Mac screens side by side. You can also use hot keys to toggle out of a DOS screen into a Mac screen running Mac software for a full-screen display.

The 16-MHz 68000–based board works with the ISA or EISA bus and System 6.0, 7.0, and 7.1. It treats IDE, MFM, SCSI, and ESDI PC hard drives as standard Mac hard drives and lets PC 3½-inch floppy drives read and write to 800-KB and 1.44-MB Mac formatted floppy disks.

TSR software for switching between the Mac and PC platforms is standard, as is the x-Fer file transfer program. The board has 50- and 25-pin SCSI ports and an AppleTalk-compatible serial port; it can connect directly to an AppleTalk or PhoneNet networking system and is compatible with PC networks such as NetWare and Ethernet.
Price: $995.
Contact: 50/50 Micro Electronics, Inc., Sunnyvale, CA, (408) 730-5050; fax (408) 732-5050.
Circle 1144 on Inquiry Card.

On-the-Fly Image Capture

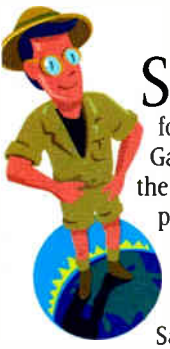
The WinVision capture board lets you capture images on the fly in 256 gray scales. The source of the image can be a camcorder, VCR, or videodisc player. With a fax board installed in your computer, you can immediately send the images to someone via fax. WinVision ships with PhotoFinish 1.01; if you don't use Windows, you can get PC Paintbrush IV Plus instead.
Price: $155.
Contact: Quanta Corp., Mountain View, CA, (415) 967-5791; fax (415) 967-8762.
Circle 1145 on Inquiry Card.

Upgrade to Multimedia

Sigma Designs' WinSound 16 CD-ROM Kit lets you upgrade your PC with multimedia capabilities. The Sony Light Internal CD-ROM drive in the kit has a data transfer rate of 150 KBps and an average access time of 550 ms. The 3-inch, 3.5-W speakers are magnetically shielded and have an external DC jack, volume control, and power-on indicator. The kit comes with six applications and is Kodak Photo CD ready.
Price: $799.
Contact: Sigma Designs, Inc., Fremont, CA, (510) 770-0100; fax (510) 770-2640.
Circle 1297 on Inquiry Card.

World Radio History

Why some software sells more than others.



Success. All software developers strive for it. Now, Don Gall was on top of the world. Software protection made all the difference. Especially in Europe and Asia. Sales were four times better than before. He is the founding father of Sentinel — the guru of software success.

Struggling Software Sales

One day, trekking through the coffee fields of Java, Don ran into his old college buddy Simon Seagull. "Don, my sales are well below expectations." Simon explained his plight, "My software should sell like yours, Don!" Yet despite critical acclaim Simon's company, SimonSays Software, teetered on a financial tightrope. "What's your secret, Don?"

They spent hours analyzing potential problems. They looked at everything.

The Key to the Problem

Finally, Don leaned back and asked the assumptive question, "What about protection – are you using Sentinel?"

Nervously, Simon sipped his coffee. His hands shaking as his eyes darted the room. "No. I didn't think I needed to."

Don's chair slid out from under him and he crashed to the floor. Amazed in disbelief, Don cried, "You What?!" Grabbing his tattered scrapbook, Don pulled out photos of his travels. "Ever been to Seoul? Prague? Anywhere? Ten bucks will buy you anything, even bootlegged copies of software."

Don's Road to Success

Thumbing through the scrapbook, Don shared his experiences. "Back in the '80s, I was in your shoes – beaten, battered and bruised." Simon listened. "Then, after a heart breaking trip around the world, I called the Software Publishers Association (SPA)."

"I could hardly believe it. They told me developers lose billions of dollars each year. Why? Illegally copied software. In some countries there are nine pirated copies for each legal copy sold."

Simon was disgusted, "It's just not fair."

"That's why I committed myself to solving the piracy problem," explained Don.

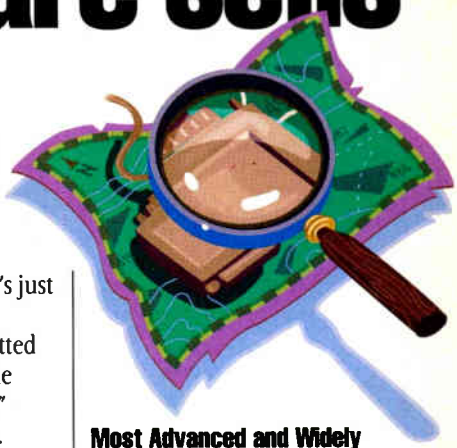
Simon's eyes lit up. "The dongle!" he shouted. Don corrected him, "Not just any dongle — the dongle that paved the road to success for over 10,000 developers worldwide — Sentinel."

Successful Developers Use Sentinel

Don pulled a stack of letters out of his gunny sack. "All of these people tell the same story." Don read about a successful developer from California who swears she wouldn't be in business without Sentinel. Another company says protection costs less than litigation, plus they don't have to spend time and money supporting illegal users.

Others confessed they wouldn't market products internationally without protection.

The hours flew by, story after story, Simon learned Don Gall's secret. To succeed is to protect. To protect is to secure with Sentinel.



Most Advanced and Widely Used Dongles in the World

Backed by the world leader in software protection, Rainbow Technologies, the Sentinel Family of hardware keys is the most diverse and comprehensive selection available. For DOS, Windows, OS/2, Macintosh, LAN, UNIX and others. They're simple to install, and are the most reliable and compatible available.

Rainbow offers just-in-time delivery and the largest technical support and engineering staff in the software protection industry.

Call Don Gall today for a free copy of **"The Sentinel Guide to Securing Software."** Or better yet, ask him for a low cost Sentinel Evaluation Kit — complete with a working dongle!

CALL

800/ 852-8569

FOR YOUR FREE GUIDE TO SECURING SOFTWARE

SENTINEL

Securing the future of software

When you need a dongle, you need Sentinel. The only dongle Don Gall will use.

RAINBOW TECHNOLOGIES

9292 JERONIMO ROAD, IRVINE, CALIFORNIA 92718 ■ 714/ 454-2100 ■ fax 714/ 454-8557
International offices are located in the United Kingdom, Germany and France.

MICROSOFT WINDOWS COMPATIBLE

© 1993 Rainbow Technologies, Inc. All product names are trademarks of their respective owners.

Circle 126 on Inquiry Card (RESELLERS: 127).

World Radio History

WE'RE ONLINE. AND IN LINE WITH YOUR OBJECTIVES.

BUSINESS WEEK

AEROSPACE DAILY

AIRPORTS

AVIATION DAILY

AVIATION WEEK & SPACE TECHNOLOGY

BIOTECHNOLOGY NEWSWATCH

BYTE

CHEMICAL ENGINEERING

CLEAN-COAL/SYNFUELS LETTER

COAL WEEK

DATA COMMUNICATIONS

ELECTRIC UTILITY WEEK

ENGINEERING NEWS-RECORD

HAZARDOUS WASTE BUSINESS

INDEPENDENT POWER REPORT

INDUSTRIAL ENERGY BULLETIN

INSIDE ENERGY/ WITH FEDERAL LANDS

INSIDE F.E.R.C.

INSIDE N.R.C.

INTEGRATED WASTE MANAGEMENT

LAN TIMES

NUCLEONICS WEEK

POSTGRADUATE MEDICINE

PLATT'S INTERNATIONAL PETROCHEMICAL REPORT

PLATT'S OILGRAM NEWS

PLATT'S OILGRAM PRICE REPORT

S&P'S EMERGING & SPECIAL SITUATIONS

S&P'S REVIEW OF BANKING & FINANCIAL SERVICES

S&P'S REVIEW OF SECURITIES & COMMODITIES REGULATION

SECURITIES WEEK

TECH TRANSFER REPORT

UTILITY ENVIRONMENT REPORT

THE WEEKLY OF BUSINESS AVIATION

UNIXWORLD

•

AND MORE. . .

When you need business information, why not get the total story, instantly! Word for word. The McGraw-Hill Publications Online database gives you just that. Unedited, full-text retrieval (except graphics) of articles exactly as they are published in McGraw-Hill magazines and newsletters.

Now you can get information on companies, people and products on any topic — pertaining to one particular industry, or search the entire McGraw-Hill library (over 35 leading publications online) for diverse editorial perspectives. Only McGraw-Hill, the world's foremost business information publisher, can deliver it all so completely — immediately! McGraw-Hill unabridged.

Access an entire universe of business information. Go online with our line. McGraw-Hill Publications OnLine. For more information, including our latest list of publications, contact Andrea Broadbent at **(609) 426-5523**. Or fax this coupon to **(609) 426-7352**.

Or send it to the address below.

Available through Dialog®, Dow Jones News/Retrieval®, NewsNet® and Nexis®.

McGRAW-HILL PUBLICATIONS ONLINE

Princeton-Hightstown Road
Hightstown, NJ 08520 U.S.A.

Please send me the complete 1992 list of your publications online. BY

Name

Title

Company

Address

City State

Zip/Postal Code Country

Tel.

GO ON LINE WITH OUR LINE.

World Radio History

Your network buy for today's business technology market.

McGraw-Hill TechNet

McGraw-Hill Magazines. Your Best Business Partners.

■ 4– Architectural Record ■ 7– A/C Flyer, Aviation Week & Space Technology, AW & ST China Quarterly, AW & ST USSR, Business & Commercial Aviation, World Aviation Directory and Buyer's Guide ■ 20– Business Week, Business Week China, Business Week Hungary, Business Week International, Business Week USSR ■ 28– Chemical Engineering ■ 32C– BYTE, Data Communications, Data Communications International, LAN Times, UnixWorld ■ 39–Electrical World ■ 41– ENR, Construction News Publishing Network (11 magazines, 4 newspapers) ■ 46– Global Finance ■ H6– The Physician & Sportsmedicine, Postgraduate Medicine ■ 114– Modern Plastics, Modern Plastics International ■ 117– Power, Power International

World Radio History

Power Supply Check

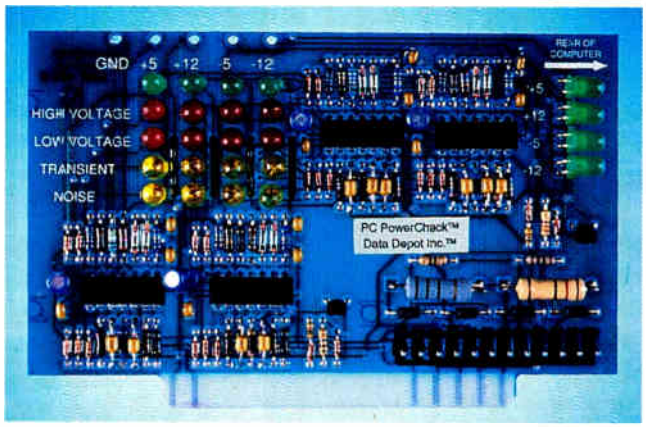
Data Depot's PC PowerCheck diagnostic and test card detects the major causes of problems in power supplies for IBM PCs and Amigas. With a normal PC edge connector as well as a 12-pin power supply connector identical to those on the motherboard, the card can be plugged into your PC or directly into the power supply for testing.

The card tests all four output voltages on the power supply for overvoltage, undervoltage, noise, and spikes. Except for the spike detectors, which trap the error condition, the detectors monitor continuously.

Price: $229.

Contact: Data Depot, Inc., Clearwater, FL, (800) 275-1913 or (813) 446-3402; fax (813) 443-4377.

Circle 1271 on Inquiry Card.



The PC PowerCheck detects poor regulation, misadjusted outputs, leaky or noisy components, and blatant component failure in your power supply.

A Power Pack for Traveling

A removable stand-alone AC module that you can use to provide 120-VAC power from any car cigarette lighter socket distinguishes the AC PowerPack from other power supplies. The PowerPack, designed for 120-V products up to 50 W, combines 12-VDC and 120-VAC capability. The removable module can also be used as an inverter to run AC devices from a DC outlet.

A built-in regulator prevents overcharging, and you can recharge the PowerPack as many as 1000 times on its replaceable, sealed lead-acid battery. Recharging from your car's cigarette lighter takes 1 to 3 hours; using the Innova AC Charger takes 4 to 6 hours. The company's solar charger takes less than 6 hours on a sunny day.

Price: $175.

Contact: Innova Electronics Corp., Fountain Valley, CA, (714) 432-1184; fax (714) 432-7910.

Circle 1273 on Inquiry Card.

The AC PowerPack.

Tone Up Your Cartridge

With a newly designed photosensitive drum and toner bin, the DoubleFill retrofitted EP-S printer cartridge holds twice as much toner as the original cartridge. The DoubleFill can also be refilled six times rather than the once or twice of the original cartridge. The reusable cartridge is compatible with laser printers such as the Hewlett-Packard LaserJet Series II, IID, III, and IIID; the Apple LaserWriter; the Brother HL-8; the NEC SilentWriter; and the QMS Turbo.

Price: $109.95; your conventional cartridge retrofitted, $99.95; subsequent refills, $79.95.

Contact: M&S Computer Products, Inc., Boonton, NJ, (201) 263-9041; fax (201) 316-0653.

Circle 1272 on Inquiry Card.

Two Ways to Power Protection

True sine-wave UPSes (uninterruptible power supplies), the 600- to 1250-V Minuteman PM600 and PM1250 include automatic frequency selection of 50 or 60 MHz. When input voltage is betweeen 92 and 103 VAC, the units switch to boost mode and boost output voltage 12 percent while continuing to charge the batteries. When the input voltage is 92 VAC or over 103 VAC, the units automatically switch to inverter mode and run on the batteries; when normal power returns, the units automatically switch back to AC mode.

Other features of the UPSes include an overload measurement in AC mode that uses lights and audible alarms to let you know that the unit is overloaded. Nonlinear current capability and automatic unit test at power-on are also present.

Price: PM600, $579; PM1250, $1049.

Contact: Para Systems, Inc., Dallas, TX, (214) 446-7363; fax (214) 446-9011.

Circle 1274 on Inquiry Card.

For those who don't need the sophisticated prowess of a UPS, a simple solution to being one step ahead of a power brownout is the Line Alarm. The device sounds an alarm whenever the 120-VAC power varies by more than 10 percent. Response time of the 3- by 1½- by 1-inch device is about 300 ms. LEDs light to indicate brownouts at 108 VAC or overvoltage at 132 VAC. Neon lamps show if you are using proper electrical wiring and grounding. When the device signals a problem, you take responsibility for protecting your computer.

Price: $29.95.

Contact: Power Alarm, Inc., Santa Rosa, CA, (800) 786-6610 or (707) 579-2364; fax (707) 579-8084.

Circle 1275 on Inquiry Card.

World Radio History

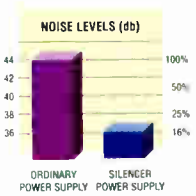
Power Packed Upgrades.

STANDARD UNITS

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

STANDARD 200 XT	**$69**
STANDARD 205 SLIM	**$89**
STANDARD 220 BABY	**$89**
STANDARD 220 AT/TOWER	**$89**

ULTRA-QUIET UNITS



Unrattle your nerves with a **Silencer** power supply, recognized since 1986 as the industry's quietest. Cooled with efficient, variable-speed fans that are virtually inaudible!

A must for home office or *multimedia* applications.

SILENCER 205 SLIM	**$119**
SILENCER 220 AT/TOWER	**$129**
SILENCER 270 AT/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, a dual-stage EMI filter, super-tight regulation, ultra-clean DC output, our 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 200 XT	**$159**
TURBO-COOL 300 SLIM	**$169**
TURBO-COOL 300 BABY	**$169**
TURBO-COOL 300 AT/TOWER	**$189**
TURBO-COOL 450 AT/TOWER	**$349**

REDUNDANT POWER SYSTEM

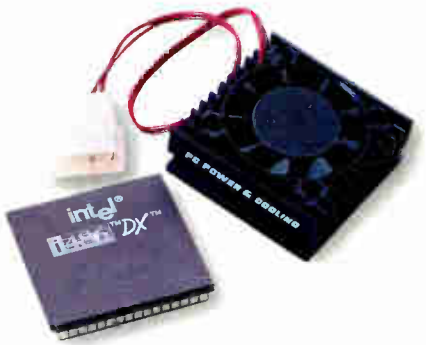
Eliminate the risk of network downtime or data loss due to power supply failure with the **TwinPower 900** redundant power system. It delivers high-capacity, fault-tolerant power to your entire network server. Consists of two **Turbo-Cool 450** power supplies in parallel, utilizing a special power-management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

- **Super Server Power.** With 900 watts of peak power, the TwinPower 900 effortlessly runs any array of drives-- without the need for sequencing.
- **100 Times More Reliable.** Why gamble with a single-unit system? TwinPower's load-sharing, redundant design lets you take the power system for granted. It's the peace-of-mind a network manager needs!

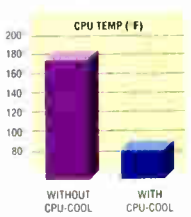
- **Hot-Swap Capability.** In the unlikely event that one of its 450s should fail, an alarm sounds, and the other 450 sustains the server while the user simply swaps in a new unit. No downtime!
- **Optional Enclosures.** We offer "monster" cases that hold TwinPower's two power supplies and interface. The Commercial Tower (76 lbs.) holds 13 drives, while the all-steel Industrial Tower (102 lbs.) allows dual systemboards and holds up to 16 drives. Now, that's expandability!

TWIN-POWER 900	**$995**
W/COMMERCIAL CASE	**$1695**
W/INDUSTRIAL CASE	**$1995**

486 CPU COOLER



It's a fact. 486 chips run hot, often exceeding 185°F! Now, you can reduce the operating temperature of your 80486 processor to a cool, safe 85° - 95°F with our popular **CPU-Cool.** You'll *prevent random system errors* and add years to the life of your investment. Consists of a quiet mini-fan embedded in a sculptured heat sink that easily mounts on the CPU. Powered by a spare drive connector. Effective, inexpensive insurance!



CPU-COOL **$39**

POWER SUPPLY ADVISOR

1. Even before it fails, an inferior power supply can be trouble. Nasty hard-to-track problems such as interference, rebooting, overheating, and hard drive errors are often power supply related.
2. You can't have too much power. A power supply delivers only what the PC needs and actually performs best at 25% -75% of its rated capacity.
3. For greater hard drive reliability, use a power supply with independent regulation and extra cooling such as the Turbo-Cool 300/450.
4. Buy from a reputable power supply specialist. You'll get real service, not some runaround like: "Here's a number in Taiwan, give them a call".
5. To save money, PC manufacturers put ordinary power supplies— with limited features— in their systems. To upgrade, call us direct or ask your PC supplier for one of our units by name.

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 and TwinPower models guaranteed for 2 years. All other products guaranteed for 1 year. Hours: 7 a.m. - 5 p.m. (PT) Mon. - Fri.

©1992 PC Power & Cooling, Inc. Silencer, Turbo-Cool, ThermaSense, TwinPower, and CPU-Cuol are trademarks of PC Power & Cooling, Inc. All other brand names are trademarks or registered trademarks of their respective companies.

Circle 116 on Inquiry Card (RESELLERS: 117).

World Radio History

WINDOWS WORLD™

Play to win in the "City of Winners"...Atlanta

It's two world-class events happening side by side in Atlanta...and the year's first opportunity to go to the cutting edge in computer and communications technology.

- More than 1,000 exhibiting companies with thousands of exciting new products!
- *Plus* dedicated Technology Showcases on Network Computing, Multimedia, Mobile Computing, UNIX®/Open Systems, OEM Sources, and Office and Imaging Systems!
- 75,000-plus attendees...including over 5,000 international delegates from more than 70 countries!
- *The rollout of Windows NT*—plus a world of new Windows applications!
- "Featured Country" program highlighting Canada!
- More than 100 separate educational conference sessions on the latest technology, business and distribution issues!
- Keynote addresses from Bill Gates of Microsoft and James Cannavino of IBM...plus "CEO Perspectives" from Robert Palmer of DEC and Jim Manzi of Lotus!

If you play to win in the computer industry, there's only one place to go this spring—COMDEX and WINDOWS WORLD in Atlanta!

World Radio History

COMDEX®

Don't miss the next COMDEX and WINDOWS WORLD!
FAX: (617) 449-2674

Hotels fill up fast—reserve your accommodations today!

YES! I want to see it first at COMDEX and WINDOWS WORLD!

☐ Send information on attending, including hotel and travel savings.
☐ Send information on exhibiting.
☐ COMDEX/Spring '93
The world's #1 computer and communications marketplace for resellers and corporate decision makers.
☐ WINDOWS WORLD '93
The official conference and exposition on Windows computing. Produced in cooperation with Microsoft.

May 24–27, 1993
Georgia World Congress Center • Atlanta, Georgia USA

8LKDA

Name _____
Title _____
Company _____
Address _____
City _____ State _____
Zip/Postal Code _____ Country _____
Telephone _____ Fax _____

Fax 617-449-2674 or mail to: The Interface Group, 300 First Avenue, Needham, MA 02194-2722 USA.

©1993 The Interface Group • 300 First Avenue, Needham, MA 02194-2722 USA. Windows is a trademark of Microsoft Corporation. UNIX is a trademark of UNIX System Laboratories, Inc., a subsidiary of AT&T.

Circle 91 on Inquiry Card.

World Radio History

Pocket Faxing

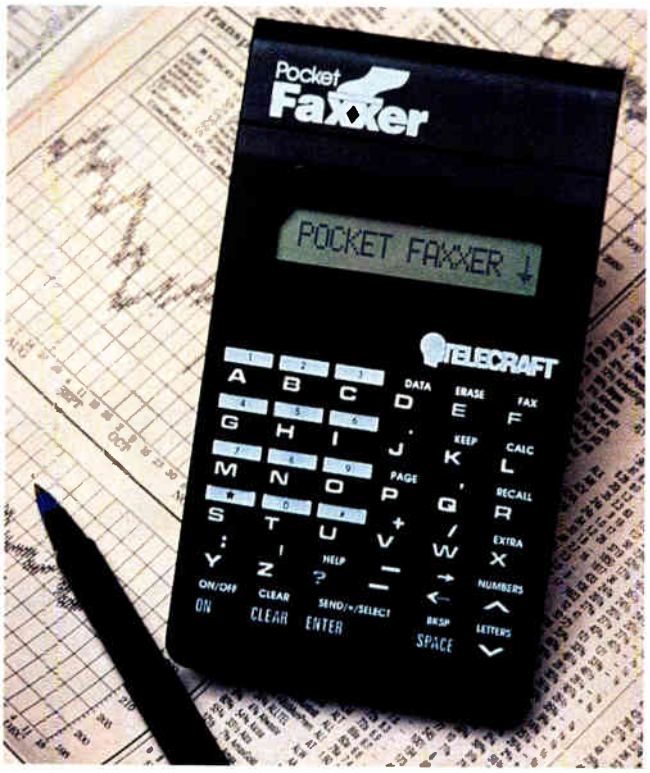
A wallet-size message-entry and telecommunications center, the Pocket Faxxer fits comfortably in your shirt pocket, a purse, or a briefcase. The paperless fax-transmission device can send messages to fax machines and beepers (i.e., radio pagers). The multipurpose communications center features 100 built-in functions that enable you to create, modify, store, and transmit information.

The Pocket Faxxer can operate as a data terminal, providing interactive communications with remote computer systems. It provides Touch-Tone dialing, reminder messages, audible alert signals, and a directory that can store names, telephone numbers, and general information.

You can program Pocket Faxxer to answer incoming calls and receive E-mail messages. The device can back up and restore all internal information to a PC.

With optional software, you can prepare messages on a PC for faxing or paging. The Pocket Faxxer can also communicate with text telephones (TDDs) used by people with hearing impairments.

Price: $399.
Contact: Telecraft Industries, Brooklyn, NY, (718) 972-0900; fax (718) 972-4695.
Circle 1276 on Inquiry Card.



To use the Pocket Faxxer, you plug it into a telephone line, type a message on the machine's mini-keyboard, and send the message via the phone line.

Overcome Analog/Digital Barriers

The Volante modem from Sonix Communications features a high-speed digital interface that breaks traditional divisions between modems and ISDN. The modem combines high analog-transmission performance with a digital interface running at up to 115,200 bps. This allows it to exploit the full benefits of data compression, particularly in applications requiring regular file transfers. In addition, the Volante is totally reprogrammable through the use of flash EPROM chips.

The Volante features V.42 error correction, including MNP, as well as V.42bis and MNP 5 data compression for maximum throughput. The package includes installation software, cabling, send and receive fax software, and data communications software.

Price: About $1148 (£795).
Contact: Sonix Communications, Ltd., Cirencester, Gloucestershire, U.K., +44 285 641651; fax +44 285 642098.
Circle 1277 on Inquiry Card.

Fax on Demand

Bogen Communications offers a full-featured fax-on-demand system, called Fax Vault, that stores documents for retrieval via fax. Using a Touch-Tone telephone, callers are requested to follow a menu of voice prompts that allow them to select and receive up to 999 pages of information 24 hours a day, seven days a week, from anywhere in the world.

You load documents into the Fax Vault from standard fax machines or PC fax modems. Fax Vault lets you change the factory-recorded voice prompts, security codes, and other components of the system from any Touch-Tone telephone. You can also individually configure lines to accept only calls, to transmit only information, or both.

A three-level security system controls access to the entire system, to specific documents, or to messages. In addition, Fax Vault features multiple-language voice prompts, international calling access, automatic cover-page generation, digital-voice messaging, and one to nine retries to send faxes. It provides you with reports on what information was requested, how many requests were filled, and the fax and phone numbers of those requesting information.

Price: Two-line model, $2995; four-line model, $3995.
Contact: Bogen Communications, Inc., Ramsey, NJ, (201) 934-8500; fax (201) 934-9832.
Circle 1278 on Inquiry Card.

Monitor Network Traffic

You can use PacketView 1.0, a PC-based network-traffic capture, decode, and display utility, with standard network controllers to capture and analyze network traffic. Compatible with Ethernet, Token Ring, and ARCnet, PacketView uses a packet driver to capture packets from any of the three media types. It then decodes the packets to display meaningful information.

Some of the protocols that PacketView recognizes include TCP/IP, Banyan Vines, Novell IPX/SPX/NCP, XNS, and AppleTalk. PacketView also lets you create your own protocol decoders using C or assembly language.

Price: $249.
Contact: Klos Technologies, Inc., Merrimack, NH, (603) 881-7777.
Circle 1279 on Inquiry Card.

World Radio History

Cross platforms easily.

New Timbuktu is the easiest way to network Macintosh and Windows computers, so you can share printers, files and screens.

Call today for a free demonstration video: 1-800-998-7760 ext. 4.

MacUser ★★★★½
PC Week Labs Overall Score 4.2
Macworld ★★★★
LAN Times 5 Nodes

Moving information between Macintosh® and Windows™ computers used to be quite a feat of skill. Let alone nerves.

But now there's Farallon's new Timbuktu® for Macintosh and Windows.

Timbuktu is the easiest way to create a peer-to-peer network. So, whether you're on a PC or Mac, you can share expensive peripherals like printers. And exchange files quickly and easily.

You also get a unique benefit—remote control. Timbuktu can send a real-time, full-color picture of your screen over the network so you can control and view it from another Mac or Windows PC. This lets you use your network for new things like collaboration and user support.

Of course, Timbuktu is easy to use and install. You don't need a dedicated gateway or server. And it works with what you've got. Even other networks on NetWare or TCP/IP.

For a free Timbuktu product demo video, just call. It's that easy. **1-800-998-7760 ext.4*.**

Farallon®
Power to the network.™

***Call 1-800-678-5075 for upgrades from Timbuktu and PhoneNET PC (previously AppleShare PC and PhoneNET Talk). Upgrades also available for SitkaTOPS and Carbon Copy.**

A copy of Timbuktu is required on each machine on the network. Single- and multi-packs are available.

All trademarks are property of their owners. ©1992 All rights reserved. For customer service, call (510) 814-5000. Or contact us on America Online® or AppleLink® ID: Farallon. CompuServe® ID: 75410, 2702. Internet ID: Farallon@farallon.com.

Circle 82 on Inquiry Card.

World Radio History

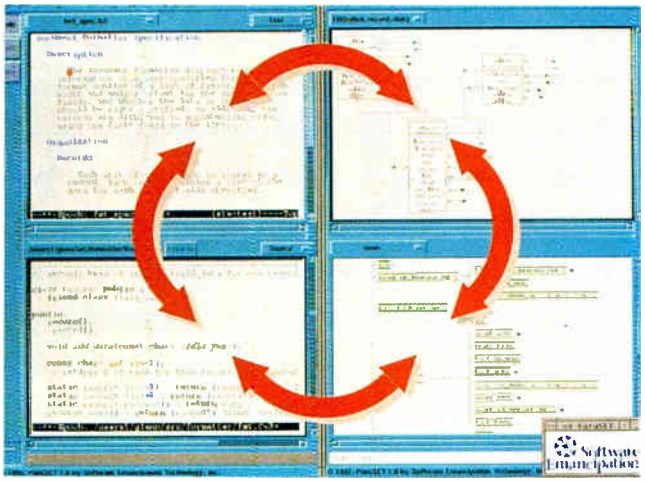
Unix Software Development

The ParaSet family of Unix software development products can improve the way you develop and maintain software. The products first establish and then dynamically maintain relationships among all the key activities of the software development process, including specification, analysis/design, coding, testing, and maintenance.

The ParaSet products support C and C++ and consist of three core modules and two options. The core system includes Para/Designer, which helps you design software using structured or object-oriented design techniques; Para/Programmer, which supports forward and reverse engineering of software; and Para/Online, which provides a hypertext-based EMACS editor for creating documentation.

The ParaSet options include Para/Analyzer, which helps you analyze and restructure existing software, and Para/Debugger, an interpreter-based debugging environment that supports incremental recompilation and relinking and mixed interpreted/compiled execution of software.

Price: $7500 and up.
Contact: Software Emancipation Technology, Inc., Waltham, MA, (617) 466-8600; fax (617) 466-9845.
Circle 1281 on Inquiry Card.



The ParaSet family of software development products uses the same model for forward engineering to develop new software, and for reverse engineering to modify, maintain, and improve existing software.

C++ Design Tools

C++ Designer combines a graphical PC-based design tool with C++ code-frame generation. The product helps you manage and manipulate objects at the design stage, as well as produce outline code. In addition, C++ Designer provides integral rule and consistency checking to help you adhere to the principles of good object-oriented design.
Price: About $282 (£195).
Contact: Select Software Tools, Ltd., Cheltenham, Gloucestershire, U.K., +44 242 226553; fax +44 242 251491.
Circle 1284 on Inquiry Cord.

Workbench for Windows

Curran's Bench 2.01 integrates and manages multivendor compilers, editors, linkers, make systems, and debuggers, so you can create an organized and intuitive Windows software engineering environment. You can configure DOS and Windows tools into the user-defined toolboxes and start a tool as a DOS or Windows process with the associated environment.

Bench lets you customize any tools to access files and directories and assign these tools execution context, command-line arguments, and initialization files. You can group tools into functional areas that correspond to the way a development team works, such as programming, documentation, and testing, or you can group them on a user or project basis.

Bench stores document revision information, comments, and changes associated with each revision under the reverse delta technique. It supports branching, multiple parallel versions, and version locking. Check-in and check-out facilities transparently accommodate team development.
Price: Bench, $395; five-user LAN license, $995; 10-user LAN license, $1695.
Contact: Curran Software, Seattle, WA, (206) 521-3790; fax (206) 822-3872.
Circle 1285 on Inquiry Card.

Automatic Documentation for OOP

Now development teams that use Digitalk Smalltalk/V can eliminate the lag between the production of code and the availability of documentation. Synopsis for Smalltalk/V automatically generates class documentation for any class in the system. In addition, you can print your class documentation with popular word processors or as text files.

Synopsis stores class summaries in class encyclopedias, which you can access via browser windows. It packages class encyclopedias in separate files, so you can distribute detailed descriptions of classes to other developers without having to ship source code. Two versions are available: Synopsis for Smalltalk/V Windows and Synopsis for Smalltalk/V PM.
Price: Windows version, $295; PM version, $395.
Contact: Synopsis Software, Raleigh, NC, phone and fax (919) 847-0650.
Circle 1282 on Inquiry Card.

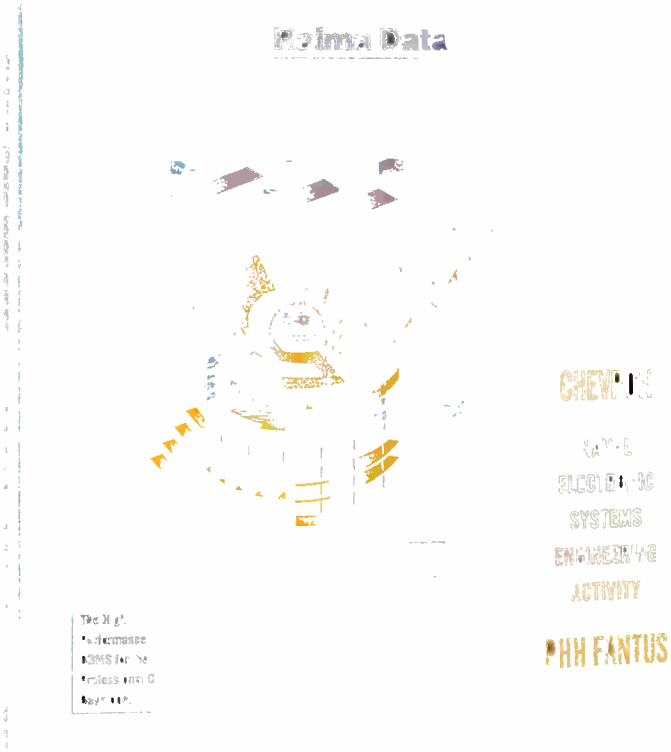
Simplify Error Tracking

An add-in utility, Feedback for 4th Dimension simplifies debugging and refining four-dimensional databases on the Mac. The software takes a snapshot of the screen, records your previous actions, and logs the exact date and time you made the request.

The utility can also trap 4-D errors, record the screen, generate a feedback slip, and store a log of events. And if other users are logged on to a network, Feedback for 4th Dimension can record a history of their actions. The software includes a copy of Backtracker, a companion program that provides more reporting and follow-up features.
Price: $295.
Contact: Macintosh Business Systems, Inc., Mamaroneck, NY, (914) 698-7215; fax (914) 698-0224.
Circle 1283 on Inquiry Card.

World Radio History

Since when is Raima first in Corporate Database Development?



Since April 7, 1992

1 800-DB-RAIMA Also available for DOS, OS/2, and UNIX

Get free information on over 2,000 products any time you like • Dial from a fax machine • Follow the voice computer's instructions • Receive literature instantly via fax

90 Industrial Park Road, Hingham, MA 02043

• Credit card orders processed only when product is shipped • All prices subject to change
• International prices will vary

World Radio History

Save lots of time,

NEWS

WHAT'S NEW • BUSINESS SOFTWARE

Program CNC Machines

Pathtrace Systems offers a Unix version of PAMS (Pathtrace Advanced Manufacturing System), its package for parts programming of CNC (Computer Numerical Control) machines, including milling machines, machining centers, lathes, milling/turning centers, and coordinate measuring machines. The Unix version offers a new GUI and a range of links to popular CAD systems.

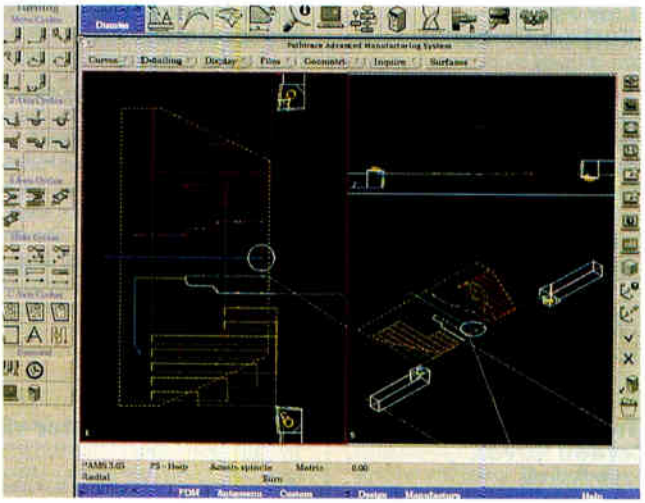
Graphical icons show you machining cutting cycles and tool selection. The multitasking package lets you run operations such as CNC code generation and tool-path solid modeling as background tasks. Complete parts-file compatibility between the DOS and Unix versions of PAMS supports mixed networks and facilitates moving from the DOS version to the Unix version.

PAMS/X runs under the X Window System and is available in a Sun OpenLook version for SPARC workstations or in an OSF/Motif version for Hewlett-Packard 9000 Series 700 systems.

Price: About $7225 (£5000 and up).

Contact: Pathtrace Systems, Ltd., Reading, Berkshire, U.K., +44 734 756084; fax +44 734 756143.

Circle 1287 on Inquiry Card.



With PAMS/X, you can program CNC lathes and show 4 Axis Lathe simulation with twin turrets.

Create Schedules

Guide Line and Guide Line Maker, two additions to Symantec's family of project management software, bring the benefits of project management to those who can answer fill-in-the-blank questions. Guide Line automatically builds project schedules, based on simple user input, that work with Time Line for Windows, Time Line 5.0 for DOS, On Target, and Microsoft Project for Windows. Guide Line Maker also lets you import files from these project management packages.

Guide Line contains 16 guides, including construction, office relocation, LAN installation, software development, consulting, small-business start-up, market research, a marketing plan, a trade show plan, and a general project plan. Three versions are available: Guide Line for Windows, Guide Line for DOS, and the Guide Line License Pack, which supports Microsoft Project for Windows.

Guide Line Maker lets you build your own project management guides from scratch or by importing previously created project schedules. It features a scripting language that facilitates development of guides and provides simple editing facilities, reusable templates, visual tools for detailed inspection of task and local variables, and report generators.

Price: Guide Line, $149.95; Guide Line Maker, $499.

Contact: Symantec Corp., Cupertino, CA, (800) 441-7234 or (408) 253-9600; fax (408) 253-4092.

Circle 1289 on Inquiry Card.

Personal Finance Software

Aatrix Software's Hi Finance is a personal finance package for the Mac that includes everything from basic bookkeeping to handling stocks and bonds to inventory tracking for individuals and small businesses. The package supports Apple's QuickTime technology, as well as unattended dial-up and downloading of stock information.

Hi Finance includes a loan calculator; retirement, savings, college, and insurance planning; an automobile pricing calculator; and even a lottery number picker. You can write checks, transfer between accounts, create budgets, and produce custom reports. The inventory manager lets you store information—such as records of family heirlooms and equipment for insurance purposes—as pictures, sound files, QuickTime movies, and text.

You can download and track stocks, bonds, mutual and money-market funds, and other investment data via modem. The software updates your portfolios and net worth and warns you of unusual market activity.

Price: $129.

Contact: Aatrix Software, Inc., Grand Forks, ND, (701) 746-6801; fax (701) 746-4249.

Circle 1288 on Inquiry Card.

Accounting for Windows

The latest version of Sybiz Accounting for Windows features flexible user-designed invoicing, integrated bank reconciliation, improved end-of-period processing, standing journals and payments, and more-focused planning and forecasting capabilities. Sybiz Accounting for Windows 3.0 lets you design and print custom invoice statements and forms in virtually any stationery layout.

Version 3.0 records payments and details of receipts and prints out full bank reconciliation reports, showing outstanding checks, deposits not listed on the bank statement, and differences between your reconciliation and that of the bank. Other features include DDE, which lets you set hot links between the accounting package and other Windows packages; mail merge; and an instant view facility, which lets you view anything in the program to service customer calls without interrupting the transaction in progress.

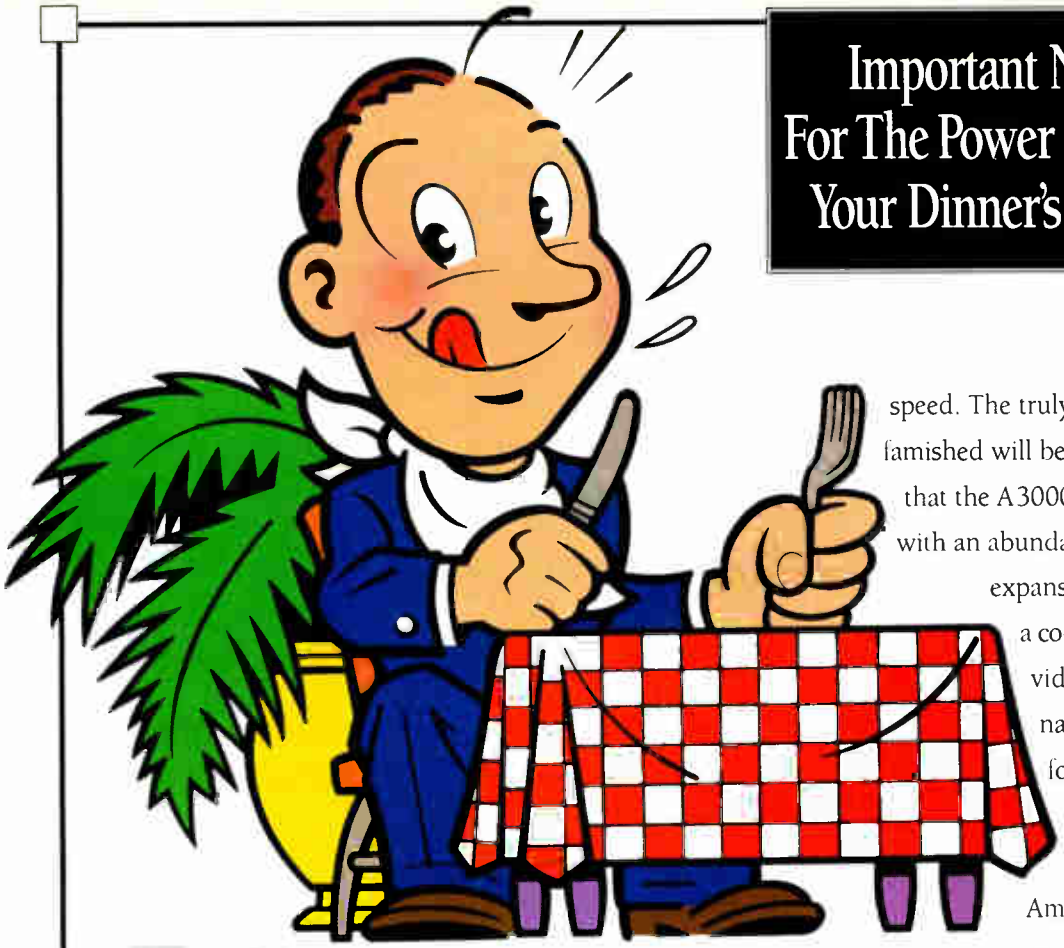
Price: Sales, Purchase, and Nominal Ledger modules, about $432 (£299); with Inventory module, about $576 (£399); with Job Costing module, about $1010 (£699).

Contact: Sybiz Solutions, Ltd., Newbury, Berkshire, U.K., +44 635 877777; fax +44 635 871887.

Circle 1290 on Inquiry Card.

World Radio History

Important News For The Power Hungry: Your Dinner's Ready.



Come and get it.

The new Amiga® 3000T multimedia workstation tower—the most expandable, flexible Amiga ever built.

Now powered by a 25 MHZ Motorola 68040 CPU, the A3000T is faster than ever before. (Current A3000T users can upgrade to a 040-based accelerator card.)

The A3000T features a 200MB hard disk drive. A 3.5" floppy disk drive. 5MB of RAM, expandable to 18MB. And 32-bit bus architecture to transfer mammoth amounts of information at breakneck speed. The truly power famished will be happy to know that the A3000T is stuffed with an abundant selection of expansion slots. There's a co-processor slot. A video slot for internal devices. Up to four PC slots. And up to five Zorro III slots. Every Amiga 3000 series computer comes with Commodore Express™ Gold Service options.* And convenient leasing terms are available.

Now, you'd expect a power feast like this to carry a fat price tag. But now with our new low price, you can sit down to an Amiga 3000T for just $2,875.** Which in itself is a powerful reason for seeing your Commodore dealer today. For a dealer near you, call 1-800-66-AMIGA. *In Canada, call 1-800-661-AMIGA.* Bon appetit.

See Us At World of Commodore AMIGA New York • April 2-4

© 1992 Commodore Business Machines Inc. Commodore and the Commodore logo are trademarks of Commodore Electronics Ltd. Amiga is a trademark of Commodore-Amiga, Inc. Products available on GSA schedule GS-00K-91-AGS-5069. * Available only on systems purchased in the U.S. through an authorized Commodore-Amiga dealer. Customer activation required. Some optional programs include a charge. **MSRP, monitor sold separately.

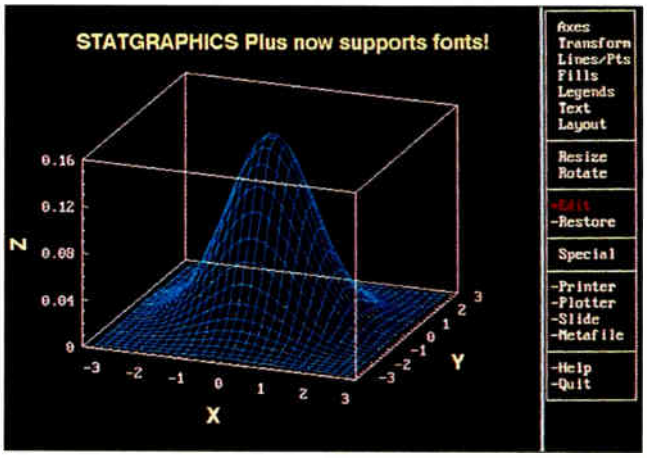
Circle 76 on Inquiry Card.

World Radio History

Statgraphics 6 for the PC

Manugistics has added increased flexibility to Statgraphics 6 and Statgraphics Plus 6 in the manipulation, presentation, and subsequent analysis of critical data. The latest versions feature a new graphical interface, improved text and data screens, and faster data queries and graph title selection.

Statgraphics and Statgraphics Plus give you the choice of using simple pull-down menus or the traditional Statgraphics menu structure. In addition, version 6 lets you choose between APL conventions and standard mathematical rules for evaluating expressions. They also feature a File Utilities procedure that makes navigating through data more convenient.
Price: Statgraphics 6, $995; Statgraphics Plus 6, $1595.
Contact: Manugistics, Inc., Rockville, MD, (301) 984-5000; fax (301) 984-5290.
Circle 1292 on Inquiry Card.



Statgraphics 6 and Statgraphics Plus 6 both feature a new graphical sidebar menu that lays out all your options.

Double Unix Throughput

Programmed Logic says that adding its HPFS (High Performance File System) to your Unix system is like getting twice the computing power out of your existing hardware configuration. The package helps your system run twice as fast or supports the workload of twice the number of users.

HPFS incorporates a new approach to meta-data management and fundamental enhancements to System V release 4's file system algorithms that collectively eliminate I/O bottlenecks. In addition, because the SVR4-compatible file system maintains plug compatibility and media compatibility with the Unix file system, you don't need to back up and restore your files—simply plug in the HPFS software module.
Price: Single-user, $249; multiuser, $499; multiprocessor, $999.
Contact: Programmed Logic Corp., Somerset, NJ, (908) 302-0090; fax (908) 302-1903.
Circle 1295 on Inquiry Card.

Organize Online Sessions

If you regularly access on-line information services, now there's a software program that can help you organize your on-line sessions. Online Log for the IBM PC records your on-line sessions, along with the vendor, database, subject or client designation, connect time, filename, and session cost.

Online Log works with communications software to post an entry for each on-line session. If you search multiple databases consecutively, you can update it midsession. Online Log stores a completed entry in a log that you can later search, edit, display, archive, or print. The program lets you search by date, client, vendor, filename, and database.

When it's time to reconcile a vendor invoice for the month, you simply enter the dates and the vendor name. Online Log then displays a list of that vendor's sessions for the month, along with a dollar total.
Price: $59.
Contact: Et Cetera, Inc., Dover, DE, (302) 738-7335.
Circle 1293 on Inquiry Card.

System 7.0 Utilities

Designed as a control panel accessible through the Apple menu, the nine Wiz Tools modules include Launcher, SubMenu, Keystroke Recorder, FinderTools, Twins, PowerBook Utilities, ColorSwitcher, WorldClock, and WatchFolder. Wiz Tools help you quickly access applications, documents, DAs (desk accessories), folders, and control panels; create up to five levels of submenus for all folders and volumes listed in the Apple menu; switch between two preset screen displays without going to the Monitors control panel; and view the time for different geographical areas worldwide.
Price: $129.
Contact: ASD Software, Inc., Montclair, CA, (909) 624-2594; fax (909) 624-9574.
Circle 1294 on Inquiry Card.

Curve Fitting and Statistics

SlideWrite Plus for DOS 5.0 combines linear, nonlinear, and weighted curve-fitting functions, statistical analysis, and sophisticated drawing and text capabilities. The program includes 100 built-in linear-approximating functions arranged in linear, exponential, power, and polynomial groups; and 15 resident parametric nonlinear equations.

In addition to curve-fitting capabilities and statistical analysis, SlideWrite Plus for DOS 5.0 has a WYSIWYG interface, on-screen drawing, sizing, and text formatting, scalable Nimbus-Q fonts, and vector-format clip art. You can import both Lotus and ASCII files.

SlideWrite Plus for DOS 5.0 comes with over 400 logically grouped vector-format illustrations. Clip-art packages are also available with illustrations relevant to specialized technical areas.
Price: $445.
Contact: Advanced Graphics Software, Inc., Carlsbad, CA, (619) 931-1919; fax (619) 931-9313.
Circle 1296 on Inquiry Card.

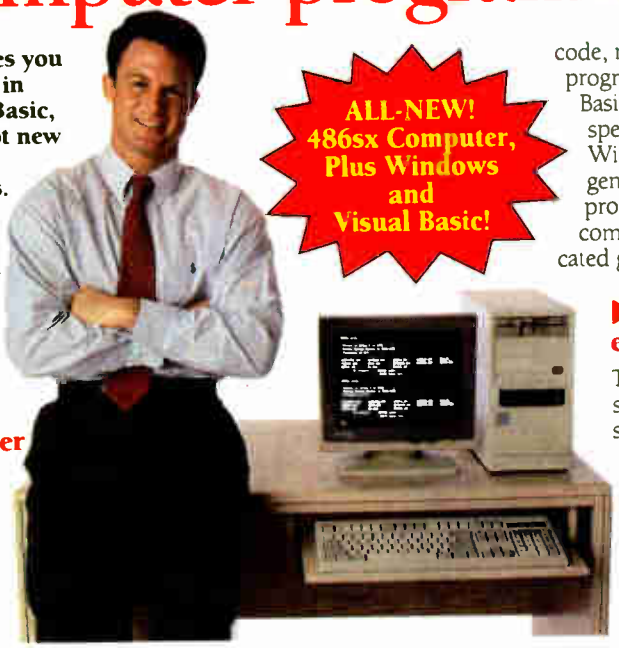
SPREAD THE WORD

Please address new product information to New Products Editors, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. The press release should contain the product description, price, ship date, and an address and telephone number where readers can get more information.

World Radio History

Get the new skills you need for a high-paying career in computer programming!

Only NRI at-home training gives you real-world programming skills in three in-demand languages: QBasic, C, and Visual Basic, today's hot new language designed for writing popular Windows applications. Best of all, you get hands-on training with a powerful new 486sx-based computer system, complete with 80 meg hard drive, Windows, and professional programming software you keep!



ALL-NEW! 486sx Computer, Plus Windows and Visual Basic!

▶ NRI, the recognized leader in at-home computer training, shows you how to take advantage of today's newest programming opportunities

Get in on the ground floor of one of today's fastest-growing career fields: computer programming. The Bureau of Labor Statistics forecasts that job opportunities for programmers will increase *much* faster than average over the next 10 years, with as many as 400,000 *new* jobs opening up by 2005.

And the fastest-growing segment of programming jobs will be PC programming, fueled by the phenomenal popularity of Windows, the efficient power of C, and the ascent of exciting new languages like QBasic and Visual Basic.

Now, with NRI at-home training, you can get the new skills you need to build a top-paying career — even a full- or part-time business of your own — in this high-growth, high-opportunity field.

▶ NEW! The only programming course that includes a powerful 486sx-based computer, 80 meg hard drive, Windows, Visual Basic, and more — all yours to keep!

Right from the start, NRI gets you actively involved in the challenge of real-world programming. Step by step, you learn to create the kinds of full-featured, powerful programs today's employers and clients demand... including programs designed for use in a Windows environment!

Only NRI gives you first-hand programming experience with a state-of-the-art 486sx mini-tower computer system, complete with hard disk drive, a full megabyte of RAM, high-density floppy drive, mouse, monitor, and more — all yours to train with and keep!

Plus you explore the extraordinary capabilities of *three* in-demand programming languages. You learn to design, code, run, debug, and document programs in QBasic, C, and Visual Basic. Best of all, since Visual Basic is specifically designed for creating Windows applications, you learn to generate fully functioning Windows programs, complete with text boxes, command buttons, and other sophisticated graphical interface elements.

▶ No previous experience necessary

Train with NRI, and immediately start getting the money-making job skills you need to be a computer programmer — no matter what your previous background.

NRI's step-by-step lessons and hands-on programming projects help you first master the programming design concepts used every day by successful PC programmers. With your experienced NRI instructor on call and ready to help, you go on to learn programming in three of today's hottest languages.

By the time you complete your course, you have a clear understanding of programming methods, languages, and techniques...and you're ready to handle any programming task with confidence.

See other side for highlights of your NRI hands-on training in computer programming ➡

SEND CARD TODAY FOR FREE NRI CATALOG!

NRI Schools
McGraw-Hill Continuing Education Center
4401 Connecticut Avenue, NW, Washington, DC 20008

For career courses approved under GI Bill, ☐ check for details

YES! Send me the FREE catalog I've checked and show me how NRI can give me the skills and confidence to earn good money in an exciting new career or business of my own.

✓ Check one free catalog only

☐ **Computer Programming**
☐ PC Applications Specialist
☐ Programming in C++ with Windows

Other Computer Career Opportunities
☐ Microcomputer Servicing
☐ Desktop Publishing
☐ Bookkeeping and Accounting
☐ Computer-Aided Drafting

Name _____ (please print) Age _____

Address _____

City _____ State _____ Zip _____

Accredited Member, National Home Study Council

5448-0493

World Radio History

Learn computer programming as you train with the latest programming tools… a 486sx-based computer system, Windows, Visual Basic, and more!

"I couldn't believe NRI gives you a computer, loads of reference material, and professional software. The course has taken my knowledge of computers and my self-confidence to new levels!"

Rob A. Chappa, *NRI Student*

Here's what makes your 486sx mini-tower computer system the ideal programming tool:

- Full IBM PC/AT-compatibility
- High-speed 80486sx CPU with 25 MHz clock
- 80 megabyte hard disk drive
- 1 meg RAM (expandable on board); 64K ROM
- Windows graphical interface
- 14" high-resolution monitor with tilt-swivel base
- 1.2 meg, high-density 5¼" floppy disk drive
- MS-DOS operating system with QBasic Interpreter
- Professional compilers for programming in C and Visual Basic

▶ Now, as never before, you can succeed as a computer programmer

NRI at-home training gives you everything you need to build a high-paying career as a computer programmer. Designed around a state-of-the-art 486sx computer system, your training guides you smoothly from fundamental principles through coding in three of today's most widely used computer languages: QBasic, C, and Visual Basic, the language designed specifically for programming in a Windows environment.

With NRI, you get the hands-on experience and the confidence it takes to master today's programming challenges. And, by creating and running your own full-length programs, you build skills you'll be proud to show any prospective employer or client.

▶ Send today for your FREE catalog

Prepare now for a high-paying career as a computer programmer! See how NRI at-home training in Computer Programming gives you the experience and the know-how, the computer and the software you need to get a fast start in this top-growth field. Send today for your FREE catalog.

If the card is missing, write to us at NRI Schools, McGraw-Hill Continuing Education Center, 4401 Connecticut Avenue, NW, Washington, DC 20008.

IBM PC/AT is a registered trademark of the IBM Corporation. Windows, QBasic, and Visual Basic are trademarks of Microsoft Corporation.

Card 72

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL

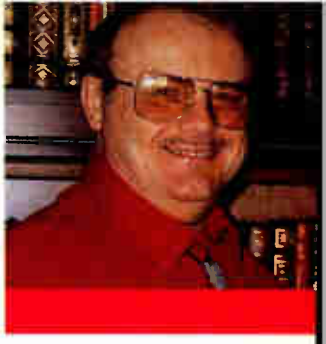
FIRST CLASS MAIL PERMIT NO. 10008 WASHINGTON, D.C.

POSTAGE WILL BE PAID BY ADDRESSEE

NRI Schools

McGraw-Hill Continuing Education Center
4401 Connecticut Avenue, NW
Washington, DC 20078-3543

World Radio History



JERRY
POURNELLE

WHAT'S HOT, WHAT'S NOT

It's January, which means this is my annual year-end column, because I stubbornly insist that a year ends on December 31. Of course, that means you are reading this in late March, and the issue is dated April. Such is publishing. Anyway, it's time for the 1992 User's Choice Awards and the annual Chaos Manor Orchid and Onion Parade.

According to my business newspaper, "1992 was the year of the personal computer." This was the year that "analysts say it became abundantly clear business moved away from the big computer systems supplied by multinationals like IBM, Digital Equipment Corp., and Wang," and "computing power shifted to the individual...." Two cheers for the industry analysts who finally figured this out, and one cheer for IBM for finally catching on to what most of us here in Microland have been saying for years. Last year, Apple almost caught up to IBM as the world's largest seller of personal computers; three cheers to Apple for getting their act together, and none for IBM, who, after all, have had since 1982 to see the light—even without reading this column.

Which isn't to say all divisions of IBM are the same. Two cheers to IBM for OS/2. I wish it could be three and an Orchid. OS/2 is definitely a better DOS than DOS, and if you work mostly in DOS and use Windows applications only once in a while, you really should consider a switch to OS/2. Its installation ease ranges between simple and sheer murder (and there seems to be no way to predict which it will be). Drivers for CD-ROM drives, WORM drives, rewritable optical drives, fast video cards, local-bus video, TV-viewer boards, fax modem coprocessors, and so forth appear from time to time. Some of them work, with some products. Some don't.

IBM really is working on letting you use such assets, and I look forward to working with the next release of OS/2, which is supposed to have a module that makes it compatible with Windows 3.1. That's a neat idea, since Windows compatibility is a moving target. The next version of OS/2 is just in beta testing and will be shipping Real Soon Now. I wish them well, but I do wonder how long we'll wait this time.

Two cheers to Lotus for making Agenda highly useful and then abandoning it as a product. Agenda is a task and time management program that incorporates a simple form of AI. It looked like a good path toward more practical applications of AI. Agenda isn't at all easy to learn, and there's no Windows version, but it will run in DOS under Windows and has no problems with OS/2. If you're an OS/2 user, you'll probably like Agenda. (Tiger Software is selling Agenda at a special price of $79.95. The original list price was $249. You can contact them at 800 Douglas Entrance, Executive Tower, Seventh Floor, Coral Gables, FL 33134, (800) 888-4437; fax (305) 529-3438.)

If you do use Agenda, you'll want President's Planner from Phase III Computing. Agenda has a macro capability so rich that it might as well be a programming language, and President's Planner is a set of macros that makes Agenda learnable and more useful. It calls itself the first "do what I mean" time and information planner, and that's pretty close to the truth. I can't quite see giving a User's Choice Award to a program that supports an orphan, so President's Planner will have to settle for a big Chaos Manor Orchid. If Lotus was really smart, they'd buy President's Planner, bundle it into Agenda, run it over Notes, and reissue the product as Agenda for Notes.

The annual Orchid and Onion Parade issues forth from Chaos Manor

User's Choice

I began the User's Choice Awards well before everyone else began handing out awards. Now there's a standing joke that you cannot find a Comdex booth without at least one product that has one of the better-known awards; but my purpose was to drive the industry in directions I wanted it to go. In those days, there weren't all that many products that deserved awards. Sometimes, "best of the year" wasn't what I could call good enough, so I deliberately didn't have fixed categories.

Nowadays there's a different problem: there are too many products that are good enough, and quite often the "best" choice isn't very clear-cut, either. As a result, I've slowly changed the nature of these awards. I generally don't and can't say that the winner is the "best" in its category, because there's no possible way I can even be aware of all the products in this industry, much less try

ILLUSTRATION: STEVE TURK © 1993

World Radio History

New Version 5.0 of Phar Lap's 386|DOS-Extender™

Now Supports 32-Bit Microsoft C/C++!

Microsoft® C/C++ users: the wait is over!

Now you can finally build multi-megabyte 32-bit DOS applications with your familiar Microsoft tools! Version 5.0 of Phar Lap's 386|DOS-Extender lets you run Microsoft's 32-bit Windows NT C/C++ compiler under DOS. You get all the advantages of Phar Lap's industry-leading DOS extender technology, while using the most popular C/C++ compiler available. Multi-megabyte 32-bit DOS development has never been easier.

640K DOS BARRIER

Award-winning 32-bit technology.

386|DOS-Extender turns DOS into a 32-bit operating environment with a flat, workstation-like address space. Your programs can access all the memory in the machine — up to 4 gigabytes! — and take advantage of true 32-bit speed and power. No more segmentation or overlay hassles. And in addition to 32-bit Microsoft C/C++, 386|DOS-Extender supports a wide range of 32-bit languages, including Fortran, Pascal, Ada, Assembler and other C and C++ compilers. An add-on Run-Time Kit is also available for delivering Extended-DOS applications to customers.

1989 BYTE AWARD OF EXCELLENCE

1991 BYTE AWARD OF DISTINCTION

COMPUTER LANGUAGE PRODUCTIVITY AWARD 1990

COMPUTER LANGUAGE PRODUCTIVITY AWARD 1991

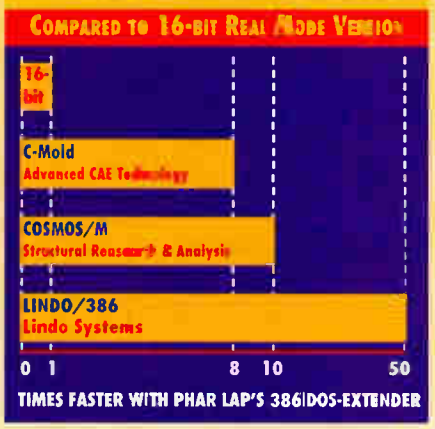
Industry-leading compatibility.

386|DOS-Extender is compatible with more than 60 popular libraries and utilities, making it easy to select the best tools on the market for your 32-bit development. Choose from user interface libraries including C-scape, DataWindows/386, WNDX and Vermont Views Plus; graphics libraries including HALO Professional, HOOPS and MetaWINDOW/PREMIUM; database libraries including AccSys, CodeBase and Raima Data Manager; class libraries including Tools.h++ and Math.h++; and many others. Only 386|DOS-Extender can offer you the universal third-party support you need.

"the highest quality 32-bit DOS extender available"

–Robert Wenig, Autodesk

See how much faster your 32-bit DOS version could run:



Complete Microsoft support.

386|DOS-Extender, Version 5.0 gives you the full functionality of the Microsoft run-time libraries, including graphics. You can still make all your 16-bit Microsoft C/C++ calls — but now with 32-bit power!

32-BIT Microsoft C/C++

New source-level debugger.

386|DOS-Extender, Version 5.0 includes Phar Lap's new 386|SRCBug, a powerful 32-bit source code debugger for protected mode 386|DOS-Extender applications.

286|DOS-Extender — the easy way to build multi-megabyte 16-bit DOS applications.

If you'd rather use 16-bit Microsoft C/C++, Borland C++ or Microsoft Fortran, then Phar Lap's award-winning 286|DOS-Extender™ is your solution. With 286|DOS-Extender, your program can break the 640K DOS barrier and access up to 16 megabytes of memory on any 80286 or higher DOS-based PC. You can even use CodeView or Turbo Debugger to debug your protected mode program.

Phar Lap Software, Inc.

60 Aberdeen Avenue, Cambridge, MA 02138 617-661-1510 FAX 617-876-2972

286|DOS-Extender and 386|DOS-Extender are trademarks and Phar Lap is a registered trademark of Phar Lap Software, Inc. Borland and Turbo Debugger are registered trademarks of Borland International. Windows NT is a trademark and CodeView and Microsoft are registered trademarks of Microsoft Corp. Other product and company names are trademarks or registered trademarks of their respective holders.

Circle 119 on Inquiry Card.

World Radio History

them out. Instead, a User's Choice Award says that this is a product I have used and liked. Generally, it's one I use now, and if not there's always a reason, such as I don't need to do whatever that product does, or I'm trying out something that may be better, but I haven't made up my mind.

In any event, the User's Choice Award goes to something I have personally tried and find good enough for the job it claims to do. I don't guarantee there's not something better. As always, while I discuss these with my colleagues and BYTE distributes the certificates, the User's Choice Awards remain my sole responsibility.

Operating Environment

Last year, the contest was between Windows and Desqview. Desqview is as good as it ever was, which is good indeed, but I fear it hasn't kept up with its rivals. In particular, it hasn't kept up with OS/2, which will run just about everything Desqview does, run it much faster, and do a passable job with Windows applications as well.

Windows, meanwhile, just keeps getting better and better. Equally important, most of the really high-powered software development people have jumped aboard the Windows bandwagon, with more to come. Many of the exciting new applications are now written for Windows first and then DOS, if at all. Meanwhile, most DOS applications run well in Windows, if you take the trouble to write a PIF (program information file) for them. The real rivals for Windows are Apple's Mac and Windows for Workgroups (W4WG for short), with OS/2 lurking in the wings.

I've been using W4WG for several months now. My first experiences were somewhat frustrating. Most of that ceased when W4WG went from beta testing to a shipping product, but some frustrations remain. The other day, for instance, I decided to retire the machine that was host to the Pioneer Minichanger CD-ROM drive and read/write optical drive and move those assets to my old Cheetah 386/25, which was already running on the W4WG network. The Cheetah would then be loaded down with other useful peripherals and put back out of the way in the cable room as a network server. Those Pioneer drives run off one CorelSCSI board, and it wasn't much of a problem getting them to work with the Cheetah under DOS.

When I brought up W4WG, I had previously defined that Cheetah's drive F to be the D drive on the 486/25 Larry Niven uses when he comes here to write. Alas, I had forgotten that. Since the Minichanger was installed as the Cheetah's F drive and had become a local CD-ROM drive, there was now a conflict. The intuitive way to fix it—going into File Manager and canceling the F-drive assignment—didn't work. Fixing that took half an hour, a phone call, and two iterations of exiting Windows and resetting the machine. (You first go to File Manager and turn off the Reshare at Startup box; exit File Manager; exit Windows; restart Windows; go back to File Manager and erase the network-drive assignment; and exit and restart Windows. You don't really have to reset the machine, but I always do.) The moral of that story is that if you change the configuration of a networked machine, you must kill *all* its network connections and make certain they don't try to reconnect on start-up.

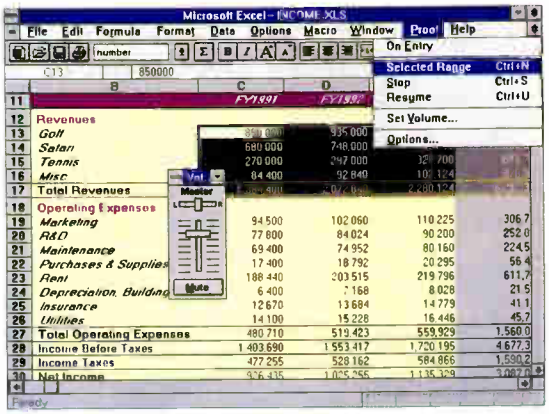
However, now that it's all done, it works just fine. It's pretty nice to have six CD-ROM discs and a 600-MB (300 MB per side) optical drive available at all times. Network access is just about as fast as if those drives were local to my own machine. It all works, too.

Well, almost all. Alas, some CD-ROM discs seem to have been hard-coded to believe they're playing off a local drive. They curl up and die at odd moments. Quanta's Desert Storm CD-ROM won't open its sound files across the network. Another one apparently looks at the Cheetah's video board (an elderly VGA) and tries to adapt to that rather than take my word that we've got an ATI Technologies' Graphics Ultra Super VGA board over here on this machine. In both cases, of course, I'm trying to run *programs* off the CD-ROM drive. I don't have any trouble retrieving images.

At worst, I can put a recalcitrant CD-ROM disc into the Multimedia Upgrade Kit CD-ROM drive that's local to my main system. A few discs won't run under Windows even there, but so far I haven't found one that runs under Windows that won't also run under W4WG.

The main feature of W4WG is the ease of both setup and use. Other networks give power, notably LANtastic for Windows (which will link in Macs, too), but getting other networks set up requires study of the manuals and considerably more work; many establishments will need a network manager. On the other hand, W4WG can be set up and running in a couple of hours by anyone generally familiar with Windows. The network boards are pretty well self-installing, *most* of the operations are intuitive (not all; some applications

What business does sound have in a computer?



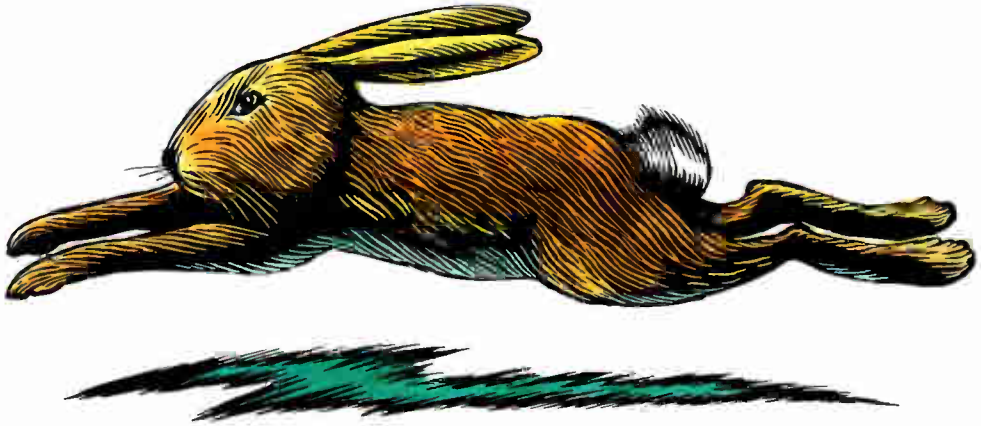
MICROSOFT WINDOWS

For starters, you can increase your productivity when you proof spreadsheets with the new Microsoft® Windows™ Sound System. Just highlight a series of numbers or words on the screen and it will read them back to you. It will even read them aloud as you enter them, if you like. To hear more, turn the page.

World Radio History

ALSO AVAILABLE IN A NEW CD-ROM MODEL

NOW BACKPACK IS SMALLER. AND FASTER.



We've just made it easier to backup your hard drive with our 250 MB parallel port tape backup unit. One model works with all PC compatibles and portables.

Here's why:

***Backpack** is easy to install. Plug Backpack into the parallel printer port. Then plug the printer into Backpack!*

***Backpack** requires no cards.*

***Backpack** is 30% smaller (1.5" h x 4" w x 7.75" l).*

***Backpack** is easy to transport and share between computers (2.5 lbs).*

***Backpack** can backup at a speed of up to 9 MB per minute.*

***Backpack** is a QIC 80 compatible and can read QIC 40 tapes.*

***Backpack** is available in 3.5" and 5.25" diskette, tape and hard disk models.*

So don't get left in the dust. Call for more information today.

Micro Solutions, 132 W. Lincoln Hwy., DeKalb, IL 60115, 815-756-3411, FAX: 815-756-2928

backpack

MicroSolutions

Computer Products

Circle 104 on Inquiry Card (RESELLERS: 105).

World Radio History

require you to check cancel to get out of them once you've done everything, others want OK, and one wants you to close it), and almost any user can begin elementary networking very quickly.

In my case, I have a number of assets on a remote machine, and when Niven and I work on a book together, we can trade files without having to save off on a floppy disk. I can also write each of the versions to a WORM drive, so that we'll never lose text due to version clashes. That alone justifies networking for me.

Windows has gone a long way to flatten out the PC learning curve. Richard, one of my Mac-using sons, was forced to use an NCR 3170 because he needed a laptop and no Mac PowerBook was available. He has now completely gone over to Windows because he found it easy enough to learn and there's a wider variety of software for Windows (or DOS under Windows) than he found for the Mac. That's particularly true of communications, but there are also business applications like Franklin Ascend that he uses constantly. Richard reports that he wouldn't want to learn DOS, but Windows and File Manager let him do what he needs to without DOS. He now prefers the NCR 3170 to his Mac.

(Of course, a visit to a large Mac show will convince you that there's a great ferment there, too. Many PC applications are being ported to the Mac, and while there are more Windows software developers, there's no dearth of Mac developers. The truth is, there are exciting developments in both fields.)

Meanwhile, we've thoroughly converted all our PC operations to Windows here in Chaos Manor; and for all my talk about networking over the years, W4WG has given me a practical network that I can maintain, use, and add to without much work. This year's User's Choice Awards for Operating Environment go to Windows 3.1 and W4WG; and the User's Choice Operating Environment of the Year is W4WG.

Computer of the Year

First, it's now clear that if you can possibly afford it, you ought to get a 486. This does not mean that the 386 systems are obsolete, and for that matter, you can get by with a 386SX if that's all you have; but if you're going out shopping for a new system, it's prudent to invest in a 486 and have done with it.

A lot of new computer systems passed through Chaos Manor this year, and we could have had more if we'd wanted them. One stands out. The Gateway 2000 4DX2-66V, a 66-MHz 486DX2 with local-bus video, right out of the box is the fastest machine we've ever had here. It has withstood being transported to the beach house and back. It has been a test-bed for sound boards and CD-ROM and SCSI devices, and it has worked fine with them all. It's a well-built machine, and the case is attractive. There's plenty of room to install an internal CD-ROM drive. Its younger brother, a 50-MHz 486DX2, has survived being a test-bed for OS/2, DR DOS, seven different sound boards, four different CD-ROM systems, two drive controllers, and any number of video boards; and like the Energizer rabbit, it just keeps going and going.

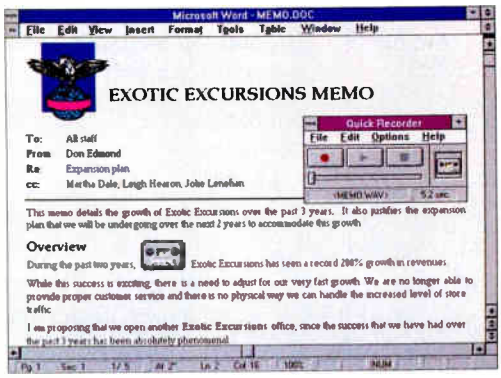
You expect local-bus video to be fast; but experienced visitors to Chaos Manor find that they didn't expect the 66-MHz 486DX2 to be *that* fast. As an example, the ships in Berkeley's Star Trek Screen Saver for Windows flow across the screen smoothly without jerkiness; we don't get that on any other machine here. Windows don't just pop up, they explode. Windows has been criticized for slowing your machine way down. If you don't have enough memory, it surely will; but even with lots of memory, Windows can drag. Not on this machine.

What we have is the standard configuration of the Gateway 2000 4DX2-66V. If I were buying one, I'd make one change. The Crystal Scan monitor that comes standard with it is more than good enough, but you can do better elsewhere. Both my NEC and Nanao monitors look absolutely gorgeous with the Gateway 2000, and I'd recommend getting one of those. Understand, though, it's a preference, not a requirement.

I took the still-crated-up 4DX2-66V and Crystal Scan monitor down to the beach house to do some serious editing on *Prince of Sparta*. There was absolutely no problem about setting it up. Everything was in there—a programmable keyboard with settable key-repeat rates, programmable macros, and even a Microsoft Mouse. Windows was already installed, so all I had to do was add Microsoft Word and the draft of my book. The computer performed flawlessly, and the speed was impressive. It's very useful to have that much speed for editing. It's also easy to get used to it so that you become impatient with anything else.

The only real negative feature is that,

What business does sound have in a computer?



MICROSOFT WINDOWS

Now you can communicate more effectively by adding your voice, or even music, to documents and presentations. Just record it, drag it and drop it in.

Microsoft Windows Sound System can also recognize and execute spoken commands like *open*, *cut* and *paste*. You can easily create custom commands in any application for the Microsoft Windows™ operating system. Want to hear something else? Turn the page.

World Radio History

There Is Strength In Numbers.

intel inside

TravelMate™ 4000 WinSX™ or WinDX™
- 486 SX/25MHz or 486 DX/25MHz
- 4MB RAM std. (20MB max.)
- 120MB HDD
- 5.6 pounds

$2,799/$3,299 SRP*

TravelMate 4000 WinDX2™
- 486 DX2/50MHz
- 8MB RAM std. (20MB max.)
- 200MB HDD
- 5.6 pounds

$3,899 SRP*

TravelMate 4000 WinSX COLOR
- 486 SX/25MHz
- 4MB RAM std. (20MB max.)
- 120MB HDD
- 6.3 pounds

$3,699 SRP*

TravelMate 4000 WinDX2 COLOR
- 486 DX2/40MHz
- 8MB RAM std. (20MB max.)
- 200MB HDD
- 6.3 pounds

$4,499 SRP*

Texas Instruments comes on strong with the widest selection of powerful 486 notebooks at incredible prices. From 25MHz to the world's most powerful 50MHz notebook in a 5.6-pound package, there's a TI TravelMate just for you.

Take a look at these numbers. You get superior 486 performance with an extraordinary three to five hours of battery life. On our color models, you get 256 simultaneous brilliant colors on a large 9.4" display. All these numbers add up to outstanding performance and value.

There's one more important number. For more information and the dealer nearest you, call **1-800-527-3500.**

Microsoft Windows™ Ready-to-Run

TEXAS INSTRUMENTS

CHOISI PAR PC EXPERT December 1992 TravelMate 4000 WinSX/25

PORTABLE COMPUTING PRODUCT EXCELLENCE

MOBILE OFFICE MO HIGH HONORS

PCComputing MVP 92 FINALIST

TravelMate, WinSX, WinDX and WinDX2 are trademarks of Texas Instruments. The Ready-to-Run logo is a trademark of Microsoft Corporation. The Intel Inside logo is a trademark of Intel Corporation.

*Manufactuter's Suggested Retail Price. Dealer prices may vary.

© 1993 TI

Circle 139 on Inquiry Card.

World Radio History

unlike the 50-MHz 486DX2, the 4DX2-66V uses an odd memory form factor I've never seen before. The machine comes with 8 MB, but you really need 16 MB, and the only source I know of is Gateway 2000. Fortunately, so long as the Department of Commerce keeps its hands out of the machinery, memory is cheap, and Gateway 2000 sells memory for the 4DX2-66V at reasonable prices.

I have no hesitation in giving a User's Choice Award for the Most Useful Computer at Chaos Manor this year to the Gateway 2000 4DX2-66V.

Sound and Multimedia

Multimedia was a disappointment this year. Several new products tried to take advantage of multimedia. Some were more successful than others, but the problem has been that the "multimedia standard" hasn't proved to be a standard at all, making it much harder to do multimedia applications. The sound scene has the worst confusion.

The best sound board for quality and high-end usefulness at reasonable cost has been the Turtle Beach MultiSound. This board has sound quality surpassed only by units that are quite a bit more expensive. It has an on-board DSP (digital signal processor), a special sound-processing chip that lets it generate sounds from a number of different sources and play them all simultaneously. You can have a classical-music CD playing in the background, add a game with sound effects, and still be able to use sound alarms. You can also associate sounds with user actions. Just like Mac users, you too can have Mr. Spock tell you "That should prove interesting" when you go to read a floppy disk, or Captain Kirk say "We better start the evacuation" when you leave an application.

If you're a serious musician, you're likely to know more about sound boards than I do, and you'll probably want one of the really high-end sound boards and speaker systems. But if you're just getting into computerized composition and sound editing, and you want to try your hand without making a really serious investment, the MultiSound is a great deal more than good enough. Incidentally, I've seen test copies of a new program that will let you scan in sheet music: it reads it and then plays it on the MultiSound. It's not out yet, but watch for it.

That's the good news. The bad news is that the MultiSound was built as an MPC board. This means that programs written for Windows will have no problems with it, since it supports the MPC sound standard and has all necessary drivers for that. You can build Windows sound objects and DLLs with no problem. However, most games weren't written for Windows. Most games were written for DOS. Nearly every game has support for Ad Lib and/or Sound Blaster sound systems; but Turtle Beach never tried to be compatible with Sound Blaster, and few games have multimedia standard drivers. The result is that a great many of the most popular games won't work with the MultiSound.

The second drawback to the MultiSound is that the output isn't powerful enough to drive speakers directly. It must be fed into an amplifier, which means either batteries or yet one more power cord to your computer system. You can also feed the MultiSound output into your stereo system, which is probably the right thing to do anyway.

If you want high-quality sound and don't care about games, or you can live with your game using the PC's internal sound system, or you believe as I do that it won't be long before the most popular games will come out in Windows versions, you shouldn't hesitate to get the MultiSound. With that reservation, Turtle Beach gets a User's Choice Award for the MultiSound.

Converting to Multimedia

If you don't need really high-quality sound, the Creative Labs Sound Blaster Pro board is good enough. This burst on the scene a couple of years ago and swept everything before it; now it's pretty well the standard for all sound software except high-end composition systems, and even those will often have hooks to let their output play through a Sound Blaster Pro.

I'm not as picky about sound quality as most people, and I find Sound Blaster Pro's sounds generally good enough; but fair warning, my musical friends think I have a tin ear. Sound Blaster Pro puts out enough power (4 watts) to drive unamplified speakers: I tend to use inexpensive ones from Radio Shack. Of course, they hardly show off the sound quality to best advantage.

Sound Blaster Pro is certainly good enough for game players and for those not *too* fussy about music quality. It does voice quite well. There's no DSP chip, meaning the board can be overwhelmed by simultaneous sound inputs. That's not fatal, given what you're likely to be using a Sound Blaster Pro card for; it just means that instead of playing multiple sound sources,

Microsoft Windows Sound System. You'll be hearing a lot about it.

MICROSOFT WINDOWS

It's the complete audio solution for your business, with all the hardware and software included. Call (800) 426-9400, Dept. JK8, for a free demo disk that'll bring the Microsoft Windows Sound System to life on your PC. It's the first audio system specifically designed for the Microsoft Windows operating system.*

Microsoft
Making it easier

*Requires the Windows operating system 3.1 or later. Demo is on a 3.5-inch high-density disk. Offer good while supplies last. Inside the 50 United States, call (800) 426-9400, Dept. JK8. For information only: In Canada, call (800) 563-9048; outside the United States and Canada, call (206) 936-8661. © 1992 Microsoft Corporation. All rights reserved. Printed in the USA. Microsoft is a registered trademark and Windows is a trademark of Microsoft Corporation.

World Radio History

it stops all but the one that it's outputting.

The best thing about Sound Blaster Pro is that you can get it with Creative's Multimedia Upgrade Kit, which consists of a CD-ROM drive using Sound Blaster Pro as a controller and a whole bunch of software (see my March column). This is probably the most painless way to upgrade your system to multimedia specifications. Sound Blaster Pro is compatible with nearly every DOS game, so you'll have sounds for those, provided you play them in DOS. Many elaborate DOS games will play in Windows, provided you use a memory management program to give yourself large DOS windows, and most will find the Sound Blaster Pro board.

However, not all of them will do that, and with W4WG I get an even stranger situation. A game like Darklands will come up, and then suddenly I'm back at the Program Manager with a message that some other program is using the sound board, so there won't be any sound; and my game has been iconized. If I double-click on that icon, the game comes up again, and there's sound as if none of that ever happened. Alas, Civilization, a DOS game that played just fine under Windows 3.1, gets locked up when I try it under W4WG. Microsoft is trying to figure out why.

A multimedia game like Sherlock Holmes, Consulting Detective, works just fine under Windows 3.1, and many games will play across the network in W4WG. The Creative Labs CD-ROM drive can be shared across the network to other stations. Creative has an active BBS and often offers updated drivers. The Multimedia Upgrade Kit is compatible with more software—DOS, Windows, and multimedia—than anything else out there.

The Creative Labs Multimedia Upgrade Kit and the Sound Blaster Pro sound card both win User's Choice Awards.

Supra Modems

I've used a lot of modems over the years. The most useful one this year was the SupraFaxModem 144 PB with error correction. This is small enough to stuff into checked luggage and take along on trips. I always do that now, because even if my portables have internal modems, the Supra with error correction works far better over the noisy connections I always seem to get when I have a critical upload to perform.

I've written about Supra modems in other columns, so it just remains to award the SupraFaxModem the User's Choice Award as Most Useful Modem of the Year.

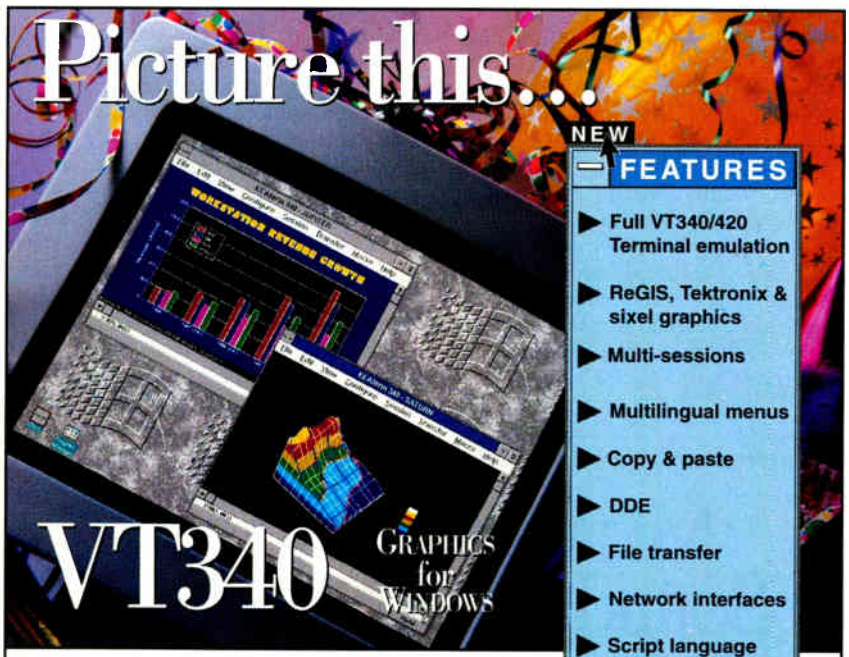
Satisfaxtion

I know I just said the Supra was the most useful modem of the year, but the Intel Satisfaxtion is a bit more than just a modem, since it has its own CPU chip and memory. The Satisfaxtion will send and receive fax messages invisibly in the background without stealing cycles from your CPU. It works over many networks. Alas, one thing it will not do is work over a Novell NetWare network underlying W4WG running over ARCnet. No one is quite sure why, and it may be fixed by the time you read this; the problem was just discovered and reported by my son Alex yesterday.

There aren't a lot of other limits on the usefulness of the Satisfaxtion, which gets a User's Choice Award as Communications Coprocessor of the Year.

Mapping and Painting

There are a lot of drawing and painting programs for Windows out there, and most of them are pretty good. Windows Draw works well. Aldus FreeHand for Windows is excellent. If you have really elaborate



WE'VE JUST ADDED A NEW DIMENSION TO VT340 FUNCTIONS—WINDOWS.

KEAterm 340 gives the power of Windows to your host applications.

KEAterm products combine the features of Windows with the features of a VT terminal for true PC-to-host integration. Control your host data just as you control PC applications—with access to the same powerful software and printers. Host data becomes truly useable.

With KEAterm 340, you can use PC graphics tools to expand the use of host graphics. Copy ReGIS, Tektronix and sixel images into desktop publishing or draw packages for further manipulation.

Picture new power for host applications with KEAterm 340 for Windows.

KEAterm 340

KEA

KEA Systems Ltd.
Call 1-800-663-8702
Phone: (604) 431-0727
Fax: (604) 431-0818

KEA Systems Ltd. 3736 North Fraser Way, Unit 101, Burnaby, BC, Canada V5J 5G1
KEAlink, KEAterm, ZSTEM, PowerStation, KEA and their respective logos are trademarks of KEA Systems Ltd. All other brand and product names are trademarks or registered trademarks of their respective holders.
Copyright ©KEA SYSTEMS LTD. 1992. All rights reserved.

See KEAterm for Windows and Windows NT at Windows World in Atlanta, May 24-27. Booth 6454.

Circle 93 on Inquiry Card.

World Radio History

MINUTEMAN TAKES CHARGE IN OVER 1000 JCPENNEY STORES.

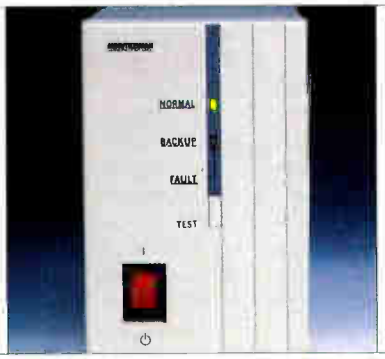
Every time JCPenney sells a pair of jeans, a toaster or a bottle of perfume, MINUTEMAN takes charge. That's because more than one thousand JCPenney stores rely on MINUTEMAN UPS systems to back up power to their point-of-sale systems.

Every day your company relies on its voice and data communications equipment to stay productive. Unfortunately, the electricity that powers these vital systems is not reliable.

Blackouts, brownouts, spikes, surges and even lightning strikes are common in most business environments. And the high cost of losing vital information and productivity due to power outages and surges calls for preventive measures.

Power requirements can be confusing. And your company has unique needs that often require custom solutions.

MINUTEMAN Alliance 300VA $159



MINUTEMAN Alliance 425VA $259

MINUTEMAN PRODUCTS:

- On-line and standby UPS 300VA to 10KVA
- Shutdown software for every available operating system
- Automatic voltage regulators
- Surge suppressors
- International models
- Two year warranty

Call our toll-free POWER HOTLINE now for your free Power Protection Guide.

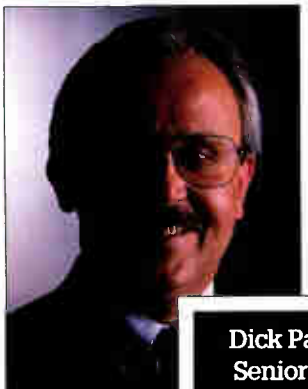
(800) 238-7272

MINUTEMAN®
UNINTERRUPTIBLE POWER SUPPLIES

Reduced prices up to 36%

Call for complete price list.

See us at COMDEX/Spring '93
Booth #1000



Dick Patefield, Senior Project Manager for Store Systems Support, JCPenney

Recently JCPenney Co., Inc. changed its operations from the old POS systems to the new PC-based technology, relying on PC platforms for point-of-sale and in-store support. And they back each one up with help from MINUTEMAN.

"There was a violent surge in one of our stores," says Patefield. *"If we didn't have the MINUTEMAN unit, it probably would have seriously damaged all of our point-of-sale equipment.*

"The key was the switch-over time from AC to battery," says Patefield. *"It really has the best continuity of the UPS systems we evaluated. Also, the price was very favorable. When you're installing them in as many locations as we are, the pricing was very attractive."*

FOR LAN MANAGER TESTED AND APPROVED

LAN MANAGER VERSION 2.1

Circle 114 on Inquiry Card.

© 1992 Para Systems, Inc., 1455 LeMay Drive, Carrollton, Texas 75007 (214) 446-7363 (214) 446-9011 fax

World Radio History

drafting work to do, you can't beat AutoCAD, but like Lotus Notes, AutoCAD is almost a way of life. Every one of these has good features. Alas, each works in a slightly different way from the others, so you restart on the learning curve every time.

CorelDraw has more features than any of the other programs but AutoCAD, and it even has a few that AutoCAD doesn't have. CorelDraw has both drawing and painting capabilities. It's not particularly easy to learn, but it's not *that* much harder than the others; and once you have learned CorelDraw, you have available a mountain of resources and features, enough to accomplish just about everything you'd want to do.

That, at least, was my reasoning when I set out to look for a program to use for drawing maps and illustrations for my stories. I did the maps for *Prince of Mercenaries* in MacPaint, and they were pretty good. But publisher Jim Baen uses a PC, and lately I've taken to shipping him everything through E-mail rather than the mails, so I wanted a PC-based drawing program. I have a wide variety of mapping needs, from the rather stark military-style sketch maps I use for the Falkenberg series, to the much more fanciful pictorial maps I'll need when I get going on a major heroic fantasy. It seemed to me that the right way to go was to learn CorelDraw, because that way I'd be able to do a lot more than just maps. I have hopes of doing some equipment illustrations, and I might think of something else.

I've had no reason to regret the decision. The learning curve is a bit steep, but I'm managing, and CorelDraw comes with a great number of canned images, many of which I can incorporate directly into my maps. Certainly CorelDraw is powerful enough, and while the published price is fairly steep, the street price is quite reasonable. I'll have more to say on this as I go along, but I've had enough experience to give CorelDraw a User's Choice Award.

Cool It!

The new 486 chips, particularly the OverDrive versions, can get plenty hot. PC Power & Cooling, which so far as I am concerned is the only company to go to for a power supply, now sells a little fan, the CPU-Cool, you can attach to the chip and plug into your PC's power supply. If you have one of the new 486 OverDrive systems, let it run for a couple of hours, turn it off, very quickly open the case, and put your finger on the CPU chip. If it's too hot to leave your finger there, you need a CPU-Cool.

A properly ventilated OverDrive chip run in a normal-temperature environment may not need one of these; but then you never know when your room will get overheated. Anyway, look into the PC Power & Cooling CPU-Cool, which gets a User's Choice Award.

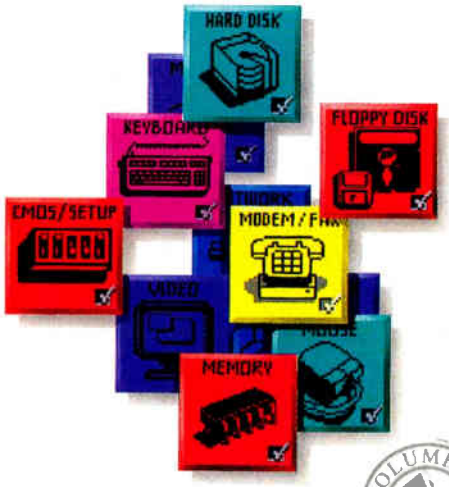
The Amiga Is Back

When the Amiga first came out, the machine was well ahead of its time and had the best video imaging of any machine on the market. It was also the first of the low-cost true multitasking systems. Unfortunately, Commodore lost most of those advantages: their video-accelerator chip set is good but no longer in a class by itself.

The good news is that Commodore is back and with a vengeance. The Amiga 3000T-040 is a good machine (see my September 1992 column). The new Amiga 4000-040 is even better: fast, flexible, and, perhaps more to the point, fun. The

INTRODUCING

The First Diagnostic that's All PRO and *No CON*.



CHECK✓IT PRO™ VOLUME 1 SYSINFO
ADVANCED DIAGNOSTIC SOFTWARE

Check✓It PRO: SysInfo provides the most accurate and comprehensive configuration data ever available. Whether you're planning an upgrade, trying to find a set-up problem, or simply becoming familiar with a new system, Check✓It PRO: SysInfo has the information you need.

- Processor/Co-Processor Model, Manufacturer, and Speed (MHz)
- Detailed Memory Maps: Base/UMB, EMS, XMS, TSRs, Device Drivers and Interrupt Vectors
- REAL Hard Drive Geometry, Model, and Interface Type: MFM, RLL, IDE, SCSI, & ESDI
- Detects Network, Modem, FAX, CD-ROM, and Sound Card Details
- Edit/Save/Restore CMOS, plus DOS & Windows System Files
- Performance Benchmarks compared to Standard or Custom System Profiles
- Built-In Technical Reference Library

The PROs and CONs of SysInfo Utilities

There's a real difference in the information displayed by Check✓It PRO, and other utility programs. For example, Check✓It PRO determines the "live" status of each IRQ – but other programs just show you "standard" assignments. Check✓It PRO also tests your hard drive to find out what type of drive is really attached, not just how CMOS is set up. If it was easy, every program would provide this type of information; but the only one that does is Check✓It PRO. No matter what other program you have, you need Check✓It PRO too.

Try it for yourself. We think you'll agree that the new Check✓It definitely qualifies as a real PRO.

QUALITY TESTED
TouchStone Software Corporation
2130 Main Street, Suite 250
Huntington Beach, CA 92648
Fax (714) 960-1886

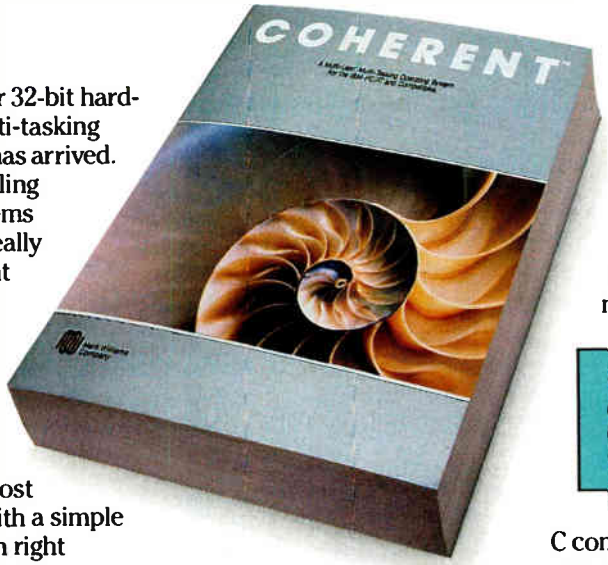
(800) 531-0450 or (714) 969-7746

Copyright ©1992 TouchStone Software. ALL RIGHTS RESERVED. CheckIt PRO is a trademark of TouchStone Software Corp. Huntington Beach, CA

Circle 143 on Inquiry Card (RESELLERS: 144).

World Radio History

The World's Best Selling UNIX Clone Just Got Better.



Now with full 32-bit implementation!

If you want to ignite your 32-bit hardware with the multi-user, multi-tasking power of UNIX, Coherent 4.0 has arrived. And if you're operating or selling small business network systems with dozens of users, that's really good news. Because Coherent 4.0 is what you want in UNIX at a price that's hard to believe.

Run UNIX applications today!

Coherent is now binary compatible with UNIX. Most UNIX PC applications port with a simple recompile and many now run right out of the box. The list is growing everyday, so call for details.

Yes, It's For Real!

How can it be? First of all, Coherent was independently developed by the Mark Williams Company, so you don't pay for UNIX licensing fees. You don't pay any mark-up or reseller costs either. Coherent is only sold directly to you.

"...(Coherent) may be the best thing that has happened to UNIX yet." –William Zachmann, PC Week

In fact, over 40,000 copies of Coherent have already been sold. And, like the ones we quote here, virtually every critic who's reviewed Coherent has raved about it.

So Much Less, Yet So Much More.

As a virtual clone of UNIX, Coherent embraces the original UNIX philosophy: Small is beautiful. Small price, yes. But there's more, much more, to Coherent than its amazing price.

Requiring only 10 megabytes of disk space, Coherent can reside with DOS. So you can keep all your DOS applications and move up to Coherent. And it runs with as little as 1 MB of memory versus 4 MB for other UNIX versions.

The World's Only Plug And Play UNIX Clone.

You'll have Coherent up and running with a fraction of the time and effort it takes for other UNIX versions. Our six disk installation is a breeze compared to their 25. You'll also learn it faster and increase overall performance. All because Coherent is smaller, faster... and better.

Small, But So Complete.

Make no mistake, Coherent is a wholly professional development system. You get a complete C compiler, assembler and over 200 UNIX commands including full sets of functions for development, administration, maintenance and text processing.

Coherent also comes with UUCP capabilities that connect you to a world-wide network of free software, news and millions of UNIX users. And it's all clearly documented in Coherent's highly praised 1200 page manual.

"Coherent comes so fully qualified as a UNIX clone, you find yourself thinking, 'I can't believe it's not UNIX!'" –Sean Fulton, UNIX Today!

Coherent.™ Still $99.95.

	MWC COHERENT Version 4.0	SCO UNIX/386 Version 3.2V2
No. of Manuals	1	14
No. of Disks	6	25
Kernel Size	100 K	375 K
Install Time	40 min.	3-4 hours
Suggested Disk Space	10 meg	60 meg
Min. Memory Required	1 meg	2-4 meg
Performance*	85.7	31.3
Price	$99.95	$2590

*Byte C Compiler Benchmark: Compiles per minute on 25 MHZ 486.

Experienced, Supported, Guaranteed.

Mark Williams Company has been developing professional programming tools since 1976. Our commitment to our products and users is unsurpassed. Users applaud our popular BBS and the widely acclaimed telephone support they get free from Coherent developers.

Still, we're not asking you to take a chance on Coherent. We've made it foolproof to see for yourself–with a 60-day money-back, no hassles guarantee. So pick up that phone and order Coherent now. And the best way to UNIX will be on its way to you!

800-MARK WMS

(800-627-5967 or 708-291-6700, FAX: 708-291-6750)

60-DAY MONEY BACK GUARANTEE!

Mark Williams Company
60 Revere Drive, Northbrook, IL 60062

Coherent is a trademark of Mark Williams Company. UNIX is a trademark of USL.

Distributors: Australia + 07-266-2270, Brazil + 011-883-2299, Czech. + 06-32-62877, France + 1-4741-4519, 1-4672-8074, Germany + 0511-53-7295, Greece + (01) 222-3511, Holland + 023-386-599, Hungary + 153-0988, Malaysia + 03-756-4477, Venezuela/Caribbean + 1-809-723-5000, Sweden + 06-60-19290, UK + (0) 81-541-5466

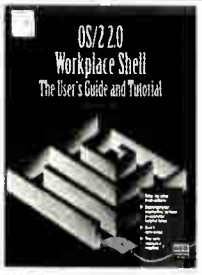
World Radio History

Circle 130 on Inquiry Card.

MASTER OS/2 WITH THE McGRAW-HILL BOOKSTORE

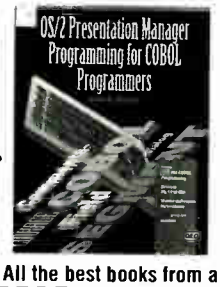
Introducing the first volumes in QED Publishing Group's new OS/2 series ...

QED Publishing Group



OS/2 2.0 WORKPLACE SHELL
The User's Guide and Tutorial
Maria Tyne

Take advantage of OS/2 2.0 with this one-stop instructional guide filled with easy-to-follow steps for tackling business tasks quickly.
0-89435-442-6, 360 *pp., illustrated,* $24.95



OS/2 PRESENTATION MANAGER PROGRAMMING FOR COBOL PROGRAMMERS
Robert Chapman

Apply the techniques and skills necessary to create Presentation Manager business applications with this comprehensive guide.
0-89435-439-6, 504 *pp., diskette,* $39.95

All the best books from all the best publishers

Clip or copy this coupon and fax or mail to: McGraw-Hill Bookstore, 1221 Avenue of the Americas, New York, NY 10020. Order by phone in NY at 212-512-4100; outside NY call toll free (800) 352-3566; or fax this coupon to us at 212-512-4105. *Fax or phone orders delivered within 10 days!*

❑ Yes! Please rush me:
___ OS/2 2.0 Workplace Shell: The User's Guide and Tutorial @ $24.95
___ OS/2 Presentation Manager Programming for COBOL Programmers @ $39.95

Check, money order, or credit card only:
❑ Visa ❑ AMEX ❑ MasterCard ❑ Discover

Account No._____ Exp. Date _____
Name _____
Address _____
City _____ State _____ Zip _____
Please add applicable sales tax, plus $2.50 for U.S. postage and handling BY393

The McGraw-Hill Bookstore—Serving Today's Professionals

USER'S COLUMN

3000T-040 comes with on-board SCSI. The 4000-040 comes with on-board IDE but no SCSI; there is a third-party SCSI board available, and Commodore is working on a SCSI-2 system for the 4000-040.

In fact, Commodore is working on a lot of things. At recent shows, they have unveiled plans for a spectacular series of upgrades and new systems. Meanwhile, the company has begun aggressive marketing of their Amiga lines.

A few years ago, I expressed the hope that the Amiga would be a real player and a rival to Apple, because I truly believe that competition is what keeps companies putting out better products for the rest of us. They haven't been that yet, but it now looks like they could be. I can't yet in conscience recommend the Amiga as the only machine for naive computer users; but if you like computers and don't mind spending some time learning what you can do with them, the Amiga has great potential and is a lot of fun to boot. It's nearly ideal as a second machine for computer enthusiasts.

Three cheers, and a large Chaos Manor Orchid to Commodore. Welcome back.

E-Mail

Three cheers and a User's Choice Award to MCI Mail. I had some problems with their service—they hadn't devoted enough resources to servicing automatic log-in systems such as Norton Commander's MCI Mail handler (which I use); but they responded quickly to complaints, and the problems went away quickly. And when I needed the way to address an E-mail message to Moscow, I sent an inquiry to MCI-Help. Within an hour, a helpful young lady called to tell me precisely how to do that.

I still think AT&T's mail service is technically superior to MCI. But for usability, and being able to get to a lot of people, including a gate to the Internet, MCI is a lot better than good enough, and it remains in my judgment the one indispensable E-mail service.

Printers

Two printers stood out for us last year: Seikosha's SP-2000 "pizza-box" impact printer and Kyocera's Ecosys aSi FS-1500A LED printer.

Our son Phillip has the SP-2000. Phillip is a deck officer aboard the USS *Tripoli*, which at the moment is just off the coast of Somalia. We recently got a 12-page letter from him: written on his Poqet computer and printed on the SP-2000. It's clear that the Seikosha pizza box—it's called that because it's about the size and shape of a box containing a 12-inch pizza—is rugged and portable. It can operate on ridiculously

World Radio History

The only Windows™ statistics package you'll ever need.

MICROSOFT WINDOWS™ COMPATIBLE

NEW
SYSTAT® for WINDOWS

#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

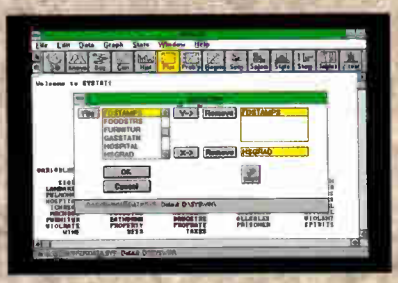
A compatible family of products

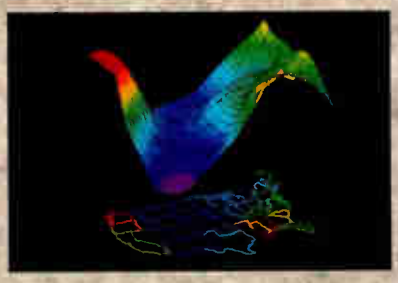
Whichever you choose–SYSTAT for Windows, SYSTAT for DOS or both–you'll enjoy the most powerful statistics and scientific graphics software available for the PC.

For more information, special offers for current users, and demo disks, call:

708-864-5670

For Windows circle 136,
For IBM/DOS circle 137.





For more information call or write: **SYSTAT, Inc.**, 1800 Sherman Avenue, Evanston, Illinois 60201-3793. Tel: 708.864.5670, Fax: 708.492.3567

SYSTAT®

Australia: Hearne Marketing 61.3.8661766, **BeNeLux:** Oasis 31.3402.66336, **Denmark:** Agrolab 45.64.406575, **France:** Deltasoft 33.76.418508, **Germany:** STATCON 49.55.4272075, **Italy:** PiSoft 39.587.213640, **Japan:** HuLinks 81.33.5902311, **New Zealand:** Hoare & Assoc. 64.78.562675, **Poland:** COMPANION 48.12.360791, **Spain:** AddLink 34.3.4590722, **Switzerland:** F & P 41.31.215151, **SYSTAT UK:** 44.81.4620093

© 1992 SYSTAT®, Inc. *Software Digest Ratings Report/8.5*, May, 1991. Software Digest is a registered trademark of NSTL, Inc.

World Radio History

unreliable current and works in odd circumstances; it let our son get his letters done in rather trying circumstances. Seikosha has since replaced the SP-2000 with the SP-2400AP, but the Seikosha pizza box still deserves a User's Choice Award in the Affordable Printer category.

The Ecosys is a rugged, high-end LED printer that doesn't use expensive cartridges. It turns out quality printing at good speeds and does it economically. Also, as the name implies, it doesn't waste any resources. It wins the User's Choice Award as Printer of the Year.

Orchid of the Year

Consider AT&T: a company that only a few years ago I said couldn't market eternal life; a company with a century of experience at bureaucratic infighting, where getting ahead didn't mean pleasing the customers but, instead, understanding rules and regulations and being able to move within them. Ma Bell. The Phone Company. Look how they've changed!

They bought NCR to learn marketing, and it worked. They've brought out a string of new products, with their Safari laptop (since renamed the NCR 3170) one of the best designs around, incorporating Bell Labs technical skills with NCR marketing pizzazz. I regret the need to turn Bell Labs into a product-oriented outfit—it used to be the nearest thing to the long-range planning group for the human race—but it seems to be happening without destroying much of the spirit of the place.

I look for great things from the new AT&T. And for proving that big ships may turn slowly, but they can turn, I give the Chaos Manor Orchid of the Year to the aggressive new AT&T/NCR combo.

Mystat and Systat

I mentioned Mystat, an introductory course and tutorial on statistics using Systat, in the January column. The package is designed specifically for use by educators. That mention sparked a lot of interest.

Keith Reehl at Systat tells me that you can now purchase Mystat directly from them. Academic users can purchase the package from NACSCORP (528 East Lorain St., Oberlin, OH 44074, (800) 321-3883). Warning: NACSCORP deals only with campus bookstores.

Winding Down

I've run out of space before I got to all the products on my list. This will be continued next month, with optical character readers, CD-ROMs, and many more software and hardware products that deserve special mention.

The book of the month is by *Fortune* contributing editor Daniel Seligman: *A Question of Intelligence: The IQ Debate in America* (Birch Lane Press, 1992). Excellent.

The computer book of the month is by Geoffrey Mandel, *Essentials of Word for Windows* (Peachpit Press, 1992). Thin, readable, and I have learned more about Word from this than from a dozen other thicker works. Highly recommended.

Of course, you should get *The Gripping Hand* by Niven and Pournelle if you haven't yet, and my *Prince of Sparta* (Baen Books, 1993) should be in stores about now.

I have three games of the year: MicroProse's Civilization, which won my Game of the Year Award last year, has held up; it's a big game of military and industrial strategy, and, remarkably, after a year it's still played at Chaos Manor. The other game is a mini card game from the Microsoft Entertainment Pack for Windows. It's called FreeCell, and I would hate to have to tell you how much of my time it

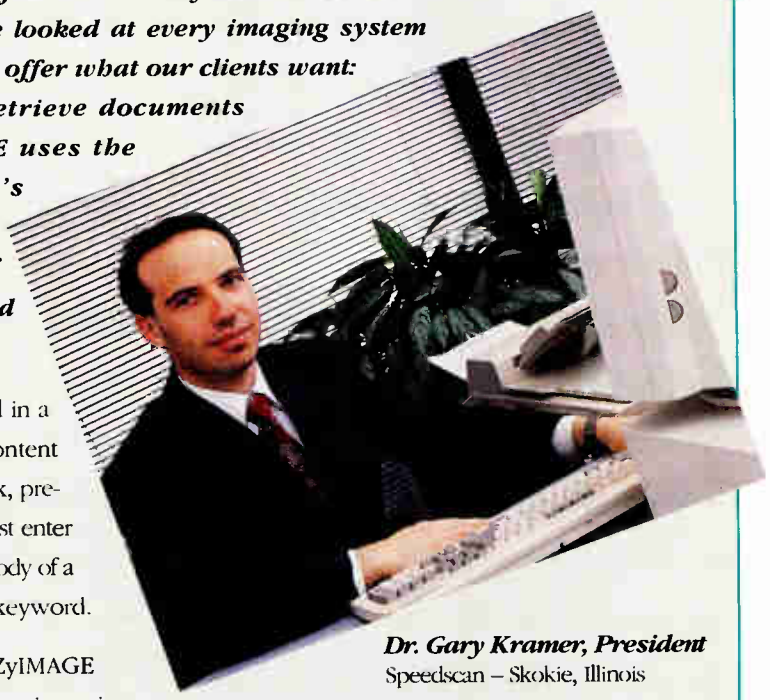
Circle 145 on Inquiry Card (RESELLERS: 146).

World Radio History

ZyIMAGE

"Finally, an imaging system that includes the most important part of a document– the words."

"We've been in the imaging business for over three years...which is a long time in this industry. We have looked at every imaging system available and ZyIMAGE is the first to offer what our clients want: an automatic way to store and retrieve documents based on their content. ZyIMAGE uses the proven technology of Calera's WordScan OCR and ZyINDEX Full-text retrieval...the best of both worlds...in a sophisticated imaging system."



Dr. Gary Kramer, President
Speedscan – Skokie, Illinois

By incorporating OCR with Full-text retrieval in a sophisticated imaging system, ZyIMAGE's content based retrieval technology gives you a quick, precise and natural way to access information; just enter words or phrases. You can search the entire body of a document. With ZyIMAGE, every word is a keyword.

In addition to OCR and Full-text retrieval, ZyIMAGE offers the full functionality you would expect in an imaging system: keyfields, batch-processing, optical drive support, compression, image manipulation and more.

ZyIMAGE also works with word processing, database and Email files to provide a complete solution for all the information your organization uses...paper, fax and electronic. And ZyIMAGE is fast...routinely searching hundreds of thousands of pages in a few seconds.

Call **(800)544-6339** for the name of the nearest ZyIMAGE Authorized Reseller.

Information Dimensions, Inc. 100 Lexington Drive • Buffalo Grove, Illinois 60089 • (708)459-8000 • FAX: (708)459-8054

Circle 153 on Inquiry Card.

World Radio History

has consumed. Finally, Hardball III from Accolade is the Sports Game of the Year. I'm no computer baseball fan, but my son Richard is, and he likes this one a lot.

Next time I'll also discuss critical technologies, particularly video compression and PCMCIA. I'll also give the Chaos Manor Onions of the Year.

It was a good year here at Chaos Manor. I hope 1993 will be as good for you. ■

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

FOR MORE INFORMATION

USER'S CHOICE AWARDS

Amiga 4000-040 .....$3699
Amiga 3000T-040.....$2875
Commodore Business Machines, Inc.
1200 Wilson Dr.
West Chester, PA 19380
(800) 662-6442
(215) 431-9100
fax: (215) 431-9465
Circle 1163 on Inquiry Card.

CorelDraw 3.0.....$595
Corel Systems Corp.
1600 Carling Ave.
Ottawa, Ontario,
Canada K1Z 8R7
(800) 836-7274
(613) 728-8200
fax: (613) 761-9176
Circle 1164 on Inquiry Card.

CPU-Cool $39
PC Power & Cooling, Inc.
5995 Avenida Encinas
Carlsbad, CA 92008
(800) 722-6555
(619) 931-5700
fax: (619) 931-6988
Circle 1165 on Inquiry Card.

Ecosys aSi FS-1500A.....$2395
Kyocera Electronics, Inc.
100 Randolph Rd.
P.O. Box 6727
Somerset, NJ 08875
(800) 323-0470
(908) 560-3400
fax: (908) 560-8380
Circle 1166 on Inquiry Card.

Gateway 2000 4DX2-66V.....$2995
Gateway 2000 4DX2-66E.....$3795
Gateway 2000, Inc.
610 Gateway Dr.
P.O. Box 2000
North Sioux City, SD 57049
(800) 523-2000
(605) 232-2000
fax: (605) 232-2023
Circle 1167 on Inquiry Card.

MCI Mail
$35 annually plus message fee
MCI
1133 19th St. NW,
Suite 700
Washington, DC 20036
(800) 444-6245
(202) 833-8484
Circle 1168 on Inquiry Card.

Multimedia Upgrade Kit $799.95
Sound Blaster Pro.....$299.95
Creative Labs, Inc.
1901 McCarthy Blvd.
Milpitas, CA 95035
(800) 998-5227
(408) 428-6600
fax: (408) 428-2394
Circle 1169 on Inquiry Card.

MultiSound $599
Turtle Beach Systems
1600 Pennsylvania Ave.
York, PA 17404
(717) 843-6916
fax: (717) 854-8319
Circle 1170 on Inquiry Card.

Satisfaxtion
from $129 to $549
Intel Corp.
5200 Northeast Elam Young Pkwy.
Hillsboro, OR 97124
(800) 538-3373
(503) 629-7444
fax back: (800) 525-3019
Circle 1171 on Inquiry Card.

SP-2400AP.....$399
Seikosha America, Inc.
10 Industrial Ave.
Mahwah, NJ 07430
(800) 338-2609
(201) 327-7227
fax: (201) 818-9075
Circle 1172 on Inquiry Card.

SupraFaxModem 144 PB.....$349.95
Supra Corp.
7101 Supra Dr. SW
Albany, OR 97321
(800) 727-8772
(503) 967-2400
fax: (503) 967-2401
Circle 1173 on Inquiry Card.

Windows 3.1.....$149.95
Windows for Workgroups.....$249.95
Microsoft Corp.
1 Microsoft Way
Redmond, WA 98052
(800) 426-9400
(206) 882-8080
fax: (206) 936-7329
Circle 1174 on Inquiry Card.

ORCHIDS

NCR 3170
from $2839 to $3829
NCR Corp.
1700 South Patterson Blvd.
Dayton, OH 45479
(800) 225-5627
(513) 445-5000
Circle 1175 on Inquiry Card.

President's Planner $159.95
Phase III Computing, Inc.
88 Bloor St., Suite 3009
Toronto, Ontario,
Canada M4W 3G9
(800) 388-9728
(416) 925-8760
fax: (416) 920-9242
Circle 1176 on Inquiry Card.

ITEMS DISCUSSED

Civilization $49.95
MicroProse Software, Inc.
180 Lakefront Dr.
Hunt Valley, MD 21030
(800) 879-7529
(410) 771-1151
Circle 1177 on Inquiry Card.

Hardball III.....$59.95
Accolade
5300 Stevens Creek Blvd.,
Suite 500
San Jose, CA 95129
(800) 245-7744
(408) 985-1700
fax: (408) 246-0885
Circle 1178 on Inquiry Card.

Microsoft Entertainment Pack for Windows, Volume Two.....$40
Microsoft Corp.
1 Microsoft Way
Redmond, WA 98052
(800) 426-9400
(206) 882-8080
fax: (206) 936-7329
Circle 1179 on Inquiry Card.

Mystat.....$39
Systat $895
Systat, Inc.
1800 Sherman Ave.
Evanston, IL 60201
(708) 570-8220
fax: (708) 492-3567
Circle 1180 on Inquiry Card.

World Radio History

© 1993 NANAO U.S.A. CORPORATION. All product names are trademarks of their respective companies.

SUPERIOR DISPLAYS ARE PART OF OUR HERITAGE.

PC MAGAZINE EDITORS' CHOICE
June 30, 1992
FlexScan F550i

1993 W100 WINDOWS MAGAZINE ANNUAL WIN AWARD
FlexScan F550i

Three hundred years ago, our ancestors in the Nanao area of Japan created Kutani, one of the classic styles of Japanese porcelain that is meticulously crafted for display. Inspired by their vision to create such colorful, intricate art, we recreate the richest, deepest colors in our innovative computer displays: the distinguished Nanao FlexScan® monitor family.

Inherited with a discerning eye and practiced touch, we finely tune every monitor, bringing you displays with a brilliant palette and clear, sharp images – retaining a tradition that reflects our vibrant history and parallels the technology of today.

From the affordable 15" to the 21" big-screen, our FlexScan family features top-of-the line flat-square CRTs with ergonomic enhancements including easy-to-use microprocessor-based controls, flicker-free refresh rates and a healthy work environment that meets the Swedish MPR II and TCO low emission standards. We've also added ecological features such as an energy-saving auto-power ON/OFF switch. And all of our monitors optimize performance for Windows users or CAD/CAM, DTP professionals.

From generations of finely-crafted displays, our renowned monitor family continues a heritage that is uniquely Nanao.

PC Computing MVP WINNER
FlexScan T660i

BEST OF COMDEX Fall '92 BYTE
Finalist
FlexScan F340iW

NANAO®
Superior in every detail.™
NANAO U.S.A. CORPORATION

23535 Telo Avenue, Torrance, CA 90505
(310) 325-5202

1-800-800-5202

Circle 108 on Inquiry Card (RESELLERS: 109).

World Radio History

FEATURE

Fighting Fatware

Today's big, bloated software means big problems. What can you do about it—now, and in the future?

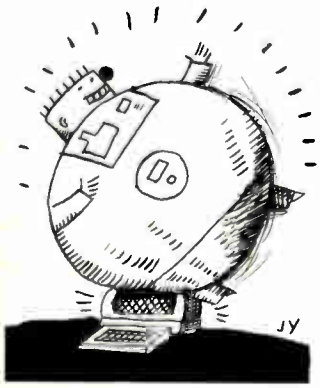
ED PERRATORE, TOM THOMPSON, JON UDELL, AND RICH MALLOY

Item: Dave Brown, a Keene, New Hampshire–based entrepreneur, got his Christmas wish last year—a copy of Microsoft's Access relational database manager for Windows. Excitement turned to disappointment, however, once Brown tried to run the program. Despite the fact that his system had the 4 MB of RAM that Microsoft recommends, Access was "hideously slow." A call to Microsoft technical support revealed the truth: He needed at least 8 MB of RAM to achieve acceptable performance. Now Brown has two options: He can spend $200 for more RAM or wait for version 1.1, which Microsoft claims will run better with 4 MB.

Item: Most users would find two 200-MB hard drives to be more than enough storage space. But not Dave LeFevre, technical marketing manager for WordPerfect for Windows. LeFevre is a heavy user of multimedia. Even after compressing his 600 MB of files, he has only 63 MB of disk space free. "I needed to buy a second computer, in part because there was no more room," he says.

Like the carnivorous plant in the movie *Little Shop of Horrors*, today's popular applications software cries out to users, "Feed me!" More RAM, more hard disk space, more CPU speed—it seems like you never have enough.

The problem is likely to get worse before it gets better. Lotus 1-2-3 for DOS has doubled in size every four years, from fitting on two 360-KB floppy disks in 1983 to 5 MB today (see figure 1). During that time, spiraling hardware requirements for 1-2-3 and other popular applications have driven the typical base configuration of a PC from 64 KB of RAM and a 360-KB floppy drive to a minimum of 4 MB of RAM and a 100-MB hard drive (see figure 2).



Fat software feeds a vicious cycle of upgrading. At Hughes Aircraft (El Segundo, CA), Jack Baumann, a manager of computer systems and networks, says users ask for hardware upgrades about two months after getting new software. Then when they get new hardware, they want software with more features (see the text box "When Bigger Is Better" on page 101).

One way to combat software bloat is for users to take simple stopgap measures, such as file compression

ILLUSTRATION: JAMES YANG © 1993

World Radio History

World Radio History

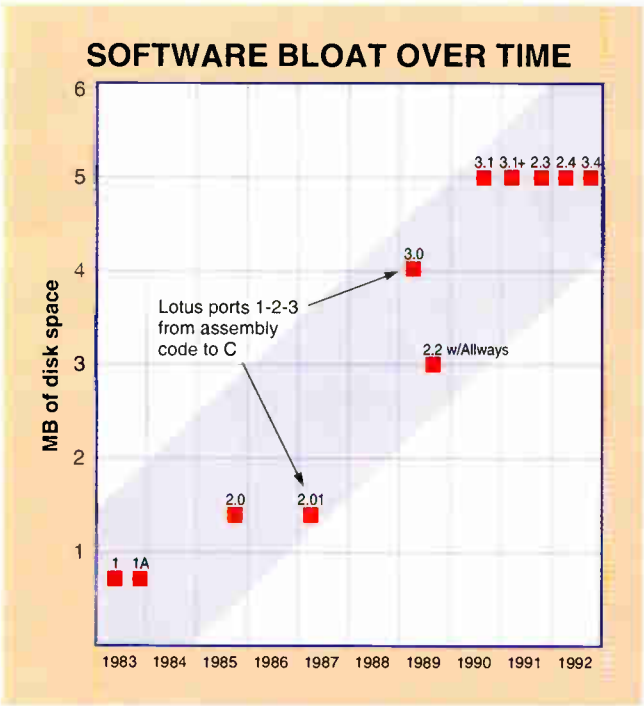


Figure 1: *Since it first appeared in 1983, Lotus 1-2-3 for DOS has grown in size from fitting on two 360-KB floppy disks to 5 MB—in effect doubling in size every two years. (Data from Lotus Development)*

or pruning unnecessary programs and modules (see the text box "Software-Bloat Antidotes" on page 104). The real solution, however, is to make operating systems and applications that are designed to reuse code rather than force applications programmers to re-create the same functions over and over again. Platforms such as Windows 3.1, Unix, and the Mac's System 7 permit code reuse, but object-based operating systems such as Apple's and IBM's Taligent and Microsoft's Cairo promise to make reusable application modules a more significant reality by as early as 1994.

Fat Factors

A vendor adds features to its software to stay competitive. Consumers use feature lists to evaluate different software packages. Computer magazines fuel the feature wars by publishing side-by-side feature comparisons.

Some vendors have tried offering slimmed-down, feature-light versions of their software, only to see users respond unenthusiastically. Products like Microsoft Write and WordPerfect's LetterPerfect, both scaled-down versions of their more full-featured word processing brethren, "are not becoming runaway best sellers," says David Tremblay, Software Publisher's Association's (Washington, DC) director of research. Quark (Denver, CO) marketing communications manager Peter Warren says that users didn't want a stripped-down version of QuarkXPress desktop publishing software for the Mac, and they proved it after Quark released the doomed QuarkStyle in the fall of 1988.

Vendors have another incentive to add features to their software: the lucrative upgrade market. Microsoft, for example, receives revenue of about $45 to $50 from each DOS 5.0 upgrade, as opposed to the ballpark $20 to $25 it earns per copy selling the original versions to system developers at $35 a pop. Application upgrades, historically composing one-fourth to one-third of a software vendor's revenue, have also undergone an upward shift, says Bill Higgs, vice president of microsystems software at market researcher InfoCorp (Santa Clara, CA). Increased competition among software vendors has pushed the percent of revenue each receives from upgrades toward 40 percent to 50 percent, he says.

Most of the large vendors now provide custom-installation routines that let users install only those features they most want. The problem with this solution, says Pete Higgins, vice president of desktop applications at Microsoft, is that users are often unsure which features they really need. The result, says Higgins, is that "everyone installs everything."

Development Issues

Poor management of software development is another important contributor of flab. Good management would prevent programmers from spending countless hours reinventing wheels, all of which end up on your hard disk. Applications built by large teams have a lot of redundant functionality, says Martin Heller, author of *Advanced Windows Programming* (John Wiley & Sons, 1992). "Developer A doesn't know about developer B's function," he says, "and developer B knows about developer A's function but thinks it sucks rocks."

One controversial aspect of the software-bloat problem is the increased use of high-level languages, particularly C and C++. While assembly programming can produce very tight code, the common belief is that with C or any other high-level language the code will be larger. However, a good programmer, says WordPerfect's LeFevre, can minimize the growth of code while making the most of a high-level language's advantages.

Lotus Development (Cambridge, MA) ported 1-2-3 from assembly to C between versions 2.01 and 3.0. Consequently, the code size nearly tripled, from 1.4 MB to 4 MB. Not all of that

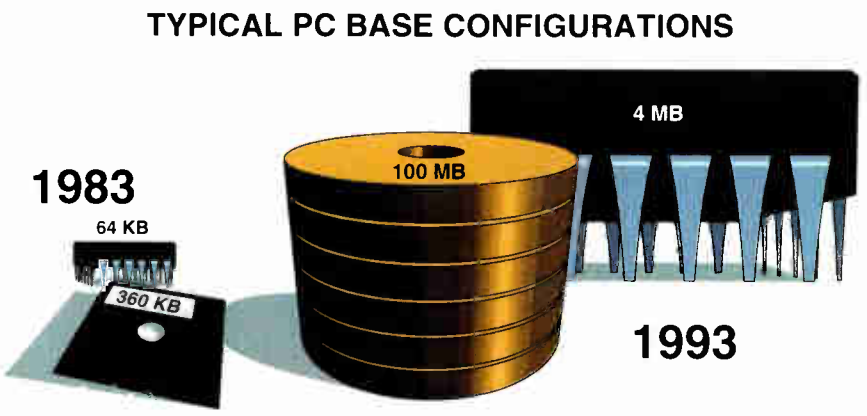


Figure 2: *In 1983, the typical RAM and storage configurations for a base IBM-compatible PC were 64 KB and 360 KB, respectively. Today, a PC with less than 4 MB of RAM and 100 MB of hard disk storage is considered inadequate.*

World Radio History

When Bigger Is Better

TOM THOMPSON

Not all software bloat is bad. Some factors that can add bulk to a program offer long-term benefits to the user. These include robust code, code that's designed for easier maintenance, and the ability of some applications to span several platforms.

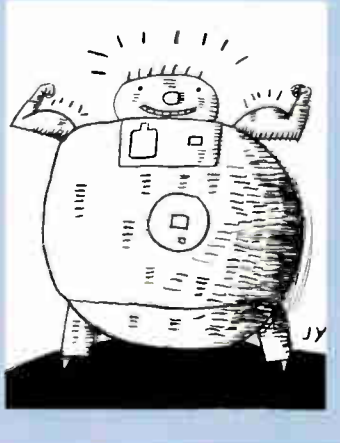
For example, a vendor might choose to implement OOP (object-oriented programming) in its application designs. One of OOP's strengths is the concept of reusable code; this ultimately reduces the vendor's development and maintenance costs once a suite of proven code objects is written. OOP typically uses high-level languages, so the object code generated by high-level-language (e.g., C++) compilers won't be as compact as code generated by, say, assembly language programs. However, because code writing has become a slow and costly process, OOP's ability to let a vendor quickly fix bugs and add needed improvements to an application far offsets the code girth it incurs.

An application designed to operate on two or more platforms, such as Aldus PageMaker or Adobe Photoshop, is bigger than a single-platform application. The Photoshop 2.5 image-editing program, for example, started life as a Pascal program on the Mac in 1989. When it came time to port the application to Windows, the engineers completely redesigned the application and rewrote it in C++. OOP was used heavily for both data abstraction and code reusability. Much of the application code was written as highly abstracted *core code*.

Core code is so named because it implements an application's core operations: In the case of Photoshop, this means color space conversion, image filtering, channel manipulation, pixel editing, and other functions. Core code doesn't deal with the user interface, the operations of which are typically platform-specific. The use of core code enabled Photoshop's engineers to write most of the core functions in portable C++ code. Porting Photoshop then became a matter of compiling the core code on the target platform and wrapping it in a layer of highly optimized user-interface code (for either the Mac or Windows).

According to Steve Guttman, senior product marketing manager for the Macintosh at Adobe Systems (Mountain View, CA), this technique offers tremendous economies of scale. First, you write the code only once. Second, a bug fix in the core code fixes the application across all platforms, because they use the same code. As in the case of the OOP example above, the core code is written in a high-level language, and it does not take advantage of any specific hardware. The end result is a larger amount of object code, but it makes the cross-platform implementation and support manageable.

Another factor that contributes to the bulk of a cross-platform application is that inevitably you must add support code to supply certain features that are absent on a particular platform or to overcome a limitation. For Windows, the Photoshop programmers had to write their own memory handler to overcome a limitation in the Windows memory management scheme.



A future concern for software vendors is migrating programs to the RISC-based microcomputers that are now coming down the pike. To date, Windows NT has been ported to the Mips R4000, DEC Alpha, and Intel Pentium, and the Mac OS is being ported to the PowerPC. Windows NT will ship sometime this year, and the PowerPC is slated for a 1994 release date. Vendors want their applications running on these new systems the moment they ship.

Planning for this transition affects program design. Normally, an application is written completely in a high-level language first. A team of assembly language programmers then rewrites specific sections of the program into fast assembly language code. By optimizing crucial code sections, a dramatic boost in the application's performance can be achieved without reducing the entire program to assembly language code. Unfortunately, these same optimizations tie the application to specific hardware. To temporarily avoid this problem, a vendor might choose not to fine-tune the high-level-language code at all in order to expedite moving the code to, say, a RISC machine. The result is a bigger, slower application, but the vendor is ready to port the application code rapidly when the time comes.

Application growth is not necessarily due to vendors' piling on unneeded features. It may actually be a result of the vendors' attempts to give you what you want: stable code, prompt bug fixes, and cross-platform operation.

growth is attributable to the difference between C and assembly—version 3.0, for example, included the printing utility Allways and had significantly more features—but it was a major contributor. The resulting product would not run acceptably under DOS until the company delayed its release to compress and optimize the code.

Program code eats up RAM, but clip art, sample documents, form letters, tutorials, and help programs feverishly devour disk space. As programs begin to include sound and video files, the required disk space will mushroom—a commonly used sample 15-second clip of the B-2 bomber, for instance, requires 2.14 MB of space, even in compressed format. Furthermore, much

World Radio History

of this data is never used. Joel Diamond, technical director for the Media, Pennsylvania–based Windows Users Group Network, says the users he speaks with on several CompuServe forums install thousands of pieces of clip art but use "maybe 20 pieces of clip art a year."

In the name of usability, many applications now include on-line help files. Microsoft's Wizards on-line help, for example, takes up half a megabyte for Access alone. A multimedia tour of Lotus 1-2-3 release 1.1 for the Mac takes up 3 MB. And Autodesk's AutoCAD release 11 Extension for Windows has an optional hypertext version of the reference manual. The size: 12 MB.

The single most cited case of disk gluttony is spelling checkers. You could have separate spelling checkers for your word processor, your desktop publishing application, and your spreadsheet, each taking up about half a megabyte on your hard disk before you add custom dictionaries. "If Windows publishers would agree on a dictionary," says Terry Currier, program chairman for the Orange Coast IBM PC User Group (Costa Mesa, CA), "we would probably save 2 or 3 MB."

The use of GUIs encourages software to expand. The Windows development process, for instance, requires an overhead that doesn't exist in the DOS environment. Windows' dialog boxes, bit maps, and graphical nature in general all consume RAM, disk space, and CPU cycles. Take WordPerfect, for example. Version 5.1 for DOS requires a minimum of 384 KB of RAM and 2 MB of disk space. By contrast, WordPerfect for Windows expects a system with at least 4 MB of RAM and 4.2 MB of disk space. Maximum space for the complete program is 15 MB, including bundled Adobe Type Manager and Reference Software's Grammatik spelling checker. For Unix, the Motif version of WordPerfect requires 5 MB of disk space, 66 percent more than for the character-based version (see figure 3).

As entrepreneur Brown discovered, software vendors are often loath to indicate the true system requirements for acceptable performance so as "not to scare people off," says LeFevre, whose company recommends a 386 with 4 MB of RAM for WordPerfect for Windows 5.2 even though it will run, however painfully, on a 286 with 2 MB.

The BYTE Lab tested nine popular software packages to gauge performance at minimum configurations. The result: All nine ran, but performance was so bad that the packages were virtually unusable (see the text box "Recommended Hardware Allowances" on page 105).

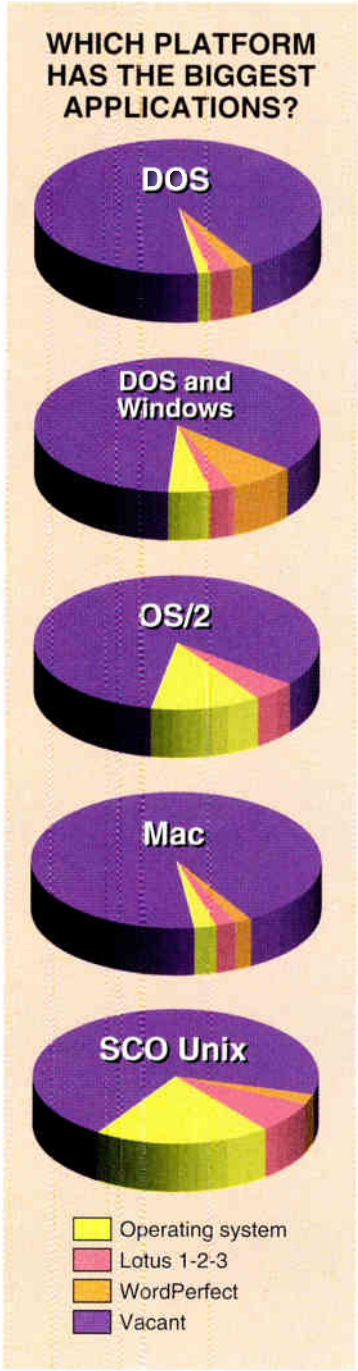


Figure 3: *The amount of disk space taken up by applications and operating systems on a 200-MB hard drive varies depending on the platform. The areas shown for operating systems represent a full installation.*

Productivity Lost

Big software also entails a tremendous cost in human resources, most of it hidden. Consider the amount of time that's involved each time a network administrator installs and then troubleshoots product upgrades across several hundred workstations. It can take up to 2 hours per PC to install and configure a program like Microsoft Word for Windows, says Hughes Aircraft's Baumann. You can expect to add up to 8 hours for additional training of less experienced users if the upgrade is a major one.

In addition, companies do not take into account how much training is actually needed for feature-heavy software. "Nontechnical management has the impression of, 'Oh, now we're in a windowing environment, so people don't need training anymore,'" says Loretta Weiss Morris, editor in chief of the *Microcomputer Trainer* (Secaucus, NJ). A GUI like Windows, she adds, still stops DOS-unaware users cold the first time a file like `c:\mydir\myfile.doc` needs to be retrieved.

Training is still going on, but in subtle yet expensive ways. Users informally train themselves by trying out various features, although unfocused self-help can result in lost work time. David Harris of SBT Accounting Systems (Sausalito, CA) published a study showing that each user spends an average of 5.1 hours a week "futzing around"—learning programs, helping coworkers, and performing other activities that are indirectly associated with their own jobs.

Many users have reported that flabware impairs usability, and vendors are beginning to agree. "If you just have a lot of features and you're not focused on usability," says Betsy Fortin, director of graphics-products marketing at Lotus, "you have what I call a 'bag of tools.' And the more tools you have, the harder it is to pick out which one to use."

Lotus, Microsoft, and a growing number of other companies have set up usability labs to determine how to make each product's benefits more accessible to users. "With most products, most of the features that you'd want are there," says Brian Moura, finance director and assistant city planner for San Carlos, California, and a frequent beta tester. Ease of use is "the next frontier," he says. The problem is that features for enhancing usability often add even more bulk to the code.

Answers in the Operating System

Software bloat is closely related to the underlying platform. If an operating system fails to make its services available in an efficient way, then each application has to include additional chunks of code to enable them. Interestingly, applications on the Mac, with its integrated GUI, are only one-third to one-half as large as corresponding applications under Windows, which grafts a GUI onto DOS (see the text box "Managing Memory and Features on the Mac" on page 106).

Advances in the operating system can allow some programs to shed bulk. For example, version 2.0 of Microsoft's PowerPoint presentation software once required 50 MB of disk space if you

World Radio History

FIX YOUR PC FAST!

RECOVER DATA FROM PHYSICALLY DAMAGED FLOPPIES & HARD DRIVES!

There's no other program like it anywhere! When you have a disk or drive that returns GENERAL FAILURE READING DRIVE (X), **RESCUE DATA RECOVERY SOFTWARE™** will read it anyway!

RESCUE DATA RECOVERY SOFTWARE™ bypasses DOS's inability to read disks and hard drives that have been physically damaged and will move the drive heads directly!

RESCUE DATA RECOVERY SOFTWARE™ will even read a floppy that has a hole poked through it! You can recover all the data excluding, of course, the actual destroyed area. This revolutionary program is now your first line of defense when it comes to recovering your valuable data. Save hundreds — even thousands — of dollars by doing your own data recovery! With **RESCUE DATA RECOVERY SOFTWARE™** you can perform miracles.* Your data is too valuable not to have **RESCUE DATA RECOVERY SOFTWARE™** within reach!

CALL NOW FOR PRICING! **Some failures may be beyond **RESCUE**'s ability to recover data.*

"In the past, General Failure messages left you few options. Norton, Central Point, or Mace Utilities weren't likely to help because they work through DOS to read the disk. Now there is a better solution... RESCUE can recover data from all but the most thoroughly trashed disk... RESCUE appears to work miracles..." INFOWORLD

NEW!

VITAL TOOLS FOR NETWORK INSTALLATION & MAINTENANCE!

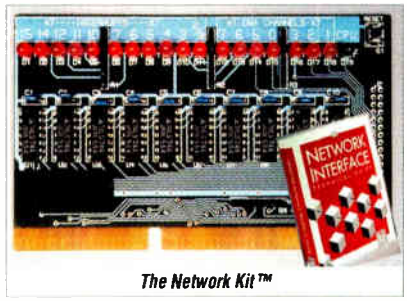
The Discovery Card™ — The first tool that ends IRQ and DMA Channel Conflicts!

• FACT: Software diagnostics cannot detect DMA usage and are inaccurate in IRQ detection. • FACT: Standard logic probes, in addition to being time consuming, are difficult to use and often lead to short circuits and damage of valuable components!

The Discovery Card™ is the safest, fastest, easiest and most accurate method to detect IRQ/DMA conflicts. There are 18 logic probes built in (11 for all Interrupts and 7 for all DMA channels) to pinpoint all conflicts. A must for anyone who installs networks or add-on cards. End the frustration!

The Network Interface Technical Guide™ just released! The largest reference on network interface cards available. This 850 page book contains over 300 different Network Interface Cards from 40 manufacturers, complete with detailed Diagrams, Jumper Settings, different Network Topologies such as Cable Lengths, Wiring Types Used, Transfer Rates and Maximum Number of Nodes.

Included in the manual are hundreds of diagrams showing NIC Type, Cable Configuration, Data Bus, Base I/O Address, Boot ROM Memory Address and Interrupt Request Configurations. There's also a Node ID Quick Reference and vital data on cable Pin Assignments and Hardware Device Settings. This manual is a must! ***CALL NOW FOR PRICING!***



The Network Kit™

Encyclopedia of Main Boards™

THE LARGEST COMPILED REFERENCE ON MOTHER BOARDS EVER! *5 VOLUMES!*

Over 850 diagrams showing all necessary jumper, connection and component locations! Each diagram includes technical specs such as: processor, processor speed, chip set, max. onboard DRAM, SRAM cache, BIOS, dimensions, I/O options and NPU options. Also includes easy to understand tables giving configuration for: user settings, DRAM, SRAM, CPU type jumper and CPU speed jumper. **PLUS MUCH, MUCH MORE!**

CALL NOW FOR PRICING!

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 components directly for true accuracy while other programs frequently give erroneous test results. Works on DOS, UNIX, Novell, XENIX, OS/2, etc. Loaded with all the tests you need to quickly and accurately isolate the source of PC failures.

PocketPost™, the most compact and feature packed diagnostic Power-On Self Test (POST) Card in the world! You can debug dead PC's in less than 5 minutes! Jumper settings allow you to read the BIOS POST codes from 6 different addresses. Debugs XT, AT, Compaq, EISA, PS/2 (25/30) and compatible. 170 page manual includes the most complete source of BIOS codes in a single reference to allow instant translation of error codes. Optional adapter for micro channels and more! **"The Super Troubleshooter Kit" also includes The Discovery Card™. ***CALL NOW FOR PRICING!***

The Troubleshooter Kit™

The Hard Drive Kit™

EVERYTHING YOU NEED TO INSTALL, SET-UP & MAINTAIN HARD DRIVES!

Drive Pro™ — The all-in-one 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 re-booting or user intervention. • DOS Format any size drive in under 30 seconds! • Drive Table Override allows almost any BIOS to have a user definable drive type. • Drive Boot Fixer is a safe alternative to low level formatting bad IDE Drives. • No more DEBUG, FDISK, SETUP, or FORMAT. Plus too many other features to mention!

Encyclopedia of Hard Drives™ — The largest compiled reference on Hard Drives ever published!

3 VOLUMES • OVER 1200 PAGES!

VOLUME ONE...*SET-UP GUIDE* • Interface Types and Installation • Hard Drive Specs for 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 500 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 275 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 L.E.D. Connections, Common Debug BIOS Format Codes and Default Jumper Settings.

The Hard Disk Technical Guide™ — Comprehensive field version of the Encyclopedia with 424 pages of vital specs! Compact to carry in the field. ***CALL NOW FOR PRICING!***

- Free Tech Support
- Performance Guaranteed
- Next Day Shipping

CALL

(800) 65-FIXED

800-653-4933

AIIMicro, Inc.

1250 Rogers St. • Suite L • Clearwater, FL 34616

(813) 443-3550 • Fax (813) 446-3075

Copyright © 1992, Custom Data Recovery Software™, The Hard Drive Kit™, The Network Kit™, and The Troubleshooter's 2K™ are trademarks of AIIMicro, Inc. All Rights Reserved. Other names are trademarks of their associated owners. Specifications subject to change.

World Radio History

Software-Bloat Antidotes

You can take steps now to minimize the effects of fatware. The nine steps listed below are not cures, but merely treatments to keep the condition easier to live with.

Buy as much speed, RAM, and storage space as you can afford when purchasing a new system. Upgrading later will be more expensive.

Buy integrated software, which includes common functions such as word processing, database management, and spreadsheet capability in one package, if you don't need a full-featured, single-task program.

Buy a CD-ROM drive on which you can retrieve files such as fonts or symbol libraries.

Centralize as many applications as is practical on a large network file server.

Compress files using both an on-the-fly compression utility for commonly used files and an archival compression utility for rarely used data files.

Delete tutorial files once you are familiar with a program.

Delete bundled applications, such as Windows Write or Windows Filer, and their help files, if you don't use them.

Identify your needs to make sure an upgrade meets them before making the switch.

Note disk space and memory recommendations on software packages.

loaded all its Bitstream fonts. But now that Windows itself includes the TrueType scalable fonts, PowerPoint weighs in at only 14 MB, a 72 percent weight loss that would make even Richard Simmons envious.

Sophisticated new features in Windows 3.1 and Apple's System 7.1 hold the best near-term promise of reversing the bloat in applications software. These operating systems provide a messaging mechanism that lets applications request services from other applications and exchange information. This capability allows an application to tackle complex tasks by farming out portions of the job that it can't handle to other applications on the system or network.

For example, a page-layout application would divide and conquer the job of creating a shareholder's report by asking a spreadsheet application to generate tables from numeric data for one page and asking a charting application to generate graphs of these numbers for another page. When confronted with a scanned image file in an unknown format, this application might ask a graphics application to extract the image, scale it, and then crop it before dropping the image into the document.

This ability of one application to take advantage of the talents of others should help to end the era of monolithic, Swiss-Army-knife software. Rather than piling on features to handle every conceivable user demand, vendors will be able to tailor their code for specific purposes. Such tailored applications let vendors concentrate on writing code in their areas of expertise. Because a tailored application's code is smaller, the tasks of debugging and optimizing for specific platforms are both simplified. Sharing functions also conserves an even more precious resource—users' knowledge of their tools. Once you've mastered that drawing program, you want to get as much mileage out of it as you can.

Under Windows' OLE and System 7.1's IAC (Interapplication Communication), applications communicate in a client-server fashion. These functions are not rigid; the same application that asks for a service (as a client) at one point might provide a service (as a server) to another application later. Because providing both client and server capabilities takes a lot of work, you can expect many vendors to supply only client or server forms of their applications.

System 7.1 keeps trim, too, by integrating network awareness, eliminating the need for extra modules. For OLE to establish network communications, however, you must have Windows for Workgroups whether or not you need its workgroup applications.

OLE Improves

Despite some drawbacks, OLE is the most ambitious and widely accepted interapplication communication tool. OLE 1.0 works sluggishly and doesn't support the seamless integration that would enable external components to compete successfully with intrinsic ones. However, the forthcoming OLE 2.0, available to developers now in beta form and possibly to users by this fall, addresses both of these problems.

By ditching Windows' cumbersome DDE protocol in favor of a proprietary form of interprocess communication, Microsoft hopes to gain enough performance to make OLE-enabled suites of applications credible alternatives to monolithic integrated programs such as Lotus's Symphony. Vendors, however, find the move to OLE 2.0 a difficult one. "We are all for the OLE vision of the world," says Steve Adams, product manager of CorelDraw at Corel (Ottawa, Ontario, Canada), "but it's not a nice baby step from OLE 1.0."

On the other hand, OLE 2.0 makes life easier for users. Suppose, for example, that you've embedded a range of Lotus 1-2-3 cells in a Word for Windows document and you want to change the value in one cell. OLE 1.0 requires two radical context switches to accomplish this task: 1-2-3 must first take foreground control, and then Word must regain it. With OLE 2.0, Word mingles fleetingly with 1-2-3 while the embedded cells have focus; it then regains its natural appearance.

But even if OLE 2.0 lives up to all expectations, it will provide just the starting point for a solution to software bloat. The real challenge then will be to build pluggable components. Today's integrated packages offer compelling advantages. In Interleaf Publisher, for example, all objects share common protocols so that a style change can ripple down through a document and apply to both text and graphics in ways appropriate to each. That object architecture is proprietary to Interleaf and is a key competitive advantage.

Although OLE 2.0's notion of "property negotiation" could

World Radio History

Recommended Hardware Allowances

STEVE APIKI

According to what it says on the box, you can run Microsoft Access on any 386-class machine with at least 2 MB of memory and 8 MB of free disk space. Indeed you can—provided you can live without SmartDrive, you can successfully coerce Windows 3.1 into enhanced mode on your 2-MB system, and you have a few extra megabytes of disk space for a swap file. But once you've tuned the configuration and you have a state-of-the-art application running on hobbled, two-year-old technology, how far can you go with it?

If you're extremely tolerant, you can probably complete just about any task with such a setup. But if your patience is less than saintly, you may run into a few problems. I ran a series of Windows applications (see figure A) on an 8-MB 486DX/33, a 16-MHz 386SX with 2 MB of RAM, and the same 386SX with 4 MB of RAM. The idea was to compare the performance of a typical modern configuration to that of one that barely met the minimum vendor-required hardware. All the applications I tested will at least run on machines that meet the minimal requirements. But they typically run at only about a tenth of the speed at which they run on a 486DX/33.

Of course, a slower, older machine won't perform as well as a modern system. Less processor horsepower means slower memory access; low memory means frequent swaps to a slow hard disk. What's telling is the surprising ratio between performance levels on typical versus minimal machines. If you have a feel for running Windows on a 486/33, you can judge for yourself the utility of a system that takes 10 times as long to respond.

Running large programs on a minimally configured system is frustrating. For example, Microsoft Access takes over a minute just to start up. A mistaken activity bar selection in Software Products International's WindowBase might leave you waiting 15 seconds to get your mouse pointer back. Scrolling a page in WordPerfect for Windows can take over 10 seconds. With any interactive application, response time is critical. When the response time of a low-end system drops an order of magnitude from that of a typical system, interactive software becomes unusable.

Although you can make it work, getting anywhere near the minimum hardware requirements for a Windows application is a bad idea. It's better to upgrade the machine or to simply forgo buying the latest software to ensure a hardware/software combination you can live with.

Steve Apiki is senior editor and director of the BYTE Lab. You can reach him on BIX as "apiki."

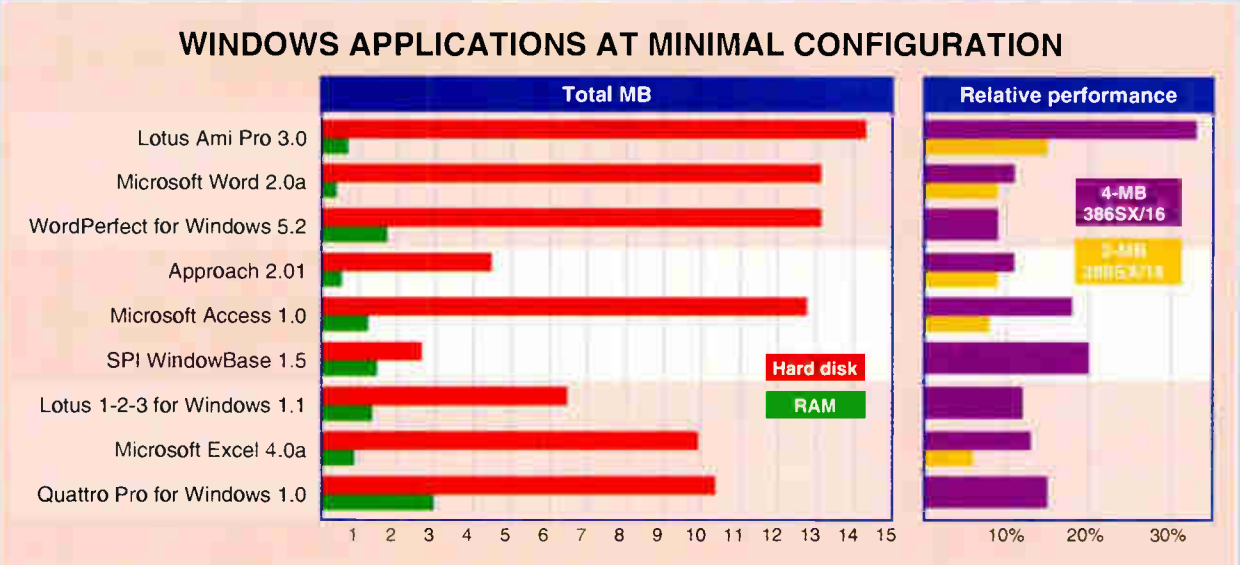


Figure A: *The disk-space figures represent a full installation. The memory used includes the opened test document. The performance figures are given as a percentage of performance on a more fully configured system (a 486DX/33 with 16 MB of RAM). Four of the applications—SPI WindowBase, WordPerfect for Windows, Lotus 1-2-3 for Windows, and Quattro Pro for Windows—have either a 3-MB or 4-MB minimum RAM configuration. For these applications, we list only the performance rating for a 4-MB system.*

World Radio History

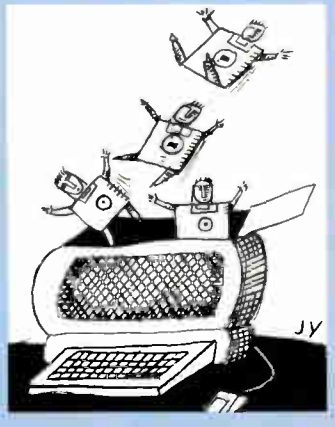
Managing Memory and Features on the Mac

TOM THOMPSON

It's bad enough when your operating system hogs disk space, but its demand for even more memory later on adds insult to injury. For example, at first Apple claimed that System 7 required only 2 MB of RAM. However, Apple now admits that System 7 needs a minimum of 4 MB of RAM, a fact reflected in the base RAM configuration of its computers.

System 7's use of this extra memory is justified by the fact that it provides important new features: TrueType fonts for the on-screen display of high-resolution typefaces, File Sharing for peer-to-peer transfer of files, AppleTalk Phase 2 (required for operating on large networks), and IAC (Interapplication Communication). Still, to make System 7 of more interest to users, Apple's engineers designed it to make more effective use of the memory it occupies.

The solution takes a two-tiered approach. First, System 7 is a modular architecture that allows you to add only those services you need. For example, QuickTime (which provides the Mac with multimedia handling capabilities), MacTCP (which implements a TCP/IP protocol stack), WorldScript (which provides support for the display and storage of documents composed in foreign languages such as Arabic and Japanese kanji), and ColorSync (which provides a foundation for systemwide color matching among applications) are currently Extension files.



Extension files, if present in the System folder or the Extensions folder, install at boot time and patch the operating system to extend its capabilities. This technique consumes memory because the additional code supplied by the Extension file must be loaded and locked in RAM. However, if you don't require the services of QuickTime, MacTCP, WorldScript, or ColorSync, you simply don't copy the files to your System folder, thus saving memory.

Apple intends to introduce many of this year's additional operating-system services, such as AppleScript (a scripting mechanism for the batch control of applications), the Open Collaborative Environment (a mail and document verification facility), and QuickDraw GX (an advanced graphics engine), as System 7 Extensions. When enough users demand them, Apple will then integrate these services into a new revision of the operating system.

The second part of the solution is to load and unload certain service software to and from memory only when it's needed. This solution exploits capabilities built into QuickTime's Component Manager. The Component Manager's original function was to bind a software component (typically a driver or a data compressor/decompressor) to specific multimedia applications or hardware (typically an expansion board) at run time. The Component Manager can search for specific components and open multiple channels to a component, which allows its services to be shared.

These same capabilities enable the Component Manager to function as a dynamic library loader. For example, in the case of AppleScript, an Extension file installs a 5-KB stub into memory.

When an application requires AppleScript, the Component Manager loads an additional 250 KB of code, which comprises the AppleScript services. This memory is released when AppleScript is no longer required by the system. This operation is analogous to Windows' use of DLLs.

While AppleScript's size seems meager compared to today's multimegabyte applications, it gives the Mac OS the ability to effectively manage future services that will make larger demands on memory.

enable Interleaf to partition its application, a non-Interleaf application would need to know an awful lot about an Interleaf component to use it as effectively as an Interleaf client could. The more complete and specific this knowledge becomes, the less likely it is that an application could freely swap in an equivalent part from another vendor's application.

What you'll likely see, therefore, are families of products that share common protocols. Within one vendor's product family you'll achieve better synergy than if you cobble together an equivalent multivendor solution. At the same time, you'll see the emergence of vendors whose entire business is providing components. A great example today is the Pinnacle Graphics Server from Pinnacle Publishing (Kent, WA), a DLL that several popular Windows databases use to graph data. Another is Tools & Techniques' (Austin, TX) Data Junction, a universal file-format converter.

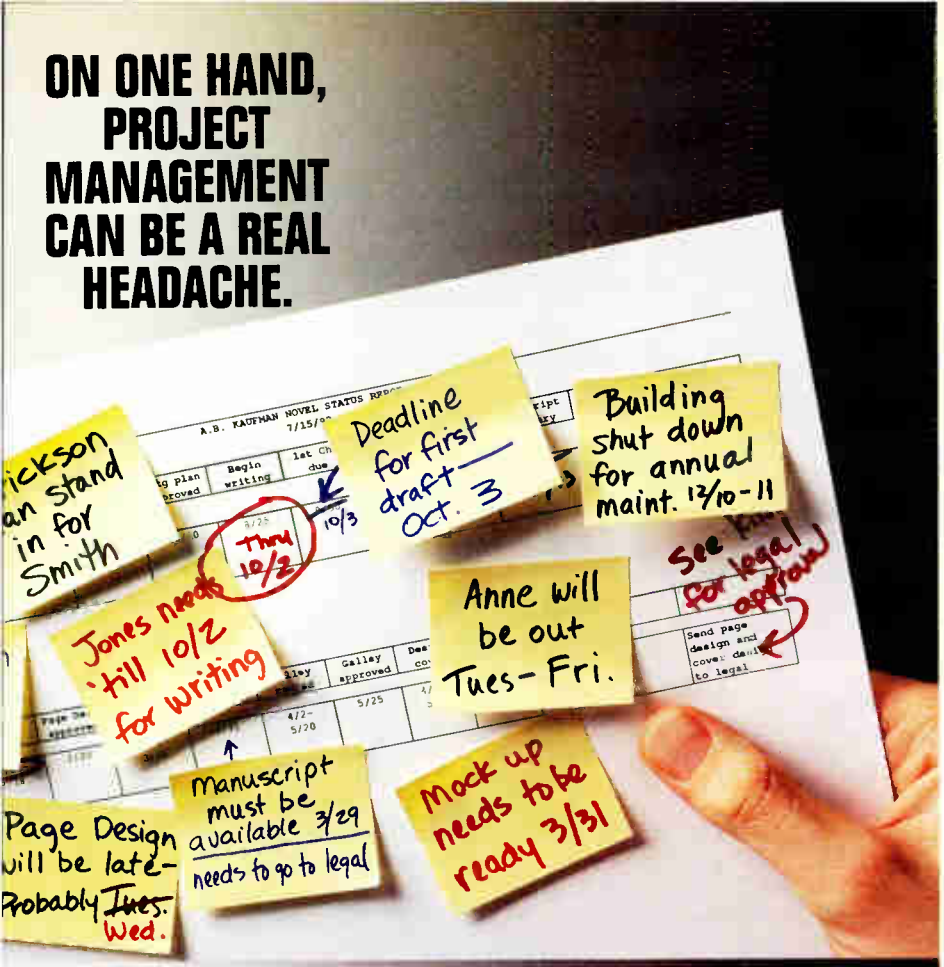
IAC's Different Tack

OLE defines an API that programmers use to implement communication services. Users implement OLE services by writing the appropriate function calls. IAC takes a different tack: A Mac application requesting a service first generates an Apple Event.

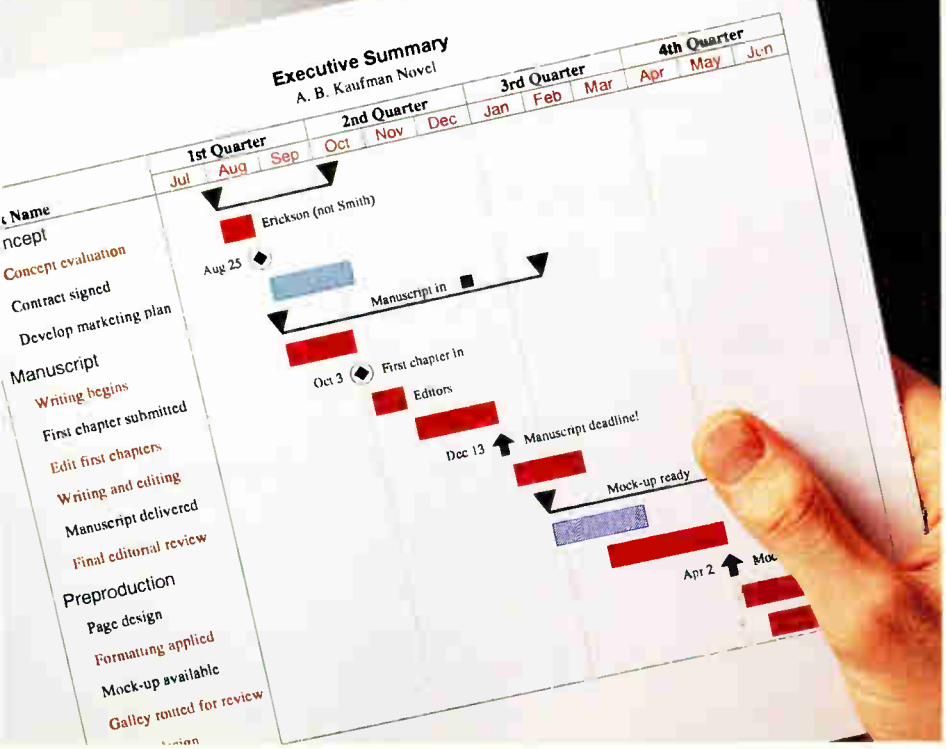
continued

World Radio History

ON ONE HAND, PROJECT MANAGEMENT CAN BE A REAL HEADACHE.



ON THE OTHER HAND, WHY SHOULD IT BE?



MICROSOFT PROJECT FOR WINDOWS

MICROSOFT WINDOWS

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 PlanningWizards 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 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.

Microsoft

Making it easier

For more information inside the 50 United States, call (800) 426-9400, Dept. JM2. Outside the U.S. and Canada, call (205) 936-8661. Customers in Canada, call (800) 563-9048. © 1993 Microsoft Corporation. All rights reserved. Printed in the USA. Microsoft is a registered trademark and Windows and the Windows logo are trademarks of Microsoft Corporation. Mac is a registered trademark of Apple Computer, Inc.

World Radio History

The Apple Event gets passed to the Event Manager (the portion of the Mac OS that processes user events such as mouse-clicks, window updates, and keystrokes), which then routes the Apple Event to the recipient application. The target application then calls handler code to process and act on the message encapsulated within the Apple Event.

One interesting aspect of IAC is that while the communications mechanism is well defined and in place, the message structure isn't. This situation is similar to having radio sets but no Morse code by which to transmit information. This wasn't an oversight on Apple's part: The idea was to encourage vendors to cooperate and define classes of actions, or *verbs*, that applications will respond to and to define their format. Apple defines a set of *core events* that all applications must respond to: open application, open a document, print a document, and quit. Currently, a 500-page Apple Event Registry document describes suites of verbs for QuickDraw, text, tables, and database events. Other event suites are still under development.

Apple Event verbs might request operations as simple as selecting a menu item or as complex as dropping numbers into a row of spreadsheet cells. Mac applications will ultimately be redesigned, or *factored*, so that the event-driven interface is decoupled from its code and communicates only via Apple Events. This allows you to automate a job by using AppleScript to monitor the chain of events that occur as you work. AppleScript records these events into a script file and can play them back later to repeat the task just executed. AppleScript can also serve as a useful intermediary on complex jobs. For example, it can query several different databases (on several networked computers) for information and then have a word processor consolidate the results into a single document.

Aldus Takes the First Step

Even assuming that vendors will agree on IAC verbs or implement OLE function calls, there's a significant problem in this divide-and-conquer scenario: Why should vendors bother? In a market populated by several species of spreadsheets, drawing packages, word processors, database managers, and so on, a vendor differentiates its product from the others by pitching its unique capabilities or feature set. Reducing an application to just its basic capabilities and then offering these capabilities to any other application that happens to call it might not prove to be a marketable concept.

Aldus has taken the first step in this area. In April the company will announce a version of Persuasion for both PCs and Macs that breaks its charting engine out into a single-purpose, stand-alone application, or *applet*. This charting applet will act as an OLE server and use OLE 1.0 on both platforms to provide finished charts to those applications that request its services. (Microsoft currently provides software that implements the OLE protocol only on the Mac.)

You'll have to purchase Persuasion to obtain the charting applet, but once you do, its services are available to all applications that act as OLE clients. The charting applet understands Persuasion's layout, so it can maintain the format and layer control of Persuasion documents when it generates a chart. Private messages allow Persuasion and the charting applet to relay color information back and forth while you work on a graph. What all this means is that you will get better coupling between Persuasion and the charting applet than you would get with other applications.

This implementation of Aldus's charting applet seems like a reasonable compromise in exploring how to market a server application without giving away the crown jewels. It also points out two divergent futures that OLE and IAC can make possible. Ideally, all vendors would write practical client and server applications that could be used interchangeably. You would then be free to select whatever applications you prefer to get the job done.

However, it's also likely that vendors will use private OLE messages or IAC verbs that allow their own applications to communicate extensively with one another, while talking poorly—if at all—with applications from other vendors. In this scenario, you'd have to purchase one vendor's suite of applications to fully use the features of all of them.

The latter scenario is likely, according to InfoCorp's Higgs. "Neither technical nor marketing realities in the industry make the widespread use of modular software practical," he says. Vendors will support the bare-bones communications standards but will add extensions to them. Higgs cites Unix as an example. Although it's a standard operating system, numerous variations of it exist because different vendors supply custom features or their own GUI.

An Object-Oriented Future

Perhaps the most promising development is the coming of object-oriented operating systems (see "Objects for End Users," December 1992 BYTE). The upcoming Taligent operating system from Apple and IBM, along with Cairo from Microsoft, promises to save unnecessary code by providing the user with a series of objects that can be purchased, enhanced, and linked together as necessary.

A preview of what these object-oriented operating systems will be like is provided by Oberon, a new operating system and language developed by the designer of Pascal, Professor Niklaus Wirth at the Eidgenossische Technische Hochschule in Zurich, Switzerland. According to Wirth, today's software has become grossly oversized, inefficient, and potentially unreliable. Versions of Oberon that run on PCs, Macs, Sun Sparcstations, and IBM RISC System/6000s are available now. [Editor's note: *A more in-depth look at Oberon will appear in an upcoming issue of BYTE.*]

Wirth's solution is extensibility. Using the Oberon programming language, users can enhance and customize a simple tool, such as a text editor, for particular applications. These customized versions would save space because they use the same underlying basic text-editor code.

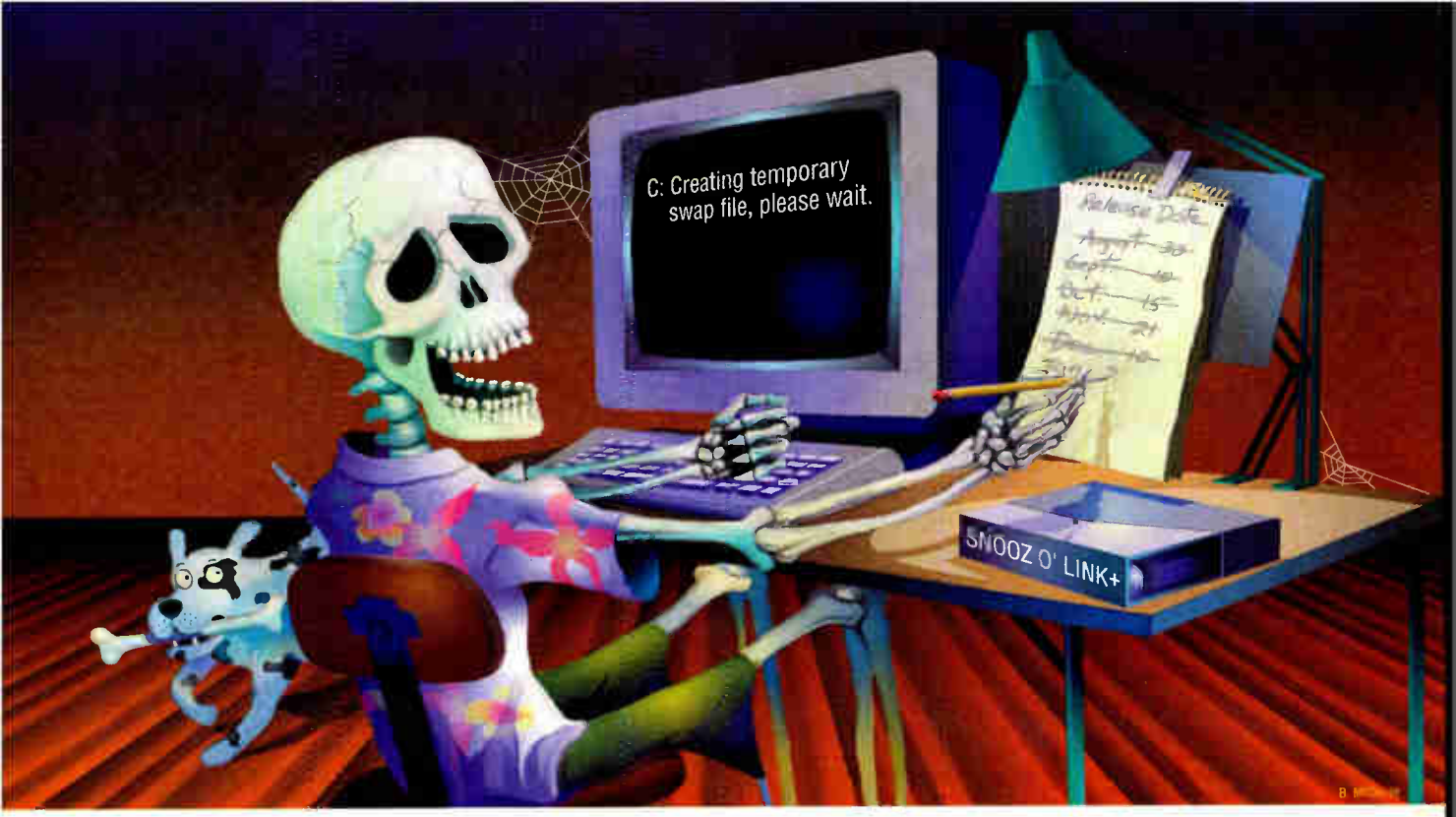
Another important feature of Oberon is the way that it allows data to be viewed. Oberon has viewers that you can use to display documents. Documents consist of text and graphics and contain commands that change the document's contents. When a change occurs, the document sends a message to all viewers so that they can update their views of it. This separation of document and viewer allows users to create new types of documents and viewers without duplicating any of the operating system's existing code.

Although Oberon is a complete GUI-based operating system with its own compiler and text-editor functionality, the PC version takes up only 1.5 MB of RAM, including source code. In contrast, Windows 3.1 consumes 9 MB. ■

Editor's note: *BYTE senior editors Gene Smarte and Tom Halfhill and news editors Pat Waurzyniak and Dave Andrews also contributed to this article.*

Ed Perratore is a BYTE news editor. Tom Thompson and Jon Udell are BYTE senior technical editors at large. Rich Malloy is a BYTE executive editor. They can be contacted on BIX as "eperratore," "tom_thompson," "judell," and "rmalloy," respectively.

World Radio History



How much longer can you afford to wait?

Create Overlaid Programs-Fast.

BLINKER™, the world's first and fastest dynamic overlay linker, reduces your link time to seconds and reduces program memory requirements. Now you can use one linker for all your software projects.

One Linker, Many Languages.

BLINKER 2.0 links and automatically overlays DOS programs written in Microsoft® C, BASIC, Assembler, QuickBASIC™, Fortran, Pascal, Watcom™ C, Zortech® C++, Clipper®, FORCE® and in Borland® C, C++, Assembler, and more.

Save Time and Memory.

BLINKER removes the need for overlay structures, simplifies program design and reduces memory requirements to save you time, effort and memory.

Memory Swap Function.

BLINKER is the ONLY linker to offer an integrated memory swap function, so you can run other large programs from within your program, with negligible memory overhead.

BLINKER™
High Performance Dynamic Overlay Linker

Don't Settle for Less.

Other major features include full CodeView® support, use of EMS/XMS at program run time, and enhanced execution speed of overlaid code.

Time is Money.

BLINKER offers all this in a fraction of the time it takes to link with your current overlay linker. You know time is money, and link time is no exception.

Free Demo

To try our free demo on your own code

Call: 804-747-6700
FAX: 804-747-4200 or

Order now!

If you can't wait any longer, we offer a risk free 30 day money back guarantee. Available in 5.25" or 3.5" diskette format.

Price $299
plus shipping & handling

VISA MC

Blinkinc
P.O. Box 7154
Richmond VA
23221

© 1991 Blinkinc. Blinker is a trademark of ASM, Inc. Offer only applicable in US and Canada.

Circle 159 on Inquiry Card (RESELLERS: 160).

World Radio History

Get a hold of the best value in LAN power protection

Now just $139!

suggested list price

Blackouts, brownouts, sags... Your data and hardware are vulnerable to problems that surge suppressors and power directors are just not equipped to handle.

Now there's a complete Uninterruptible Power Supply solution to suit any budget. The Back-UPS™ 250 is reliable protection for LAN nodes, 386SX machines, 286, small PS/2 systems, and internetworking hardware such as routers, bridges, gateways and repeaters.

From the largest server to the smallest router, the Back-UPS Series will increase your productivity by providing a cost-effective solution to power problems. Call for your free power protection handbook.

The **Back-UPS 250** offers even more cost-effective protection for LAN nodes (typical runtime for a 386SX system is 10 minutes).

NEW!

Guaranteed ABSOLUTE™ Protection

- ABSOLUTE™ Protection guarantees repair or replacement of equipment (up to $25,000) if damaged by a surge while protected by a properly installed Back-UPS (See warranty for details).
- UL, CSA and Novell approved with a 2 year warranty
- Full-time surge protection and line filtering
- Most models include LAN interface for automatic-shutdown of Novell, LAN Manager, LAN Server, LANtastic, Banyan, SCO Unix, and others
- Ask about PowerChute® UPS monitoring software and Novell compatible UPS monitoring boards
- 230V models available

LAN TIMES READERS CHOICE 1992
1991, 1990

Computer Reseller News Editors' Choice

	Model	Application	List	New List
	Back-UPS 250	LAN nodes, 386SX, 286, internet hardware, POS	~~$169~~	$139
	Back-UPS 400	Desktop 386, 486 systems, 286 servers	~~$249~~	$229
	Back-UPS 450	Tower 386, 486 systems, servers	~~$329~~	$279
	Back-UPS 600	Heavily configured systems, CAD/CAM workstations	~~$449~~	$399
NEW!	**Back-UPS 900**	Multiple systems, longer runtime applications		$599
NEW!	**Back-UPS 1250**	Multiple systems, LAN hubs, small minis, telecom equipment		$799

The Back-UPS™

by American Power Conversion

(800)800-4APC, Dept. A2

APC Europe TEL: (+33)1.64.62.59.00 FAX: (+33)1.60.17.80.29
Latin American TEL:(401)789-9771 Asia/Pacific FAX:(401)789-1631

©1992. Back-UPS, PowerChute, Guaranteed ABSOLUTE Protection are trademarks of APC. All other trademarks are property of their respective owners.

Circle 66 on Inquiry Card.

World Radio History

Putting Fuzzy Logic into Focus

When dealing with ambiguous data, desktop fuzzy-logic applications deliver precise results

JANET J. BARRON

Fuzzy logic has long excelled at delivering exact results from imprecise or ambiguous information, and its primary use has been in embedded controllers. Now fuzzy logic is entering the mainstream with a wide range of desktop applications.

Aptronix's (San Jose, CA) FIDE (Fuzzy Inference Development Environment) lets you develop fuzzy-logic-based applications. It runs under Windows on 386/486 machines and costs $1495. FIDE includes a fuzzy inference language, a fuzzy-system standard environment, a graphics editor (with which to draw graphs of membership functions), debugging tools, and a real-time code generator.

Another company, FuziWare (Knoxville, TN), makes several products, including FuziCalc for Windows, FuziQuote, FuziCell, FuziChoice, and FuziCost. These products are used as management decision-support systems for custom, turnkey, and off-the-shelf applications, as well as software techniques to implement both fuzzy logic and fuzzy math.

FuziWare's forecasting, estimating, and modeling software—FuziCalc for Windows—sells for $995. Using it, you can make decisions based on complicated combinations of hard (well-understood) and soft (fuzzy) factors. It produces answers that are mathematically verifiable and easy for people new to the field to model and interpret. FuziWare claims that if you have an appropriate application, you can improve your productivity some 30-fold.

Other vendors of fuzzy-logic products include the following: Motorola (Austin, TX), Omron (Kyoto, Japan), Togai Infralogic (Irvine, CA), National Semiconductor (Santa Clara, CA), HyperLogic (Escondido, CA), and NeuraLogix (Sanford, FL).

Even though fuzzy logic is used worldwide, it is most popular in Japan (see the text box "Japanese Leaders in Fuzzy Logic" on page 116). Its acceptance outside Japan has been slow—some people blame the name itself, which Lotfi A. Zadeh (developer of the field and currently professor emeritus of electrical engineering at the University of California, Berkeley) chose to call the technique.

Using Fuzzy Logic

Fuzzy logic is a multivalued logic that allows for degrees (e.g., normal versus slow or fast) of set membership—a more practical way to deal with the issues you face in the real world. Unlike binary (yes or no) information, fuzzy logic emulates your ability to reason and make use of approximate

ILLUSTRATION: MARTY BRAUN © 1993

World Radio History

Fuzzy-Logic Glossary

At first glance, the words pertaining to the technology of fuzzy logic often seem fuzzy; however, with a few clues, you'll find them straightforward.

crisp logic Another name for traditional logic to differentiate it from fuzzy logic. In crisp logic, the three logic operations AND, OR, and NOT return either a 1 or a 0.

crisp set The traditional definition of a set in classical or symbolic logic. Traditional or crisp sets have strict membership criteria in which an object is either completely included or excluded from the set. They are mathematical sets with definitive boundary points (e.g., 400°F is hot; –400°F is cold).

defuzzification A process in which fuzzy output is converted into crisp, numerical results.

fuzzification The process of fuzzifying an element by combining actual values (e.g., the temperature of a liquid) with stored membership functions to produce fuzzy input values.

fuzziness A term that expresses the ambiguity that can be found in the definition of a concept or the meaning of a word or phrase. The terms *high temperature* or *very soft* qualify as fuzzy.

fuzzy logic The process of solving problems that deal with ambiguous data (e.g., that in the real world) using a multivalued logic to represent a crisp-logic system. Fuzzy logic holds that all things are a matter of degree (e.g., warm versus cold or hot). In fuzzy logic, the three logic operations AND, OR, and NOT return a degree of membership that is a number between 0 and 1.

fuzzy set A nontraditional type of set that allows an element to have gradual or partial degrees of membership. In fuzzy logic, the traditional Boolean values of true and false (1 and 0) are replaced by continuous-set membership values ranging from 0 to 1.

fuzzy inference The process of using the degree of truth in production rule premises to select an appropriate rule to execute.

genetic algorithm A process for optimizing the suitability of a function to some observations.

membership The degree of inclusion in a set. Fuzzy sets have values between 0 and 1 that indicate the degree to which an element has membership in the set. At 0, the element has no membership; at 1, it has full membership.

set A collection of objects.

data to find precise solutions.

Among fuzzy logic's benefits are fault tolerance and the ability to provide accurate responses to ambiguous data. According to David Brubaker, president of the fuzzy-logic and embedded-systems consulting firm Huntington Group (Menlo Park, CA), products designed with fuzzy logic have simpler controls, are easier to build and test, and provide smoother control than those using conventional systems.

The largest commercial uses for fuzzy logic are as controllers for tasks such as managing temperatures and energy efficiency in heating and cooling devices and regulating timing and fuel flow in automobile engines. Controllers also are used to make constant operating adjustments to subway trains, home appliances, cameras, and elevators.

In the next few years, fuzzy logic will enter domains such as computer chips, computer graphics, software development, financial planning, information processing, sales analysis, speech recognition, machine vision, and character recognition (see the text box "Fuzzy-Logic Applications" on page 114). It will improve speed, maintenance, extendability, and efficiency. According to Earl Cox, CEO of the Metus Systems Group (Chappaqua, NY), a fuzzy-logic and fuzzy-neural network consulting organization, the use of fuzzy logic can dramatically reduce product development times for a range of embedded control applications from the idea to the prototype stage.

Cox cites an example of a fuzzy-logic application that he developed for a bank. The application runs on PCs with Windows 3.1 and Excel, and it analyzes and rates the complexity of a software development project. This program takes into consideration function point, code density, and the total operational interface.

The application calculates complexity indicators in software, such as the number of IF...THEN...ELSE statements, nested IF...THEN...ELSE statements, GO TOs, and comments. You use these rough figures to calculate ratios and statistical measures and feed them into a fuzzy-evaluation model.

Previous attempts to measure complexity relied on sharp boundaries between what is and what is not complex. The fuzzy approach more closely models the way that managers think in degrees such as somewhat, moderately, and highly complex.

continued

FUZZY-LOGIC ADVANTAGES

- requires no complex mathematical constructs
- uses natural language
- is easy to set up
- provides accurate results
- works well in tandem with other techniques

TRADE-OFFS

- must understand and be able to define problem
- must evaluate and fine-tune results

World Radio History

What to do when Windows® won't work.

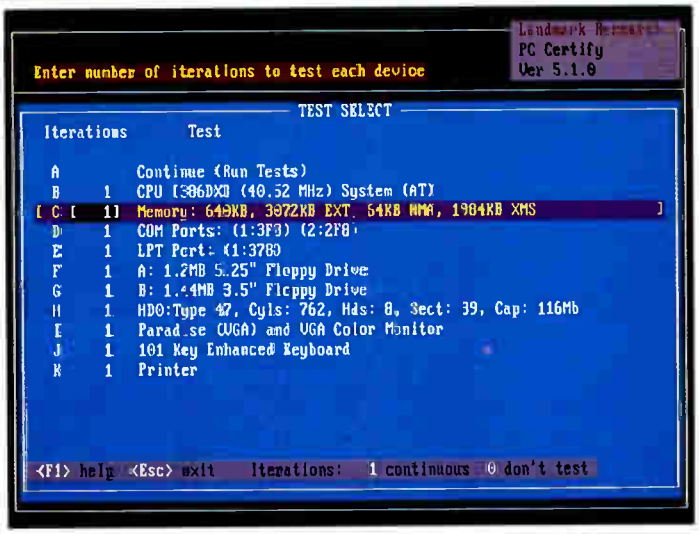
PC Certify™ from Landmark resolves hardware and software conflicts FAST!

CPU & System Board Tests -
Clock speed, instruction set, DMA controller 1 & 2, interrupt controller 1 & 2, CMOS RAM, 8253/8254 timer, math coprocessor (instruction set).

COM & LPT Port Tests -
COM (1, 2, 3, 4), LPT (1, 2, 3, 4), internal loopback, identifies addresses.

Hard Drive Tests -
Non-destructive testing of drive and controller for MFM, RLL, IDE, ESDI, and SCSI. Includes indentification of IDE specs (hds, cyl, spt) for quick and easy setup.

CMOS Save & Restore -
CMOS recovery program for restoring lost CMOS settings.



Memory Tests -
Tests conventional, UMB, HMA, XMS, extended and expanded, identifies address, bit, and parity failures, displays bad RAM address.

Floppy Drive Tests -
Non-destructive tests for 3.5" and 5.25", with high and/or low density controllers.

Video Tests -
Text attributes, ASCII character display, scrolling character set, high and low resolution graphics, EGA/VGA color tests. Supports Hercules, MONO, CGA, EGA, and VGA (up to 1MB).

Printer & Keyboard-
Printer character and barber pole tests, 84 and 101 key model keyboards.

WHAT IS PC CERTIFY?
PC Certify is an easy-to-use, non-destructive PC diagnostic program designed to quickly identify hardware faults and system configuration errors. Windows setup problems can be frustrating. You don't know whether it's the software, configuration, or a hardware fault. With PC Certify you'll quickly be able to pinpoint what the source of the problem is.

WHAT DOES PC CERTIFY DO?
PC Certify software allows you to easily:

- Diagnose hardware vs. software failures.
- Identify system setup problems.
- Keep track of system upgrades and configuration changes.
- Run a complete preventative maintenance check on your system.
- Print a testing and certification report for quality control and inventory records.

WHY YOU NEED PC CERTIFY
Few things are more aggravating than computer downtime and lockups. You waste time waiting for help and usually pay a dear price to get it *when* you finally do. Your time is valuable, so let PC Certify handle the problem for you.

Anyone can use PC Certify. Simply run the program in AUTOMATIC or QUICK MODE, sit back, and relax while PC Certify scrutinizes and tests your computer system for hardware failures.

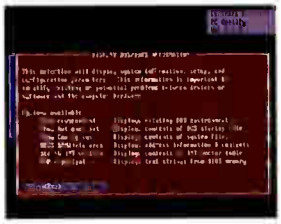
Once the battery of tests is complete (usually within minutes), a Test Results Summary will be on your computer screen. You can route the summary to a disk file or your printer. Either way, you'll know what's wrong with your PC hardware.

SLASH TECHNICAL SUPPORT TIME
When you find yourself needing technical support for your software and hardware or when you experience a computer malfunction, PC Certify is the quick, inexpensive answer.

With PC Certify on your system, you can quickly identify the source of the problem; hardware, software, or configuration. Telephone support becomes fast and easy. Repair bills drop like a rock (50% and more of your repair bills are for diagnosing the problem, PC Certify does it for you at NO COST!).

EASY PC INVENTORY CHECKS
With PC Certify you can check your system configuration and use the hidden database to compare the current configuration with the original. This will eliminate unauthorized system configuration changes or loss of computer system components. You'll identify hardware problems and know exactly what parts you'll need to repair your system.

PRODUCT FEATURES
- Run tests in single or multiple passes.
- Run tests with or without operator interaction.
- Prints system certification document.
- Utility included to park the hard drive.
- Detects and stores presence of major system components.
- Keeps an up-to-date internal database with complete system information.
- Internal database can be output to delimited ASCII file to any database for tracking of system assets and configuration changes.
- CMOS Save & Restore CMOS recovery program.
- Includes easy to understand on-line help & manual.



Regularly $99 Now Only $39! Special mail-in offer. Save 60%!

SYSTEM INFORMATION
- Displays DOS environment.
- Displays AUTOEXEC.BAT.
- Displays CONFIG.SYS.
- Displays software interrupts.
- Displays BIOS RAM data area.
- Displays ROM copyrights and text strings.

COMPATIBILITY
PC Certify requires 256K of RAM, DOS 3.0 or greater, and is compatible with all IBM PC/XT, AT, 386, 486, or true compatible computers. PC Certify is not a Windows program. It can be run in Windows configured in Standard mode. However, it is imperative that you run any PC diagnostic from DOS or a boot disk and not from within Windows, otherwise you will not be able to fully test your memory and hard disk functions.

• 90 Day Money-Back Guarantee
• Toll-Free Lifetime Tech Support
• Discount Two-Day Shipping

ORDER DIRECT:
Call (800) 683-6696
FAX (813) 443-6603• Int'l (813) 443-1331

LANDMARK
RESEARCH INTERNATIONAL CORPORATION
703 Grand Central Street • Clearwater, FL 34616

Copyright © 1992. All Rights Reserved. PC Certify is a trademark of Landmark Research International Corporation. Windows is a registered trademark of Microsoft Corporation. Other names are trademarks of their associated owners.

Circle 134 on Inquiry Card (RESELLERS: 135).

World Radio History

Fuzzy-Logic Applications

Currently, fuzzy logic is most often used for controllers; however, the technology is finding its way into other applications.

computers—embedded computers, chips, sensors, signal processing, data/information processing, software development, and speech recognition

transportation—automobile components (e.g., transmissions and braking systems)

military—aerospace

industrial—robotics, pattern recognition, and machine vision

consumer electronics—TVs, cameras, and camcorders

microelectronics—plasma-etching machines and fabrication

business—decision making, elevators, heating and cooling systems, risk assessment, copy machines, and enterprise modeling

home appliances—washing machines, air conditioners, and heating systems

financial—forecasting, analysis, decision making, and risk assessment

economics, sociology—nonlinear systems

medicine and health science—diagnostic tools

marketing—analysis and forecasting tools

Listing 1: *Overlapping membership ranges often used in fuzzy-logic applications. A mock traffic-control system could use fuzzy rules to control the main artery traffic in a city. A speed of 10 miles per hour might be assigned to both the Sluggish as well as the Moderate category. The actual value for green-light time is derived from the combination of several rules executing.*

```
Problem:
      IF  main artery traffic is blocked
    THEN  traffic-light sequence is probably
          inadequate

Solution:
      IF  traffic is blocked
    THEN  increase main artery green-light
          time

Fuzzy rules:
      IF  traffic flow is Sluggish
    THEN  green-light time is Long
      IF  traffic flow is Moderate
    THEN  green-light time is Extended
      IF  traffic flow is Normal
    THEN  green-light time is Normal
      IF  traffic flow is Fast
    THEN  green-light time is Reduced
      IF  traffic flow is Maximum
    THEN  green-light time is Restricted
```

Crisp vs. Fuzzy

The concept of crisp sets comes from traditional, or classical, logic (see the glossary on page 112). Crisp sets have rigid membership requirements where every object is either completely included or excluded from a set. In contrast to this true or false scenario, fuzzy sets allow for continuous-set membership values ranging from 0 to 1.

Bart Kosko, professor of electrical engineering at the University of Southern California, says, in his book *Neural Networks* and *Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence* (Prentice Hall, 1991), this type of multivalued logic was first explored some 60 years ago by Jan Lukasiewicz, a Polish logician who also defined reverse Polish notation. Max Black, a quantum philosopher, furthered Lukasiewicz's work and created the beginning of what people now think of as fuzzy-set membership functions.

In the early 1960s, Zadeh enhanced the original research. He subsequently developed what people know as fuzzy-set theory, introducing the term *fuzzy* into our language to deal with what Black had referred to as *vagueness*. In 1965, Zadeh published a seminal paper on the subject, entitled *Fuzzy Sets*.

A Fuzzy-Logic Model

The fuzzy-logic procedure consists of analyzing and defining your problem, creating your sets and logical relationships, converting your information to what are called fuzzy sets, and interpreting your model (see listing 1). You can use a number of criteria to determine whether a fuzzy-logic approach would lend itself to solving your specific problem. These prerequisites include the level of ambiguity of the data (determined mathematically) and the required accuracy of the output.

To use a fuzzy-logic model, you would

- analyze your problem, making sure you understand it fully;
- define your problem by identifying your membership functions (i.e., the degree of inclusion in your prescribed sets);
- convert the language of the problem into a rule;
- set up an appropriate procedure for fuzzifying and processing the problem;
- learn to interpret the model and evaluate your results; and
- fine-tune the results if they are inappropriate or unsuitable.

Before you perform your calculations and build your model, you should make sure that a fuzzy model is an appropriate way to deal with your problem. If another model would be more suitable, you will find that you can't understand or evaluate your results.

Why Fuzzy Logic?

You can set up a fuzzy system for the same purpose you set up any other computing system—to map inputs to outputs. Basically, it consists of three stages: fuzzification, rule evaluation, and defuzzification.

Fuzzification is a process that combines actual values (e.g., barometric pressure) with stored membership-function data to produce fuzzy input values. Rule evaluation, or fuzzy inferencing, is a way of producing numeric responses from linguistic rules based on system input values. In the last stage—defuzzification—a fuzzy system combines all its outputs and obtains a representative number.

To see if this number solves the original problem and gives you an accurate answer in all cases, Fred Watkins, president of HyperLogic, a firm that produces fuzzy-logic development tools, says it's necessary to come up with a performance measure (theoretically, an ideal correct response). You can then run the engine

World Radio History

he Silentwriter® Model 95.

Come see what all the noise is about.

Purchase the $1749* Silentwriter Model 95 by April 30, 1993, and get a $250 rebate along with Adobe® PostScript™ Level 2 interpreter, HP® PCL® 5 emulation, PC and Mac® compatibility, 6PPM speed and microfine toner.

Because ⬆ is the way you want to go.

NEC

*Manufacturer's suggested retail price

For information, call 1-800-NEC-INFO (in Canada 1-800-343-4418), or NEC FastFacts™ at 1-800-366-0476, request #SWM95.

Silentwriter is a registered trademark and FastFacts is a trademark of NEC Technologies, Inc. All other trademarks are the property of their respective owners. All quotes are reprinted with permission from the respective publications © 1993 NEC Technologies, Inc.

Circle 110 on Inquiry Card.

World Radio History

Japanese Leaders in Fuzzy Logic

JEFFREY D. SHEPARD

The Japanese recognized the potential of fuzzy logic more quickly than people in other parts of the world. One of the reasons for the explosion of fuzzy-logic applications in Japan was the success of Japan's Sendai automated railway system.

When it opened in 1987, the Sendai Metro used a Hitachi fuzzy control system. An earlier study by Hitachi had shown that a fuzzy control system was superior to a conventional one in a number of ways—increased accuracy in stopping at a platform, greater rider comfort (smoother acceleration and braking), and lower electric power usage. The performance of the Sendai system was so impressive that within 12 months, over 50 Japanese companies were working to develop fuzzy-logic technology.

The result has been the application of fuzzy technology by Japanese companies in a wide range of products, including computers, cameras, automobiles, and home appliances. In 1991, Japan captured nearly 80 percent of the several-billion-dollar-per-year world market for fuzzy logic, according to Market Intelligence Research (Mountain View, CA).

Computers Will Benefit

The Japanese are setting their sights on the application of fuzzy techniques to produce future generations of high-performance personal computers and workstations. The advent of more powerful personal computers and workstations has created a demand for faster seek times in hard drives. The seek time is limited by the performance of the actuator moving the head, as well as by the control method.

A fuzzy-logic algorithm has been applied to a controller for a 3½-inch hard drive, improving seek times by about 20 percent to 30 percent over that of conventional controllers. The algorithm was developed at the Information Equipment Research Laboratory of Matsushita Electric Industrial (Osaka, Japan).

Someday, you may even find fuzzy logic regulating the output voltage of the switching power supply in your new personal computer or workstation. A team from Kumamoto University and Kumamoto National College of Technology (Kumamoto, Japan) has developed a new control system using fuzzy logic. The group implemented this experimental fuzzy controller in software on a personal computer.

OKI Electric Industry (Tokyo) recently introduced a new fuzzy-inference IC that is expected to improve the performance of fuzzy controllers by an order of magnitude and substantially reduce the controllers' cost. Another Japanese company, Omron (Kyoto), holds over 700 patents for fuzzy products and already offers a VLSI fuzzy-controller IC. These chips represent second-generation designs.

Other Projects

The Laboratory for International Fuzzy Engineering Research (LIFE), a six-year project of the Ministry of International Trade and Industry, is developing future fuzzy-logic applications in decision support, robotics, and fuzzy computing (including fuzzy associative memories). At the independently funded Japanese Fuzzy Logic Systems Institute in Iizuka, a fuzzy neuron has been used in an experimental handwriting-recognition system.

A fuzzy neuron is analogous to the neuron in neural computing except that it takes fuzzy sets as inputs and yields a fuzzy set as an output. A number of people in the Japanese research community expect neural and fuzzy technologies to complement each other and to evolve together into a "neuro-fuzzy" technology.

A team at the Hiroshima Institute of Technology has demonstrated an optical fuzzy-inference device. In this case, light passes through translucent plates on which are inscribed the membership functions of fuzzy sets representing a rule's premises, and the amount of light emitted is measured to derive the rule's conclusion. Fuzzy optical computing could provide real-time recognition of moving images.

LIFE has developed a fuzzy flip-flop circuit. Currently, a study is under way to define the architecture of a fuzzy-logic-based workstation. The machine is expected to embody both fuzzy (multilevel) and classical (binary) processing in the same architecture. You would use the machine to tackle problems such as natural language and image understanding—applications that are difficult to implement with conventional personal computers and workstations.

Jeffrey D. Shepard is a freelance writer living in Norco, California. You can contact him on BIX c/o "editors."

in a variety of contexts. If the number doesn't turn out to be a good solution, you tune the system parameters until you reach a satisfactory conclusion. Even as the rules of a fuzzy engine become more complex, says Watkins, the general concepts remain the same.

According to Emdad Khan, manager of fuzzy and neural networks for the Embedded Systems Division of National Semiconductor, you can construct a PC-based fuzzy-logic system (e.g., to use in a simple management project) using software alone. However, general-purpose or dedicated microprocessors are available for more complicated applications (see the figure).

Cross-Fertilization

Fuzzy logic, neural networks, expert systems, genetic algorithms, and OOP (object-oriented programming) are some of the ways of efficiently handling problems that are rife with ambiguity, although each method handles uncertainty differently. If you use a blend of these technologies, the results are sometimes more than the sum of their parts.

World Radio History

According to Khan, combining both fuzzy logic and neural networks results in a synergy that improves speed, fault tolerance, and adaptiveness. A neural network can convert knowledge into fuzzy rules and membership functions, and fuzzy logic can optimize the number of rules that the neural network learns.

NeuraLogix's senior software engineer David Ratti says, "In tandem, you gain fuzzy logic's ability to deal with inexact measurements and input data, and a neural network's ability to learn." The fuzzy approach assumes a priori knowledge and leverages it without the significant training times of neural networks. In and of themselves, fuzzy systems aren't adaptive, he says, but neural networks are. By observing what the fuzzy system does, the neural network can adjust the parameters of a fuzzy system and can tune it.

You might want to build a fuzzy system using an expert system if you need a simple method for encoding nonlinear data, such as market forecasts or the financial stability of an organization. Fuzzy expert systems can handle both incoming and already computed information in either a crisp or fuzzy format. They perform well at relatively high speeds on conventional computers and specialized hardware. This type of combination system produces results similar to the way humans intuitively handle most kinds of real-world problems.

Huntington Group's Brubaker says that most fuzzy systems are rule-based, but the rules in a fuzzy expert system execute to different degrees. "Rather than an all-or-nothing response," he says, "the fuzzy rules produce 'shades of gray' responses depending on the degree of belief in the premise of each rule."

Several efficient fuzzy systems have been created using genetic algorithms. Metus's Cox says that combining these technologies provides a good way to address difficult and often intractable problems. It also offers one of the best techniques to handle nonlinear problems that are normally addressed by statistics and advanced mathematical models.

Ralphe Wiggins, president of Ryan, a data-analysis consultancy based in Hartford, Connecticut, began using fuzzy logic two years ago. In combination with genetic algorithms, he found the technology a valuable way to handle applications such as financial forecasting and abstractions for data interpretation or machine learning. When performing machine learning, for instance, Wiggins found that the use of fuzzy logic greatly simplified the ways of representing data; thus, he was able to find solutions to problems that had previously defied analysis.

The blend of fuzzy logic and object orientation has proponents and opponents. "You can build a fuzzy system using object-orientation technology where rules are objects," says HyperLogic's Watkins, "but it isn't necessary to use these two technologies together."

In a combination fuzzy-logic, object-orientation system, objects themselves can be fuzzy. A given object can have only partial (a degree of) membership in its class. Wiggins says to solve very complex problems, a fuzzy-logic/object-oriented system might be the answer.

Nonuniversal Acceptance

Cox says that fuzzy sets are easy to design, build, validate, and tweak, and for several reasons, such as their fault tolerance and capabilities for parallelism, they are extremely robust. But some people are unwilling to use fuzzy-logic systems because they believe that creating, verifying, and refining them is too difficult, or that the systems are unstable.

While Ed Katz, a member of the technical staff at Hewlett-Packard Laboratories Division (Palo Alto, CA), is a proponent and user of fuzzy logic, especially in the noncontroller domain, he says

Built for harsh climates, including today's economy.

Introducing the 4210, the affordable, rugged PC.

You don't have to go broke to get a PC that won't break in harsh operating environments. Because starting at $3,087 for a 25MHz 486 SX system, you can get the new 4210 from Texas Micro.

Available in desktop and rackmount versions, the 4210 is built for high reliability under elevated temperature, dust and shock, making it ideal for mission critical office and industrial applications.

intel inside

The 4210 has a sturdy chassis with a 10-slot passive backplane to allow for easy CPU and peripheral upgrades.

Call Texas Micro today to get complete specification and price literature on the new 4210. And find out just how rugged a computer has to be to survive the economy.

TEXAS MICRO

Call 1-800-627-8700.

©1993 Texas Micro, Inc. The Intel Inside logo is a registered trademark of Intel Corporation.

Circle 140 on Inquiry Card.

World Radio History

Circle 155 on Inquiry Card (RESELLERS: 156.)

fractal image compression

Fractal image compression. The technology that inspired *PC Magazine* to proclaim "The advantages of fractal compression are unmatched." The technology selected for Microsoft©'s breakthrough CD-ROM Encyclopedia, Microsoft© *Encarta*.

This technology is now available to Windows 3.x developers in **POEM ColorBox**, which provides DLLs for:

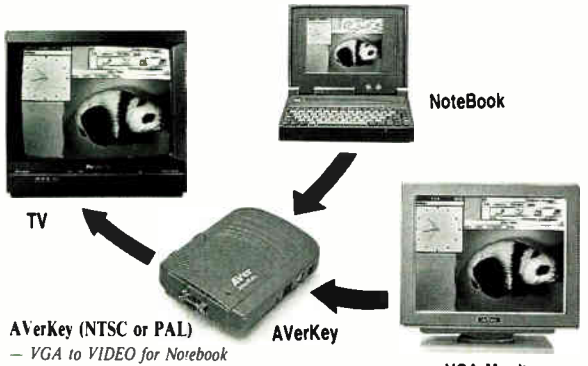
- ultra-high compression;
- resolution independent images;
- fast decompression; and
- superior 24-bit color rendering.

For multimedia, archiving or other imaging applications, **ColorBox** is comprehensive, easy-to-use and at $995, surprisingly affordable.

Call today for more information. Learn why **ColorBox** is the solution to your image compression needs.

Iterated Systems
5550-A Peachtree Pkwy., Suite 650
Norcross, GA 30092
Tel: 1-800-4FRACTL
Fax: (404) 840-0806

AVer MULTIMEDIA



AVerKey (NTSC or PAL)
- *VGA to VIDEO for Notebook*
- *Flicker-Free filter*
- *Supports Windows 3.0 and 3.1*
- *Supports all IBM standard modes up to 640×480 with any colors (256, 32K, 64K,...) for NTSC or PAL For PAL TV system, 800×600 is supported if Cirrus CL-GD6410 VGA chip is used.*
- *Supports 640×480 mode without loading any AVerKey driver.*
- *Compatible with all VGA cards*
- *Simultaneous graphics display on both VGA and TV monitors.*

We also have following items:
- *VGA to Video OVERLAY/GENLOCK card*
- *Live Video Window controller*
- *VGA to Video Converter card*
- *TARGA 16 compatible card*
- *JPEG compression card*
- *TUNER card*

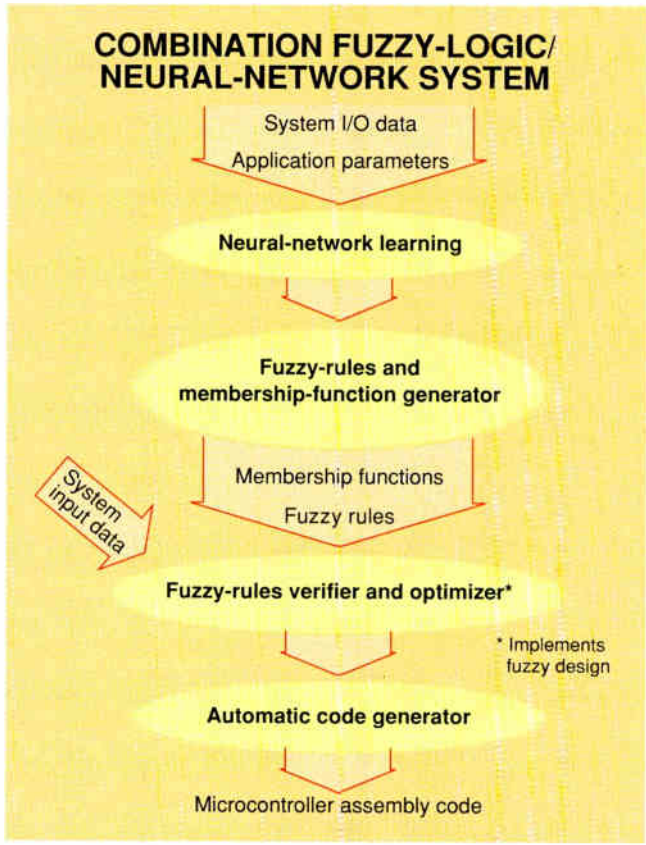
DISTRIBUTOR & OEM WELCOME

MANUFACTURED BY:

ADDA (USA, CA)	TEL: 1-510-7709899	FAX: 1-510-6231803
ADDA (CANADA, BC)	TEL: 1-604-2783224	FAX: 1-604-2782909
ADDA (TAIWAN)	TEL: 886-2-2484131	FAX: 886-2-2484276, 2488214, 2404538

All trade marks are the property of their respective holders.

Circle 154 on Inquiry Card.



National Semiconductor's NeuFuz system combines fuzzy logic and neural networks, which learn the system behavior based on I/O data, and a rules generator, which creates fuzzy rules and membership functions based on the neural-network learning process. A fuzzy-rule verifier validates and optimizes the number of generated rules and functions. Finally, an automatic code generator converts these rules and functions into an embedded controller's assembly code.

that there are trade-offs to the technology. One problem lies in the area of refining your membership functions. No procedure exists for determining what a membership function looks like or for adjusting it, he says.

One issue being debated is whether fuzzy models provide ambiguous or accurate results. According to Cox and others, the use of fuzzy logic offers the same kind of deterministic results that you can expect from many other conventional systems. Cox says, "Boolean logic is to fuzzy logic as a light switch is to a dimmer switch."

Problems in the real world are imprecise. You seldom can solve them with either a yes or no. Fuzzy logic dramatically improves people's knowledge-modeling capabilities in vague areas such as economics or behavioral science. According to Cox, "[it] brings the way a computer reasons closer to the way that people think." ■

ACKNOWLEDGMENT

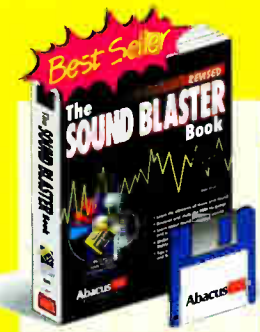
My thanks to Earl Cox, Maureen Caudill, and Ralphe Wiggins for their expertise.

Janet J. Barron is a BYTE technical editor. You can reach her on BIX as "neural" or on the Internet at neural@bytepb.byte.com.

World Radio History

We Deliver Computing Know How

Learn More with Computer Books from Abacus



Sound Blaster Book

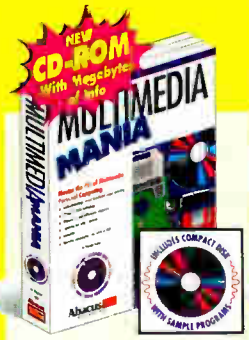
This book is your guide to **Sound Blaster**, from installation to custom programming. Includes an overview of the different **Sound Blaster** cards, many specific software products and much more. Also includes simple MIDI system to use with your **Sound Blaster**.

#B181. ISBN 1-55755-181-2. Price $34.95 with 3.5" companion diskette.

The 486 Book

Explains the features that make this processor so advantageous - the memory capabilities, the math coprocessor, the specialized software that maximizes the CPU's performance and more. PC INFO program and System Sleuth™ diagnostic software on companion diskette.

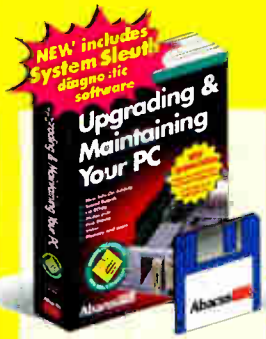
#B183. ISBN 1-55755-183-9. Price $34.95 with 3.5" companion diskette. 420 pages.



Multimedia Mania

This book removes the hype surrounding multimedia. 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 techniques to get you deep into the world of multimedia. Also includes several commercial multimedia demonstrations

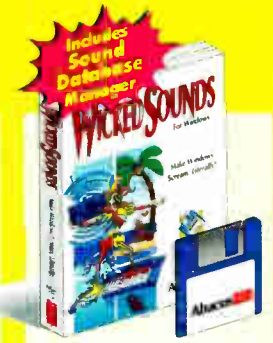
#B166. ISBN 1-55755-166-9. $49.95 with companion CD-ROM.



Upgrading & Maintaining Your PC

Turn your PC into a high performance screamer. Whether you're adding memory or a hard drive, 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 Sleuth™ diagnostic software. 598 pages.

#B167. ISBN 1-55755-167-7. Suggested retail price $34.95.



Wicked Sounds

This outrageous book/disk lets you sit back and have some fun with Windows' built in sound capabilities. "Sound off" by attaching a sound to any of 12 different Windows events: closing a window, etc. Includes Sound DATA BASE manager to organize and identify your growing library of wave forms.

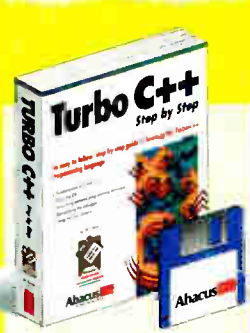
#B168. ISBN 1-55755-168-5. Price $29.95 with companion disk including wave forms and Sound Database Manager.

PC INTERN

The encyclopedia of DOS programming know how for the professional programmer. Includes parallel working examples in Machine Language, **C**, Pascal and BASIC.

- DOS and BIOS internal structures and functions
- Programming video cards, sound, TSRs

#B145. ISBN 1-55755-145-6. Price $59.95 with over 2MB of source code on one diskette. 1300 pages.

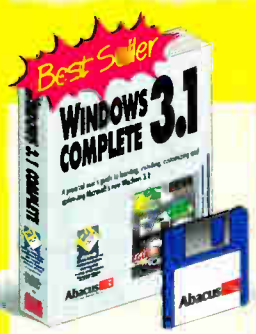


Turbo C++ Step by Step

Teaches you step by step C++, the language of choice among professional developers.

The lessons are designed to be short, progressive and to the point, so you can learn quickly.

#B156. ISBN 1-55755-156-1. Price $34.95 with 3.5" companion diskette. 300 pages.

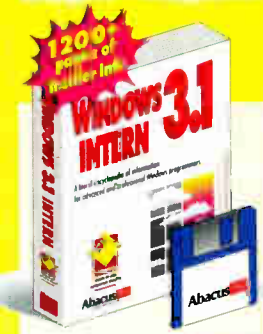


Windows 3.1 Complete

Find out how to customize Windows to your needs with this in depth book covering all the ins and outs! Learn dozens of tips and practical techniques from the pros.

Includes two complete Windows utilities ready to run- Disk Backup and Snapshot screen capture.

#B153. ISBN 1-55755-153-7. Price $34.95 w/Windows utilities disk. 875+ pages.



Windows3.1 INTERN

Introduces the reader to the overall concept of Windows programming and events using dozens of easy-to-follow examples. A comprehensive info source for every Windows programmer. It's a solid guide for beginning to intermediate Windows programmers who need to know more, faster.

#B159. ISBN 1-55755-159-6. Price $49.95 with 3.5" companion diskette. 1200+ pages.

PC Assembly Language Step by Step

Teaches you machine language from the ground up, at your own pace. Learn assembly language using the unique assembly language simulator which shows how each instruction functions as the PC executes it. You'll get hands-on training with this exceptional book/disk combination.

#B096. ISBN 1-55755-096-4. Price $34.95 with 2 5.25" companion diskettes.

Order Toll Free 1-800-451-4319

Available at B. Dalton, Crown Books, Software Etc., Waldenbooks, Computer City and other retailers nationwide. In Canada, Coles W.H. Smith and Classic Bookshops. In the UK, call Computer Bookshop: 02*-706-1188 In Australia call Pactronics 02-748-4700.

In US and Canada add $5.00 postage. Foreign orders add $13.00 postage per item. We accept Visa, Mastercard or American Express.

Abacus

Dept. B4, 5370 52nd Street SE, Grand Rapids, MI 49512
Phone: (616) 698-0330 • Fax: (616) 698-0325

Circle 61 on Inquiry Card (RESELLERS: 62).

Please rush me the following books:

___	Sound Blaster Book	$34.95 ea.
___	The 486 Book	$34.95 ea.
___	Multimedia Mania	$49.95 ea.
___	Upgrading & Maintaining	$34.95 ea.
___	Wicked Sounds	$29.95 ea.
___	PC INTERN	$59.95 ea.
___	Turbo C++ Step by Step	$34.95 ea.
___	Windows 3.1 Complete	$34.95 ea.
___	Windows 3.1 INTERN	$49.95 ea.
___	PC Assembly Language	$34.95 ea.

Subtotal: _____
All orders include 4% sales tax: _____
In US & Canada add $5.00 shipping: _____
Foreign orders add $13.00 per item: _____
Total amount (US funds): _____

For fast delivery Order Toll Free 1-800-451-4319 EXT. 24, or FAX (616) 698-0325

Or mail this coupon to: Abacus, 5370 52nd Street SE, Grand Rapids, MI 49512

Method of Payment: ❑ Visa ❑ Master Card ❑ Am.Express ❑ Check / M.O.

Card#: |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| Expires: ____/____

Name: _____

Company: _____

Address: _____

City: _____ State: ____ Zip: _____

Phone#: _____ Fax#: _____

❑ Yes, please rush your free catalog of PC books and software. Dept. B4

World Radio History

World Radio History

ILLUSTRATION: LYN BOYER-PENNINGTON © 1993

VISUALIZATION: SEEING IS BELIEVING

Grasp and analyze the meaning of your data by displaying it graphically

JACK WEBER

Imagine a Wall Street scene. People shout, screens scroll, and adrenaline flows. But one broker stares intently at a computer screen showing what appears to be a field of wheat waving gently in the breeze. Bizarre? Yes, but real.

This image is one example of a growing force in computer applications called *data visualization*. When information overload means that you can't see the forest for the trees, visualization offers a way of identifying and analyzing the underlying patterns in data. For example, convert the prices of individual stocks into the motion of vertical stalks, plant several hundred of them on a computer screen, and watch as market trends are revealed in the shimmering crop before you. It's called Biz Viz.

Data visualization is about comprehension, not graphics. Think of it as a range of techniques that enable you to display abstract numerical data and statistics in graphical form.

After all, you comprehend information most intuitively through your visual senses. With half the neurons in the brain dedicated to visual processing, images provide the greatest mental bandwidth. Thus, by offering a picture of the data and its internal relationships, visualization makes it easier for you to understand information that's too complex to perceive numerically.

New techniques bring new possibilities. Scientists use visualization to analyze the results of experiments in fields as far-flung as pollution studies, semiconductor physics, and drug design. In engineering, visualization can provide rapid solutions in design, development, and production planning. Civic and voluntary organizations can use visualization to obtain demographic data. And in business, the use of visualization techniques can reveal buying patterns, sales penetration, or investment returns. Investors can benefit from visualization's ability to explain performance rather than just track it. The advantages of sharper financial analysis or faster product prototyping are increasingly important (see the text box "Visualization Applications" on page 126).

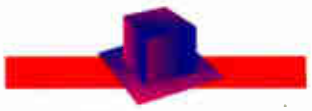
Tim Bartel, a researcher at Sandia National Laboratories (Albuquerque, NM), is using visualization to develop a boat that the U.S. Coast Guard can safely drop into the water, complete with crew, from a helicopter. He's using Tecplot software from Amtec Engineering (Bellevue, WA) on both PCs and Unix systems to animate the boat hitting the water, submerging, and resurfacing. "Without this kind of visualization tool," Bartel says, "the task of analyzing the huge amounts of data from the simulation would be almost impossible."

Until recently, only supercomputer users had access to visualization's full potential. Now anyone with a PC or a Mac can produce sophisticated and meaningful visualizations with off-the-shelf software (see screen 1).

Visualize This

Many elements combine to make up data visualization technology. Among them are animation (rapidly changing still images used to create the illusion of movement), 3-D graphics (an illusion of depth produced by using perspective), and rendering (computer images created to represent the surfaces of 3-D objects, complete with shading and texture).

Visualization is often used in conjunction with simulation, but there is an important distinction between the two. Simulation is any technique that allows you to mathematically



Visualization: Seeing Is Believing
BY JACK WEBER
120

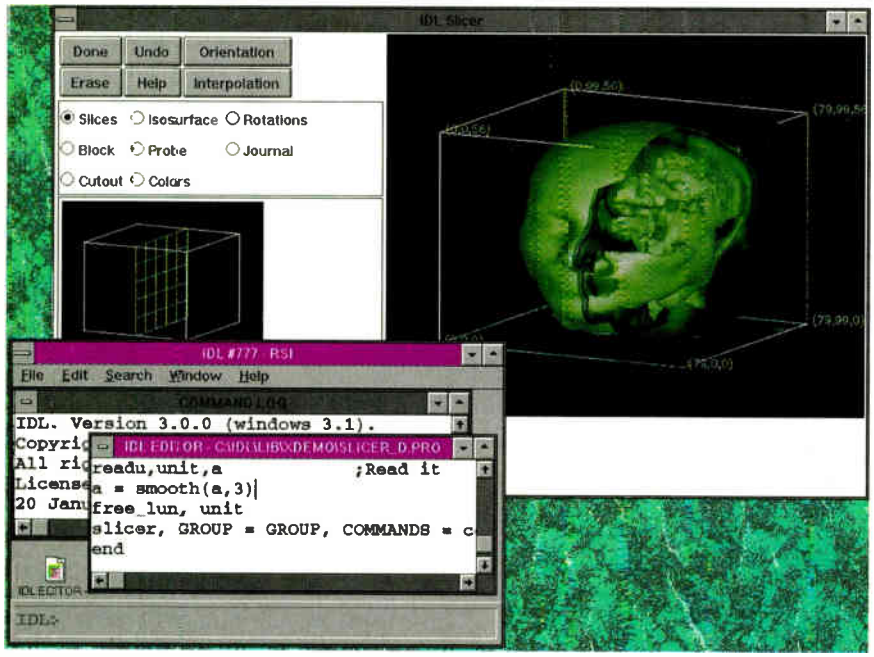
Navigating the Data Flood
BY WILLIAM RIBARSKY
129

Image Building
BY PETER WAYNER
137

The Difficulty with Data
BY NAHUM GERSHON AND JEFF DOZIER
143

Resource Guide: VISUALIZATION SOFTWARE
148

World Radio History



Screen 1: *A sophisticated 3-D visualization produced with IDL (Interactive Data Language) for Windows from Research Systems (Boulder, CO). In this example, the data comes from a magnetic-resonance scanner, but such cutaway 3-D images are used in many areas of engineering and science.*

model the behavior of a physical or abstract system in such a way that you can analyze the response of the system (e.g., Flight Simulator). The results of a simulation are usually numerical rather than graphical and often are fed into a visualization environment to obtain graphical representations in various dimensions.

A simulation must be valid and correct in its own right, but the choice of a visualization technique will vary according to the purpose of the job. Visualization can reveal flaws in a simulation model that were invisible in the numerical output, and it can guide the development of the model as well as the analysis of the results.

Systems You Can Use

A small proportion of the most demanding visualization is performed on dedicated machines, such as the Princeton Engine, developed at the David Sarnoff Research Center (Princeton, NJ). This supercomputer is a scalable parallel machine, with up to 2048 processors, that was designed for fast graphics processing and visualization.

But many users want to do visualization on the machines they have at hand, and they can do so. According to Mike Peery, president of Amtec, 35 percent of his company's customers use PCs. The rest use workstations because that's what they have on their desks.

Whether you use a Mac, a PC, or a workstation, the main requirements for visualization are fast math-processing capabilities and high-quality graphics (see "Image Building" on page 137). To perform most kinds of visualization, all you need is a 25-MHz 386 or 486 PC with VGA graphics or a Mac IIvx. The more powerful the machine, the more sophisticated the visualization application can be. If you plan to add animation, you may want a video output card so that you can dump sequences to videotape.

The Right Software

Choosing the right visualization software is a challenge. You can perform modest data visualization with almost any popular spreadsheet, but spreadsheet charts are usually restricted to 2-D data sets and offer few options.

Statistical programs provide a step up in functionality. Products such as Systat from Systat, Inc. (Evanston, IL), or Statistica from Statsoft (Tulsa, OK) give you a wider range of charting options and make it easier to display 3-D data sets than to do spreadsheets. Beyond this category, you encounter the dedicated visualization packages, which offer access to more specialized techniques.

An example of a specialized technique often used in financial visualization is *heat-mapping*. This procedure produces a surface plot in which you use height and color to represent different variables. For instance, the height of any point on the plot can represent the price of a stock, and a color can represent the age of the data—current information can be red, and more dated values can cool off toward blue (see screen 2). The technique is simple but not readily available outside of dedicated visualization software.

Many aspects of visualization software are changing. One trend is toward graphical interfaces and visual programming (see "Navigating the Data Flood" on page 129). Most high-end visualization products are specialized programming languages, and many are moving to icon-based techniques that make it possible for you to customize the software.

The Application Visualization System from Advanced Visual Systems (Waltham, MA), the Iris Explorer from Silicon Graphics (Mountain View, CA), and the Data Explorer from IBM (Hawthorne, NY) offer visual programming for assembling program modules. Some products, such as PV-Wave from Precision Visuals (Boulder, CO), are available in two formats—a command-language version and a point-and-click version.

At this most advanced level are workstation programs that offer animation, transparency, cross-sectioning, and real-time visualization of multidimensional data sets. But you can carry out some of these techniques on more humble hardware.

Doing animation on PCs is possible, says Robert Simons, president of CoHort Software (Berkeley, CA), but you must compress the data when it's first loaded and use two pages of video RAM. His company's CoVis software performs real-time, animated visualization on a PC. The software draws each frame to the off-screen page and swaps pages.

The price you pay for the real-time action is the loss of options such as logarithmic axes and hidden-line removal. On the other hand, a program such as Mathematica from Wolfram Research (Champaign, IL) creates and stores all the frames in advance. Animations in Mathematica

Visualization Benefits

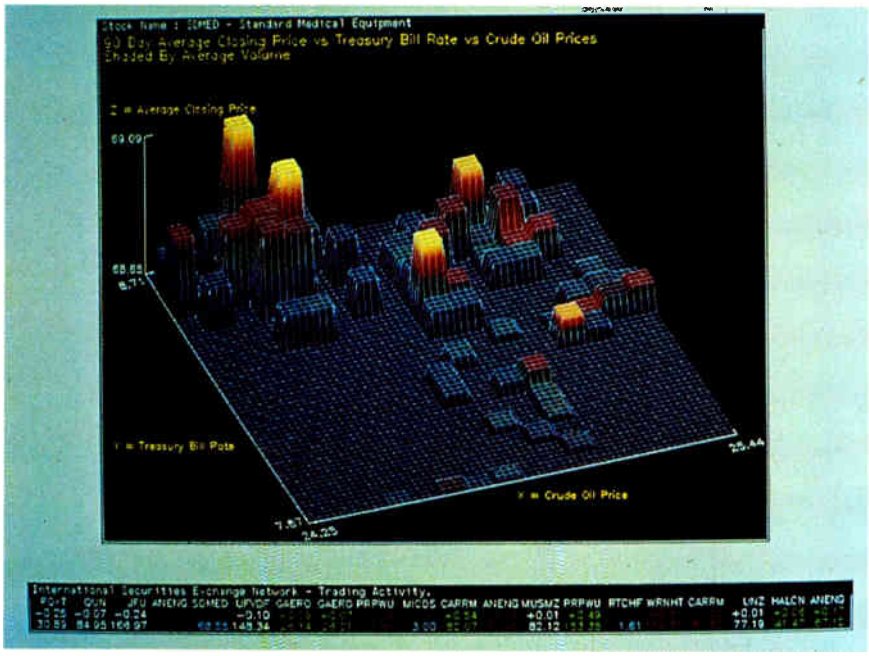
- analyze numerical data graphically
- view data multidimensionally
- comprehend complex information more easily

World Radio History

Verbatim® tapes, optical and floppy disks. Your best defense against data loss.

Circle 148 on Inquiry Card.

World Radio History



Screen 2: *This real-time financial visualization in PV-Wave from Precision Visuals (Boulder, CO) uses heat-mapping. Shown are stock prices represented in a bar graph, with colors overlaid to indicate the age of the data. By using time and color in this way, you can display two additional dimensions of data.*

can take longer to produce (depending on the clock speed of the machine and the amount of RAM that it has), but they impose almost no limits on the visual complexity of the result. For instance, you can fly through your data with full control over virtual lighting on the surfaces using a 386-based PC or a color Macintosh.

Applying the Technology

Two projects being carried out at the Georgia Institute of Technology's Graphics, Visualization, and Usability Center (Atlanta, GA) reveal the potential of visualization technology. John Stasko, an assistant professor of computer science at Georgia Tech, is using visualization to analyze algorithms and programming techniques. "We are trying to use animations to help researchers get a better understanding of very complex algorithms," he says. "These people often deal with large problems, and frequently, to conceptualize, they doodle—they draw pictures to get ideas." For example, Stasko's colleague Walter Rodriguez, an associate professor in the school of civil engineering, is working on the Construction Visualizer, a program to help contractors plan site layouts by visualizing the movements of materials, machines, and trucks as the project develops.

Even in the traditional field of scientific visualization, the range of applications is expanding. Until now, many of the people performing this type of work used the paradigm of a spreadsheet or statistical charting program. But that's not the only way to look at numerical data. The National Research Council (Ottawa, Ontario, Canada) is using data from the flight recorder of a plane that crashed to produce an animated movie of the events that led to the accident. By adding information from radar and eyewitnesses, they can verify whether the witnesses were able to see what they reported in their accounts.

One application that is experiencing rapid growth is medical imaging. Stephen Pizer, a professor of computer science at the University of North Carolina at Chapel Hill, says that the need to interpret data from magnetic-resonance devices and CT (computer tomography) scanners has led to volume-rendering techniques that are used to visualize many types of 3-D data.

Financial visualization provides no physical objects to be modeled. In this field, you must identify abstract data patterns. Spreadsheets can provide numerical, or quantitive, information; however, that is no longer enough. "For me, visualization is there to gather and generate qualitative information," says a New England financial analyst. "I will see something [e.g., a stock market trend], and I'll immediately use the mathematics in Mathematica to analyze it. I can't perform that function with Lotus 1-2-3."

Critical Challenges

A major issue in visualization is determining the most meaningful way of representing data. You can use color, texture, animation, stereoscopy, sound, and touch as part of your visualization toolkit. These elements aren't just gimmicks; they represent dimensions of your data.

One of the biggest hurdles to be faced in visualization is finding enough ways of representing multidimensional data (see the text box "Inside Multidimensional Data" on page 132). Although a simple line graph is drawn in two dimensions, mathematically the data is considered to be unidimensional because it has one independent variable. Similarly, 2-D data needs to be shown in three dimensions. You could plot it as a contour or surface graph using color or perspective to stand in for the third display dimension. Beyond that, you run out of simple graphing tricks. Animation can help; so can slicing the data or using transparency to reveal what lies inside an image. But the choice is much more difficult and subjective than with visualizations with fewer dimensions.

A typical example of 3-D data might be the results of a demographic survey showing how voting behavior across the country relates to age (one dimension for age, and two dimensions for geographical location). But that's hardly a complex example. Many sociological and business-oriented applications are more demanding. Scientists are developing ways of visualizing systems with more than 100 dimensions.

According to Mike Garrity, president of Jaguar Software (Winchester, MA), a company that develops visualization software, it's common to see financial data represented in five or seven dimensions (i.e., different variables). Some financial users are considering 50-dimensional data sets. Coping with such demands is one of the critical challenges facing the field of visualization in the near future.

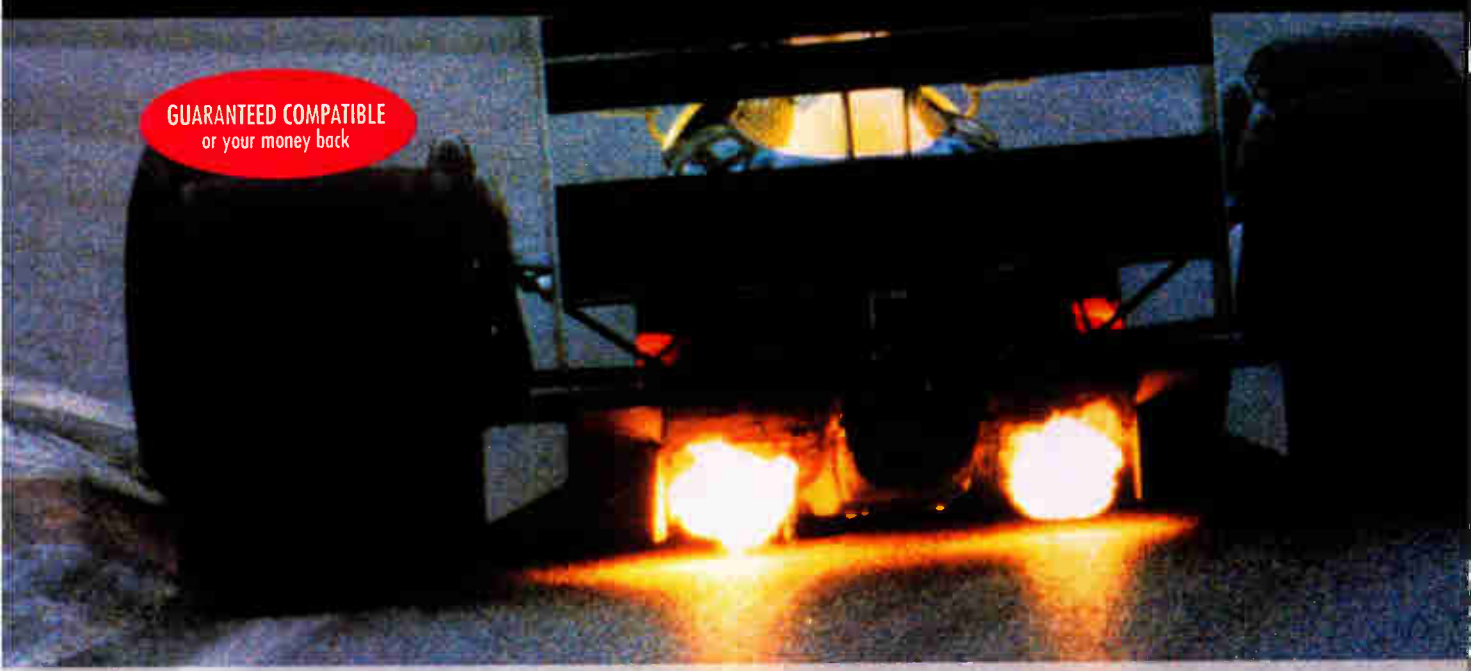
Another hurdle faced in visualization is the need to establish standards (see "The Difficulty with Data" on page 143), which is a consequence of the downward migration of the software from supercomputers to workstations and PCs. Just like spreadsheets, off-the-shelf visualization products need to provide a wide range of import/export options. But unlike spreadsheets, these products have to deal with multidimensional data sets, handle data primitives that can't be represented on a regular grid, and output results in all kinds of graphics and video formats. You can implement these types of visualizations with some of the

World Radio History

There's Sound...

"vroom, vroom"

...And There's SoundMan™.



SoundMan™ 16. Get Real.

SoundMan16 delivers sound so real, 85% of the time people can't tell the difference from live sound. That's because it's packed with the absolute latest in sound board technology: up to 16-bit/44KHz record/playback, Yamaha OPL-3 stereo synthesis 20-voice chip, 100% Sound Blaster™ and Ad Lib® compatibility, and more. SoundMan brings you the highest CD-quality sound available, for all your games and applications, in Windows™ and DOS. From Logitech, the peripherals leader. At your dealer, or call 1-800-732-3021. TM/® Trademarks belong to their respective owners.

LOGITECH
The Senseware™ Company

Circle 97 on Inquiry Card (RESELLERS: 98).

World Radio History

Visualization Applications

MAXINE D. BROWN

Scientific visualization provides researchers with an invaluable tool for scientific insight and understanding. But this tool is more than just a visual representation of data that results from a computation; it's also a visual representation of data during a computation.

Using this methodology, you can distill huge amounts of numeric data into a single image or a series of images over time in animations. This capability is vital to scientific discovery and to the communication of those discoveries.

In recent years, a new generation of scientists and engineers has emerged that relies on the computer as its primary tool for discovery. These scientists and engineers develop mathematical models to simulate the behavior of the physical or theoretical worlds that they study. They work in numerical laboratories, which are environments with graphics workstations that may or may not be networked to supercomputers.

Scientific investigators, technologists, and visualization experts—commonly referred to as interdisciplinary teams—form close collaborations. These result in effective and reusable tools that are shared with scientists and engineers in other research areas.

Scientists have always posed the question "What if?" Today's computational researchers want to drive the discovery process and navigate, or steer, their calculations in near real-time. They want to interact with their data and further explore the many possibilities that their simulation models can forecast. When they change parameters, resolution, or color representation, they want to see the effects.

Shown here are visualizations in three fields: engineering, financial analysis, and science. In each case, you can read about the visualizers' goals and the data that he or she used to create the representations.

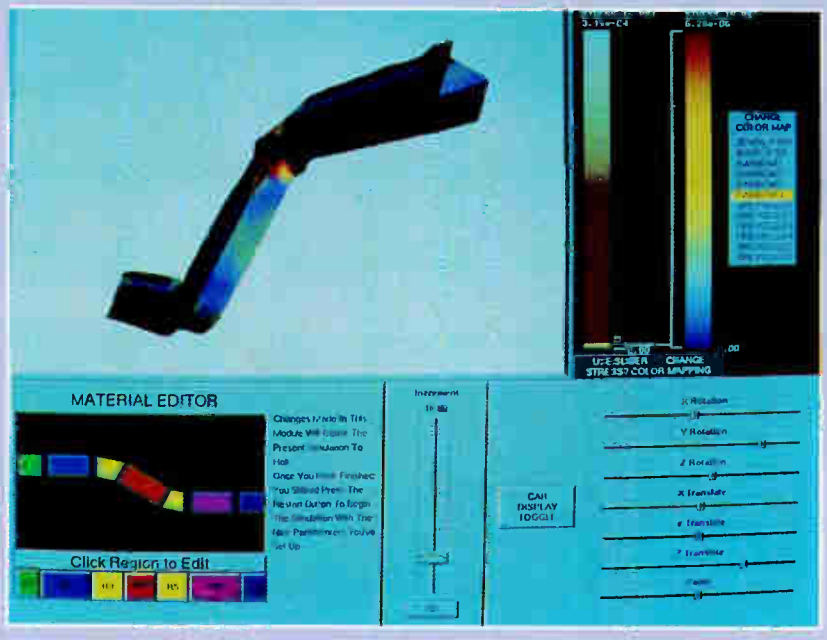
Engineering for Design

Until recently, the availability of commercial software for scientific analysis has been limited. But computer visualization technologists are developing the necessary tools to make the hardware and software more accessible.

Using computers, engineers can investigate the potential of new designs by dynamically altering and tuning simulation parameters. In addition, they can monitor the progress of a simulation and terminate poor design directions. Results of this type of research are paving the way for new, reusable scientific and engineering tools.

In the screen below, an engineer is using scientific visualization to optimize the design of a front-end automobile component from the perspectives of weight, cost, and manufacturability. From a local workstation, the engineer can define the size and material properties of a structure and invoke a crash (i.e., impact) simulation running on a networked supercomputer. The engineer can then visually examine the resulting stress levels and modifications to the structure.

After a simulation has been executed, the engineer sees the resulting stress contour superimposed on the deformed component. Selecting a rainbow color map and a stress (force-per-unit area) range, where regions of high stress are red and regions of low stress are blue, the engineer notes that the bent areas, with high stress and extensive deformation, are critical sections. The engineer can move the structure around to study it from different vantage points or display the component in the context of the entire automobile.



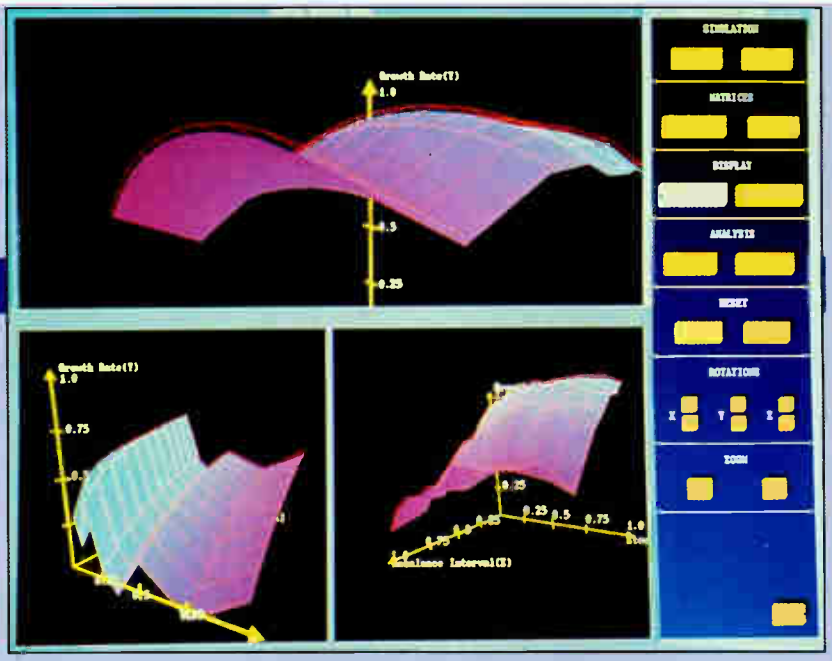
Front-end automobile component *(Screen courtesy of Edward Plaskacz, Steve Karlovsky, and Fred Dech of the Argonne National Laboratory)*

World Radio History

Financial Analysis

A research analyst studying investment strategies can use financial models and visualization techniques to aid his or her analysis. In the portfolio management example in the screen on the right, an analyst investigates trading strategies and examines the resulting changes in the growth rate of a portfolio.

The financial analyst plays a number of what-if scenarios before deciding which strategy will make the most money for the client. In search of the optimal investment strategy, an analyst interactively defines the characteristics of a portfolio—the number of stocks, the percentage of each stock in the portfolio, and the stock prices. In this visualization, the analyst is also defining the investment risk factor (i.e., the volatility), the period of time before rebalancing, and the cost of trading at each portfolio's rebalance.



Portfolio investment analysis *(Screen courtesy of Carolina Cruz-Neira, Andrew Morton, and Stanley Pliska of the Univeristy of Illinois at Chicago)*

This simulation uses the asymptotic growth-rate model. This is a model in which each year's growth rate is random, but over the long run, the average growth rate converges to the theoretical value of the strategy.

The problem becomes more complex as the number of stocks in the portfolio increases. A portfolio with three stocks is a five-dimensional problem, encompassing the value of the portfolio, the length of time of the investment, and the varying investment percentages of each of the three stocks.

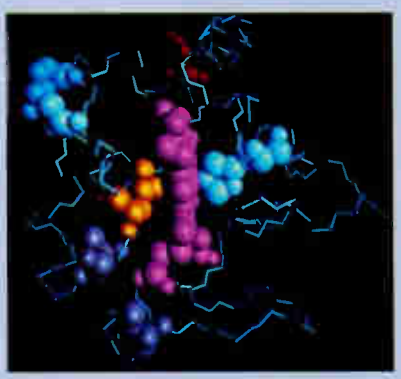
Because a 2-D workstation display can't show a multidimensional chart without cluttering the image, the diagrams are simplified to show the growth rate (the *y* axis) over a period of time (the *z* axis) using one of the stocks as a reference (the *x* axis). In other words, the *x* axis represents different percentages of the investment in a stock, from 0 percent to 100 percent. The surface's color represents volatility: Red means a strategy with high risk, and blue means a strategy with low risk.

Structural Biology

Interactive graphics is an integral part of academic and industrial research on molecular structures and interactions. Scientists are successfully carrying out the process using supercomputers to model complex systems, such as proteins and DNA. The pharmaceutical industry is increasingly using molecular modeling to design modifications to known drugs and to propose new therapeutic agents.

Structural biologists, working with a visualization expert, created the visualization of cytochrome C shown in the screen on the right. Their goal is to better understand the properties and functionality of this protein structure.

The line drawing represents the amino acid backbone structure of the protein. The colors (other than the orange, which represents iron atoms) are used to highlight various properties of the amino acids that compose the protein. Visualization provides structural biologists with greater insights into the mystery of how this protein transfers electrons.



Molecular modeling *(Screen courtesy of Christina Vasilakis and Emanuel Margoliash of the University of Illinois at Chicago and Edwin Westbrook of the Argonne National Laboratory)*

Maxine D. Brown is codirector of the Electronic Visualization Laboratory at the University of Illinois at Chicago. You can contact her on BIX c/o "editors" or on the Internet at maxine@bert.eecs.uic.edu.

World Radio History

software packages now on the market (see the Resource Guide on page 148).

Much confusion has come about because visualization grew out of many fields, each of which brought its own file formats. Meteorology has BUFR (Binary Universal Form for Representation) and GRIB (Gridded Binary Form) files. Remote sensing has ERDAS (Earth Resource Data Analysis System) images. CAD uses IGES (Initial Graphics Exchange Specification) files. And the DICOM (Digital Imaging and Communications in Medicine) format is being developed for medical images. Dozens of other file formats exist—most of which are incompatible with each other.

"The standards are really awful," says Garrity. "The field's not going any further until they start taking on a more permanent form." And what will cause the standards to crystalize when they are in such flux? Garrity's bet—and that of other industry representatives—is on the HDF (Hierarchical Data Format) developed by the National Center for Supercomputer Applications (Champaign, IL). HDF is extensible, available in the public domain, and capable of handling data and images as well as scaling information. The fact remains, however, that if you are an advanced visualization user, you'll probably always be drawn to formats developed for your own needs.

Excitement and Caution

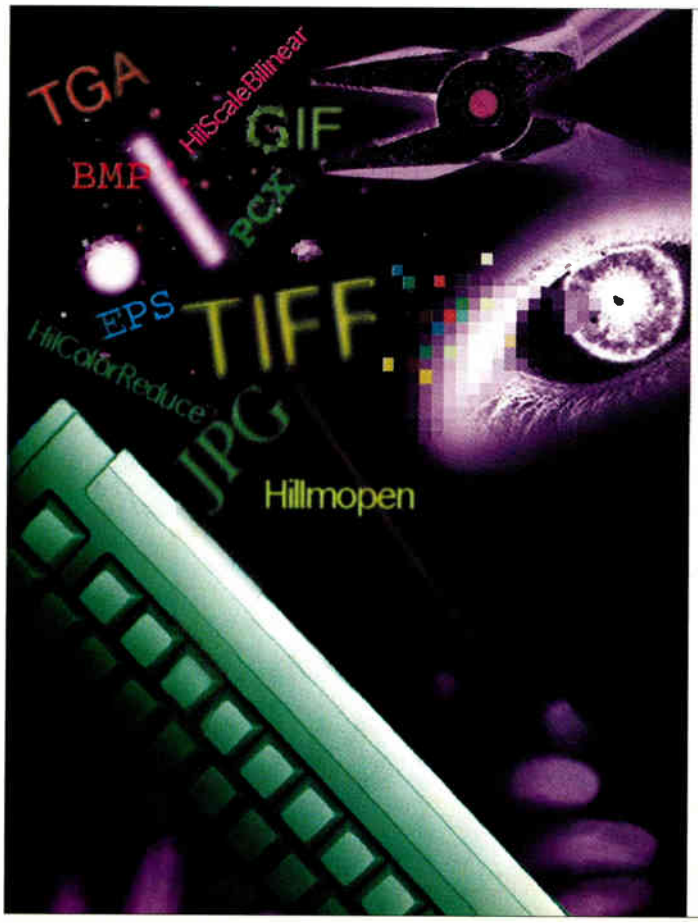
Powerful new desktop computers and workstations are enabling the development of new software products to serve increased demands for visualization. Novel uses for this technology are appearing on a regular basis.

Even the nature of visualization is changing. At the University of North Carolina at Chapel Hill, researchers are adding virtual-reality techniques to visualization to simplify drug design. Using a force-feedback arm, they are able to pick up a molecule visualized on a screen and push it onto a biological receptor. An easy fit implies that the drug can be effective at that site. Physical resistance shows that the shape or distribution of electrical charges would make the drug ineffective at that site.

There is a need for a degree of caution, though. Precisely because it allows you to see the invisible, the capabilities of visualization, with its pizzazz and drama, can also blind you to what it reveals. To watch the dynamic ebb and flow of market forces or to reach out and touch an enzyme molecule is a seductive experience—so seductive that you can easily forget the approximations and interpolations that went into it.

"One of the problems with data exploration and visualization," says Paul Velleman, president of Data Description (Ithaca, NY), a maker of visualization software, "is that these technologies make it easy to find patterns that may or may not be real." Color, shading, sound, and other dimensions that add realism to visualization are equally capable of making the unreal seem more plausible. But used intelligently, visualization can change the way people use computers to analyze and interpret numerical data. ■

Jack Weber is a TV producer working for the BBC, making documentary films and producing the weekly prime-time science-and-technology program Tomorrow's World. *You can contact him on BIX c/o "editors" or on the Internet at jweber@cix.compulink.co.uk.*



HALO IMAGING LIBRARY
GIVES PROGRAMMERS THE
POWER TO WRITE
IMAGING MAGIC.

A sophisticated toolbox for today's program designers who need state-of-the-art imaging technology in their software programs—read, write and convert such popular formats as TIFF, PCX, BMP, GIF and more. Enhance and Transform your images...Pixelize, Posterize, Blend and Sharpen...Save time and money with this powerful, modular library. Produce sophisticated programs using award-winning technology from the industry-recognized leader. Contact Media Cybernetics to learn more about this imaging alchemy...

Call 1-800-992-HALO

MEDIA CYBERNETICS®
The Imaging Experts

Available for—
Windows
OS/2
Macintosh
OPEN LOOK
Motif

8484 Georgia Avenue • Silver Spring, Maryland 20910 • USA
301/495-3305—voice • 301/495-5964—fax

Circle 102 on Inquiry Card.

World Radio History

NAVIGATING THE DATA FLOOD

Create a visual road map to maneuver through your data

WILLIAM RIBARSKY

For 10 years or more, people have been digitizing all types of data, from images to simulations to scientific and engineering observations. And this trend will continue. For example, in six years, NASA's Earth Orbiting System satellites will become functional. As a result, the data on atmospheric chemistry, weather patterns, and ocean currents and temperatures will increase at a rate of 1 trillion bytes per day.

To facilitate easy access to and understanding of this data, a number of software and hardware makers are mapping database management and query strategies onto parallel and distributed architectures. Among these companies are Oracle (Redwood Shores, CA), Sybase (Emeryville, CA), and Kendall Square Research (Waltham, MA).

However, the results of these undertakings will be of little use if your desktop computer is overwhelmed by the sheer volume of the data. According to Barbara Mihalas, a research scientist at NCSA (National Center for Supercomputing Applications, Urbana-Champaign, IL), "We must learn to drink from a fire hose."

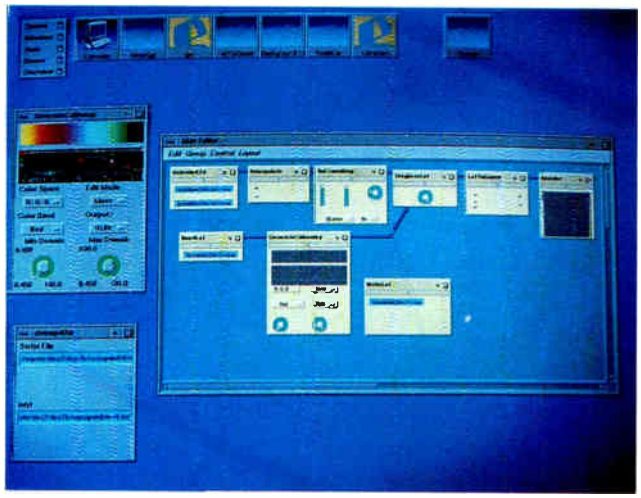
But a flood of data is not the same as the spray from a fire hose. Unlike water, each particle of data is unique and carries with it links to other data. Context is everything, and you must explore and reveal the underlying meaning of the data if you are to understand what you have retrieved.

Interacting with Your Data

There are two main categories of software in visualization technology. To an extent, both methods allow you to display and manipulate data quickly without having to

ILLUSTRATION: LYN BOYER-PENNINGTON © 1993

World Radio History



Screen 1: *The GUI of the Iris Explorer shows the graphical network (i.e., the map editor) and the color-map module menu for an application. Note the interactive buttons and dials on each module.*

perform graphics programming.

The first category is characterized by a point-and-click approach. The interface uses an iconic representation and mode of interaction similar to that found on a Mac, in which you select menu options with a mouse. It includes pull-down, scrollable menus and additional windows.

After a data display appears in the window, you are able to rotate, pick, probe, and animate the material (as a sequence of still images). From the extensive task menus, you can choose visual representation operations, such as probes, annotations, scales and colors, and views of data around a central window.

With this type of software, beginners can often convert, display, and analyze their data within a few hours. In addition, the interface allows you to take full advantage of your workstation's windowing capabilities. Examples of this kind of software include DataVisualizer from Wavefront (Santa Barbara, CA), PV-Wave from Precision Visuals (Boulder, CO), and IDL from Research Systems (Boulder, CO).

The second category of software uses a data flow approach. The tool sets allow you to build your own applications by constructing graphical networks of modules (e.g., modules for data input, filtering, pseudocoloring, and rendering). The links between the modules in the graphical display represent the flow of data through the network. Each module is a program that performs an operation on the data (e.g., filtering or pseudocoloring) and passes the results to the next module (see screen 1). When you execute the visual program underlying the network, the system causes the connection of modules and the exchange of data. AVS from Advanced Visual Systems (Waltham, MA), Iris Explorer from Silicon Graphics (Mountain View, CA), Data Explorer from IBM (Hawthorne, NY), and Khoros from the University of New Mexico (Albuquerque, NM) are a few of the products that fall within this category of software.

The data flow approach incorporates elements of visual programming, which uses graphical symbols to represent program elements. But it lacks important components, such as flow control, a feature that deals with how data travels through your program and branches at certain points.

The power of data flow and similar environments lies in their flexibility, extensibility, and interactivity. Because they use a Unix pipe-and-socket construction, the modules can be distributed across a network of disparate computers, such as Crays and graphics workstations (e.g., Sun's Sparcstation, DEC's DECstation, and Silicon Graphics' Indigo). In addition to using preprogrammed modules, you can program your own modules in FORTRAN, C, or C++ and incorporate them into your data flow environment.

Besides giving you the ability to create new modules whenever you need them, the extensibility of this approach also makes data flow environments movable feasts, with an unending supply of new modules available from expert users. Some organizations, such as the International AVS Center (Research Triangle Park, NC), are already furnishing a mechanism for collecting, organizing, and publicizing the new modules. Finally, these tools allow you to participate at each stage of execution, because each module in a data flow network can have its own control panel, with its own interactive dials, sliders, and widgets.

Data Flow Environments

The real power of data flow environments lies in the concept of building customized applications by focusing on the flow of data through modules that can exchange data with one another. These environments provide a strong, attractive framework on which to hang new interaction or analysis capabilities (by creating new modules), because they retain the rich functionality of all their existing modules.

As a result, data flow environments are becoming the favorite foundation for visualization and usability researchers and third-party applications developers. This attractive development arena offsets the shortcomings of this set of tools.

Among the shortcomings are the lack of a full visual programming language, inefficiencies in the handling of both distributed computing and large amounts of data, and the tendency in more complicated applications for the data flow network to grow bewilderingly complex. One strategy to overcome these problems is to optimize the data flow execution model for large amounts of data and to provide new structures (e.g., hierarchical groupings) for the data flow network.

How will you use these tools to modulate data flow? Researchers are developing methods that will allow you to take data from any source (e.g., observations, simulations, or accumulated databases), automatically transform it into a common data format, and display the data from different sources together (see the text box "Inside Multidimensional Data" on page 132). This satisfies the two most important criteria for finding the correlations and interdependence of data: easy access to data and side-by-side comparison.

Glyphs for 3-D Data

Another important area in visualization is the use of glyphs to portray 3-D data and its interrelationships. *Glyphs* are objects whose attributes (e.g., shape, position, color, size, and orientation) are bound to independent data variables. Examples of simple glyphs are the spheres in molecular structures or dynamics calculations.

The work of Georges Grinstein, Haim Levkowitz, and their colleagues at the University of Lowell (Lowell, MA) provides another example of glyphs. These scientists are mapping data to the angles, lengths, or coloring of simple stick-figure glyphs. Their images of satellite or MRI (magnetic-resonance imaging) data, with pixel values mapped to tens of thousands of glyphs, show the information in the images (e.g., vegetation patterns or tumor structures) as subtle textures or color patterns. If you generalize the glyph concept to include the binding to data of surface structures (and their coloring) and volume elements (and their transparency), you have encompassed most of today's visualizations.

continued

World Radio History

Pacific DirectNet. It teaches your LaserJet® to look both ways.

Until now, most network interface cards for the LaserJet could only look in one direction. And over time, that restriction proved to be inefficient and costly.

Now there's Pacific DirectNet™ from Pacific Data Products. With it, your LaserJet printer can work on Novell® alone. Or Novell and TCP/IP together.

Even if you currently run only one type of network, it's likely it won't stay that way. In fact, experts say that most networked organizations will eventually run both Novell and TCP/IP networking software.

To accomodate this, Pacific DirectNet contains flash memory which allows it to be upgraded by the user. If your card initially supports only Novell, it can be easily upgraded to support both Novell and TCP/IP, as well as future network operating systems. With this capability, your investment in Pacific DirectNet is fully protected.

And, Pacific DirectNet lets you locate a printer anywhere on your Novell or TCP/IP LAN. That means the printer will be located where it's needed. Not where the file server happens to be. All you have to do is choose the most convenient location, then get ready for fast, low cost access to a high performance network printer.

FEATURES INCLUDE:

- Compatibility with Novell NetWare® 2.2 and 3.11, as well as all Sun®, HP®, and other UNIX® networks which support TCP/IP network protocols and LPR/LPD, TFTP, FTP, and RSH printing prototcols
- Simultaneous support for multiple Novell print server, remote printer, and UNIX print connections
- Easy-to-use — includes Novell-like configuration software. No host software required for UNIX
- Contains 512KB of base memory — user upgradeable to 4 MB for optimum performance in complex network environments
- Versions available for LaserJet III, IIID, 4, PaintJet® XL300, and DesignJet® plotters
- Pacific Data Products' well known customer service — Lifetime warranty, 60-day money back guarantee of satisfaction, and unlimited technical support
- Novell version available for $599 list price. Novell and TCP/IP for only $799!

If you'd like to teach your LaserJet to look both ways with Pacific DirectNet, call Pacific Data Products at (619) 625-3608, Fax (619) 552-0889.

PACIFIC DATA PRODUCTS

Pacific Data Products, Inc., 9125 Rehco Rd., San Diego, CA 92121. In Europe, call (353) 61 475609. Pacific DirectNet is a trademark of Pacific Data Products, Inc. HP, LaserJet, PaintJet, and DesignJet are registered trademarks of Hewlett-Packard Co. Novell and NetWare are registered trademarks of Novell. Unix is registered trademark of Unix System Laboratories, Inc. Sun is a trademark of Sun Microsystems, Inc. IBM and AIX are trademarks of International Business Machines Corp. Ethernet is a trademark of Xerox Corp. All other brands and product names are trademarks or registered trademarks of their respective manufacturer. © 1993 Pacific Data Products, Inc.

World Radio History

Inside Multidimensional Data

LLOYD A. TREINISH

Visualization implies creating a pictorial form for data. The geometry composing such a picture, like your data, can be classified by its dimensionality. To visualize data appropriately, you must understand its characteristics. To grasp the nature of data, consider its five key attributes: dimensionality, parameters, rank, mesh structure, and aggregation.

Data is a function of independent variables, or dimensions (e.g., space, time, and energy). Some complex data can have five or more dimensions. A parameter is the data (or function) itself or dependent variables and can have more than one value (or rank). Rank 0 is a scalar (i.e., it has one value), and rank 1 is a vector (i.e., it has three values in three dimensions). Some complex data can be rank 2 or greater.

Often there is an association between the dimensionality of data and its geometry, which is called a mesh, or a grid. This association describes the relationship of the size, shape, and organization of the data to the physical coordinate structure (see the figure).

DIMENSIONALITY OF VISUALIZATION GEOMETRY

Table A: *The dimensions of typical geometries used to compose visualization images.*

Dimension	Geometry
0	Point
1	Line
2	Polygon
3	Volume

Collections of data can be aggregated. For example, weather data might consist of temperature, rainfall, and barometric pressure measurements. A time series can be composed of a decade of monthly sales figures. And a hierarchy can embody the structural organization describing the parts of an airframe.

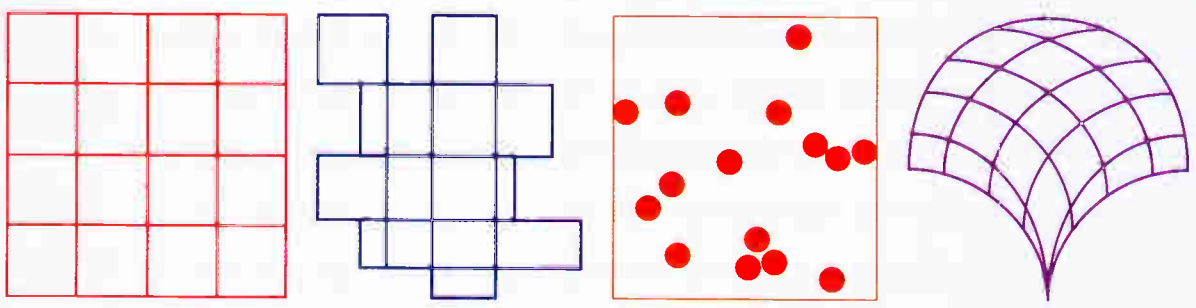
Multidimensional Techniques

Table A lists several visualization geometries with their dimensionality. Table B shows a number of visualization techniques (categorized by dimensionality and rank) that you can use with multidimensional data. For example, time is a data dimension that can be mapped into a visual dimension. Similarly, you can treat animation as a visual dimension for sequencing other techniques.

You can combine these techniques to represent multiple parameters. It's possible, for instance, to embed a lower dimension in a higher dimension, such as inserting a line, plane, or surface in a volume. The dimensionality of a visual representation can be different from that of the data (see screens A and B).

The size and complexity of data are growing faster than the speed at which desktop systems are increasing in power. From a hardware perspective, the problem is not how much raw floating-point speed and bulk storage you have but whether your system can achieve efficient processor utilization and rapid access to the data. From a software perspective, the problem is not rendering an

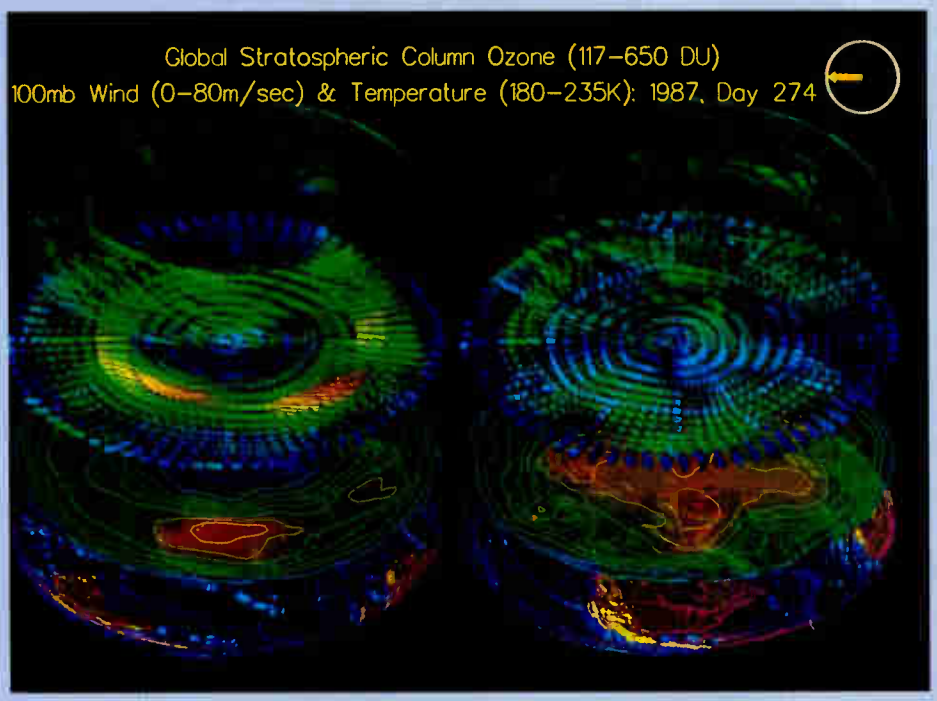
EXAMPLES OF 2-D MESH STRUCTURES



a) Regular grid b) Irregular grid c) Ungridded d) Deformed regular (structured grid)

These mesh structures portray relationships between the dimensionality of data and its geometry: **(a)** *a regular grid, such as a temperature map;* **(b)** *an irregular grid, such as several satellite images with gaps in coverage;* **(c)** *ungridded (scattered points), such as sales figures or rainfall in specific towns; and* **(d)** *a deformed (curvilinear) grid, such as the pressure on an airframe. The data can have one or more variables dependent on the dimensions.*

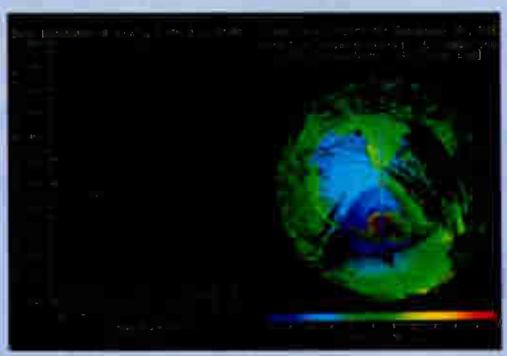
World Radio History



Screen A: *The relationship between ozone depletion and atmospheric dynamics on October 1, 1987. The images are produced from five 2-D data parameters and two sets of 2- and 3-D objects. On the left is the southern hemisphere, and on the right is the northern hemisphere. In each stack, from top to bottom, you see a colored surface indicating ozone density, arrows showing wind velocity colored by speed, a colored disk with contour lines reflecting temperature, magenta lines representing coastlines and national boundaries, and a surface map delineating the topography. (Copyright 1992 IBM. All rights reserved. Data courtesy of NASA/GSFC-NSSDC)*

image. It's selecting strategies to create effective visualization and storage structures for data of varying dimensionality, parameters, rank, mesh structure, and aggregation.

Lloyd A. Treinish is a member of the research staff of the Visualization Systems Group at IBM's Thomas J. Watson Research Center in Yorktown Heights, New York. You can reach him on BIX c/o "editors" or on the Internet at lloydt@watson.ibm.com.



Screen B: *A 1- and 3-D representation of a 2-D parameter—column ozone density. On the left is a line plot of ozone versus latitude at a specific longitude. On the right, the ozone is shown as a translucent surface covering a globe. (Copyright 1992 IBM. All rights reserved. Data courtesy of NASA/GSFC-NSSDC)*

DIMENSIONALITY OF SAMPLE DATA AND VISUALIZATION TECHNIQUES

Table B: *Shown here is a sampling of visualization techniques appropriate for data of different dimensionality and ranks. This table illustrates the diversity of data and some ways it can be visualized.*

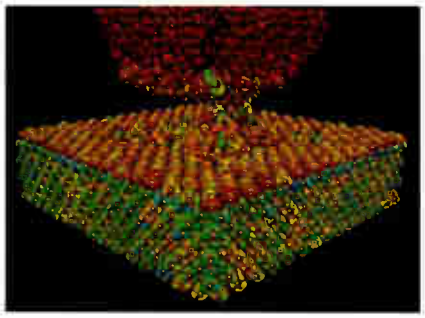
Dimension/rank	Example of data	Discrete technique	Continuous technique
0/0	Sales	Histogram	
1/0	Sales history	2-D scatter plot	2-D line plot
2/0	Ground temperature	Multiple *x-y* plots	Isocontours
	Medical image	3-D scatter plot Colored 2-D scatter plot	Pseudocolor image Surface/height map
2/1	Ocean surface currents	Arrows	Streamlines
3/0	Atmospheric temperature	Colored 3-D scatter plot	Volume rendering
	Stacked medical images	Isosurfaces	
3/1	Atmospheric wind	Arrows	Streamlines

World Radio History

Glyphs are a powerful medium for distinguishing and comparing several variables at once. They take advantage of your eye's ability to perceive small differences in shape or position and to discern properties such as color and shape. As a result, you have at your command several attributes (the most quantitative being spatial position) that you can bind to variables while still being able to see each of the attributes separately. This capability is necessary for the quantitative comparison and correlative analysis of data.

Glyphs also fit naturally into the landscape of 3-D displays and virtual environments. In such interactive environments, using glyphs allows you to perceive patterns of clustering and details of spatial arrangement in all three dimensions.

To find the limits in the number of variables and the amount of spatial complexity that a multidimensional representation can handle, my colleagues and I have studied the simultaneous binding of several variables in applications such as complex molecular-dynamics structures. Because these calculations are molecular-dynamics simulations, you can designate another dimension—time—via an animation.



Screen 2: *Simulation of a nickel atomic-force microscope tip pulling up a gold surface, where shape distortions and coloring of spheres indicate components of atomic stress. (Screen courtesy of Robert Minsk and William Ribarsky, taken from supercomputer calculations by David Luedtke and Uzi Landman)*

Visual representations like these are successful in pinpointing the relation between stresses and dynamic behavior. Such a method is general and can be applied to many types of data whose performance can be affected by several variables (e.g., stocks and bonds).

For example, stress buildup can eventually lead to inelastic deformations, flow, and fracture in these systems. Therefore, you have complex structural information, atom types, and six components of a tensor field all depicted in the same image (see screen 2).

If the visualization program you have won't accept and display data in a suitable manner, however, you must address issues in the areas of graphics programming and conversion of data to appropriate geometries. Researchers in visualization and usability are making significant strides in these areas. They are building tools for the data flow environment that allow you to create your own glyphs in a 3-D editor and bind them to your data any way you want. The objective of this work is to develop a highly interactive environment that doesn't need programming.

The interactivity and ease of glyph construction make it possible for you to play what-if testing and compare combinations of variables and visual representations for different data ranges. With this capability, you can recognize and analyze the different characteristics of your multidimensional data.

11x17

FitCenter News

A Monthly

Jim Watts' regular workouts helped prevent permanent heart damage.

FitCenter Profile:

Jim Watts—from walking "time bomb" to running inspiration.

Exercise P

ANNUAL DEATHS FROM HEART DISEASE

Japan Germany U.S.

900,000
800,000
700,000
600,000
500,000
400,000
300,000

FitCenter News

DON'T FORGET! May 15th is National Employee Health and Fitness Day. Come celebrate at FitCenter East or FitCenter West.

$6995

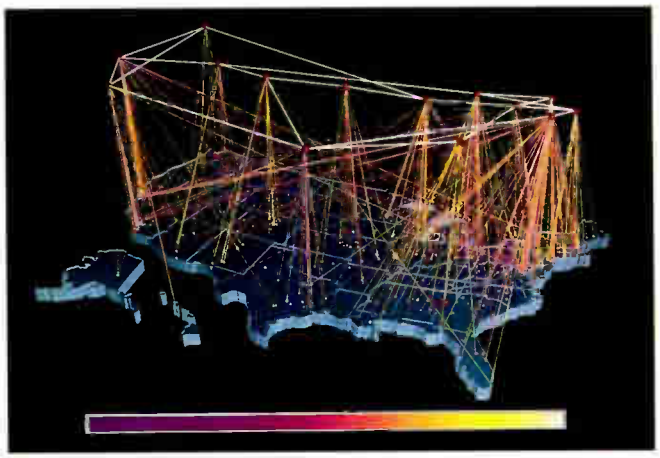
2400 dpi

World Radio History

Research to the Rescue

Interdisciplinary efforts are under way to make the navigation of data easier and more efficient. They are taking place in sites such as the Graphics, Visualization, and Usability Center at the Georgia Institute of Technology (Atlanta, GA); Xerox PARC (Palo Alto Research Center, Palo Alto, CA); and the Institute for Visualization and Perception Research at the University of Lowell (Lowell, MA).

Researchers at Xerox PARC and other institutions are developing 3-D visualizers of information structures (see "The Information Theater," November 1992 BYTE). And in many research centers, work on visualizing scientific multidimensional data has much wider implications. For example, the efforts at NCSA and other national supercomputer centers focus on accurate, interactive display and analysis of large data sets derived from supercomputer calculations. The results of these calculations include representations of complex molecular structures, unsteady air flows around aircraft, and loads on bridges. The Environmental Protection Agency is also beginning to visualize the effects that result from its air-quality models.



Screen 3: *The interconnected backbone networks and selected regional networks collectively called the Internet. This representation correlates node connectivity with geographical location. (Screen courtesy of Donna Cox and NSCA)*

With the growing complexity of information stores (e.g., the Internet), symbolic representation must become 3-D to show their full character (see screen 3). To understand the interdependence of the Internet's parts so that you can formulate plans and carry out troubleshooting, you must be able to interactively navigate the network and open windows to reveal deeper levels of its hierarchy. As you can see from this example, the need to find new ways to perform interactive analysis is growing in an expanding number of areas. ■

William Ribarsky works at the Georgia Institute of Technology (Atlanta, GA). He is the manager of the Scientific Visualization Laboratory and an associate director for service at the Graphics, Visualization, and Usability Center. You can reach him on BIX c/o "editors" or on the Internet at bill.ribarsky@oit.gatech.edu.

NO OTHER PRINTER MEASURES UP.

Introducing the Image Xpert™ 5000. Windows™ output that's bigger and a whole lot better.

No other laser printer even comes close to matching XLI's Image Xpert 5000 for quality, performance—*or price*. It delivers superb PostScript™ font quality of 1200 × 1200 dpi, amazingly detailed halftones at 2400 dpi equivalents with 256 gray levels, all in an 11" × 17" format. That means you can easily produce side-by-side page masters or full-bleed single pages with crop marks, all with incredible resolution produced by XLI's acclaimed SUPER LGA™ technology.

The Image Xpert 5000 is ideal for tab newspaper masters, newsletter spreads, oversized technical/scientific documents—any application requiring detailed text with photos.

Call today for the complete picture on how the Image Xpert 5000 can give your big jobs a whole new look. 1-800-433-8040

XLi CORPORATION

XLI Corp., 800 West Cummings Park Suite 6650, Woburn, MA 01801.

Circle 163 on Inquiry Card (RESELLERS: 164).

Image Xpert, SUPER LGA are trademarks of XLI Corporation. Windows is a trademark of Microsoft Corporation. PostScript is a registered trademark of Adobe Corporation.

World Radio History

Now Even Bad Reports Can Look Good.

New CA-RET™ 1.0: The Friendliest, Most Powerful Report Writer Ever.

Add bitmapped images anywhere in your report for graphic impact.

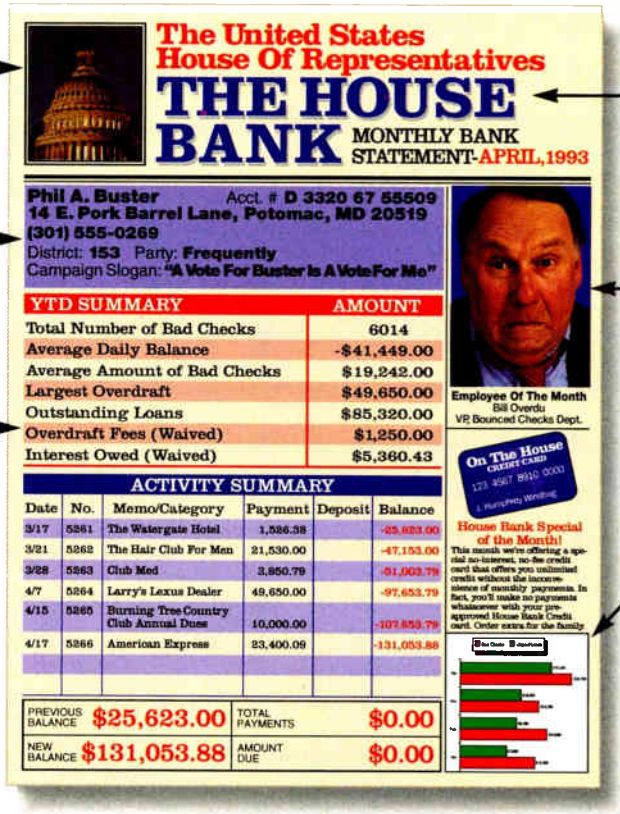
Create exciting output from your CA-Clipper, dBASE and text files.

Dozens of built-in number-crunching functions are available for powerful data analysis.

Using different fonts adds pizzazz to your reports. CA-RET makes it a snap.

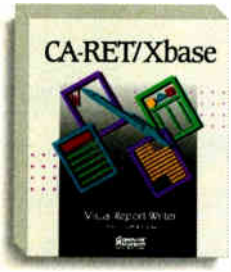
The allure of color: You get it in an easy, WYSIWYG environment.

You can even turn your data into eye-catching graphs.



Whatever the news, make it look great with new CA-RET/Xbase, the visual report writer for Windows.

With drag and drop, WYSIWYG design, it's as easy to use as a word processor, yet powerful enough to produce stunning results. Choose a wide variety of pre-formatted tabular layouts, labels and form letters – or create your own. Now you can add dazzling color, fonts and bitmaps to any report.



Place database fields, computed fields and aggregate computations anywhere and use the more than 40 built-in functions for extensive analysis.

And CA-RET's single-pass computation engine is the most efficient available.

From dBASE to Clipper, CA-RET/Xbase works with top databases (or text files) and acts as a DDE server so you can include reports in other Windows applications. And the unlimited use runtime license lets you distribute report applications for free.

MICROSOFT WINDOWS COMPATIBLE

SPECIAL OFFER FOR R&R USERS.

Registered users of R&R Report Writer for Xbase can upgrade to CA-RET for just $79 ($89 in Canada). To order, just call 1-800-531-5236 (in Canada: 1-800-665-5449).

Call today and find out how easy it is to turn the mundane into the magnificent.

COMPUTER ASSOCIATES®
Software superior by design.

© Computer Associates International, Inc., One Computer Associates Plaza, Islandia, NY 11788-7000.
All product names referenced herein are trademarks of their respective companies.

Circle 216 on Inquiry Card.

World Radio History

IMAGE BUILDING

Architecture determines visualization software's power and flexibility

PETER WAYNER

Computers can now create complex graphical systems that allow you to examine data in ways that never existed before. The power and flexibility of a visualization system depend on the software architecture that designers develop.

There are two types of visualization software architecture. One is an object-oriented environment, which you program in a straightforward procedural manner. The other is a WYSIWYG environment, which allows you to handle data directly and see the results of your work at each step of the process. Both approaches have advantages and trade-offs, and there are many similarities between the two.

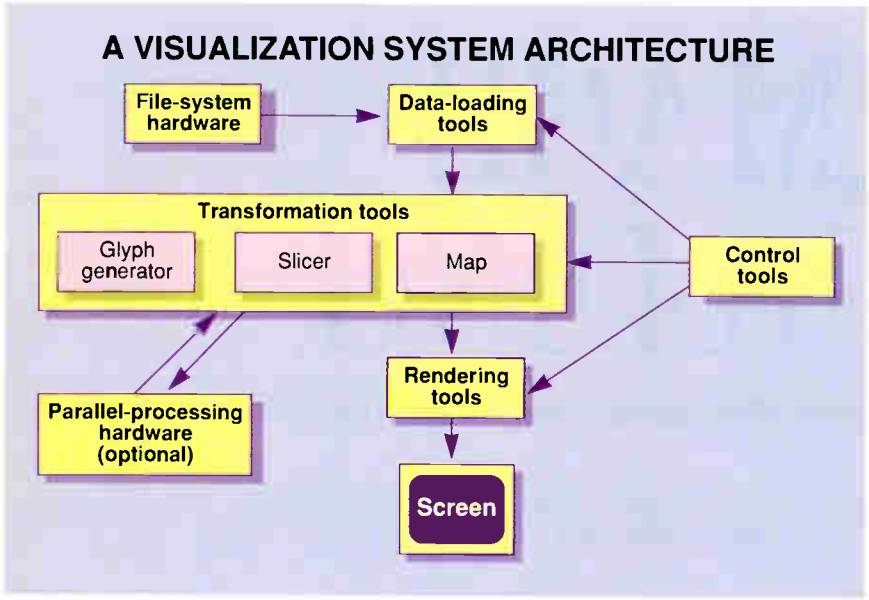
A Common Tool Set

Whatever the architecture, basic visualization software has four types of tools, or routines, that you link to produce an image. These include tools for loading, transforming, rendering, and controlling data (see the figure). Loading tools read data in from a file and construct an internal structure to hold the data. Transformation tools operate on data and refine it. Some transformations can be as simple as smoothing the data by averaging neighboring values; others (e.g., finding contour lines connecting equal-valued points) might create new data sets. Rendering tools use sophisticated hidden-line and rendering algorithms to convert information to pictures. And with control tools, you can modify the actions of the other tools.

When data is loaded, the software must format the values into an internal structure that is robust enough to describe all possible forms that the data can take as it passes through the different tools. Each

ILLUSTRATION: LYN BOYER-PENNINGTON © 1993

World Radio History



Tools in a system such as this are implemented in software and can use as much hardware as is available. Transformation tools make up the core of the software and do much of the work.

tool knows the structure and reads and writes data into it. This process allows you to connect the tools in arbitrary chains without having to be concerned about whether the tools know how to exchange data—they all read and write the same language.

In some cases, software architects find it easy to let the transformation tool act on all forms of data. A transformation tool that rotates data, for example, works similarly on 1-, 2-, and 3-D data objects. In other cases, though, the architect has to think in more abstract terms.

For instance, a transformation tool that finds contour lines works well in a 2-D image, but the idea does not generalize well to a 3-D image because the outermost contour line is really a 2-D surface that obscures all the interior ones. In such situations, most contour-generating transformation tools produce only one 2-D surface when presented with 3-D data.

The internal data structure allows transformation tools to be flexible. These tools can produce new views of data based on the type of input they receive as long as they output the views in the standard format of the internal data structure.

One such tool might take data representing a 3-D array of the wind and temperature in a region, find the lowest windchill, and output a new data structure consisting of one point marking this location. Another transformation tool might take the same data and construct a set of lines that represents the isothermal contour lines. Both the point and the contour lines are new data sets that other tools can transform farther down the chain.

The large number and diversity of transformation tools are good measures of the power of visualization software. Among the most common transformation tools are map tools, which match up two sets of data and interpolate the results if the sets don't line up exactly, and color tools, which add a layer of color to the data based on a range of values. Other typical tools include arithmetic tools, which perform most of the basic operations on data; glyph generators, which create vectors, flags, and icons at locations scaled to the values in the data; and slice tools, which pull out 2-D slices of data from 3-D data sets.

A rendering tool draws and combines all the data sets presented to it. It can create a weather map by combining the temperature contour lines and the minimum windchill point that the previously described tools produced. Using graphic routines, the rendering tool should allow you to modify variables such as the position from which the data is viewed or the faux lighting used to illuminate the data.

Those who work with visualization usually want to modify images and look at the data in different ways. The simplest control tools inform the rendering tool of any changes in the positions of the images so that you can perform this image manipulation. Other tools send messages back to data-transformation tools to modify their transformations. One control tool might send a value n back to the coldest windchill finder, instructing it to find the coldest n points in the country. Another might send a message to the contour function modifying the interval between the lines.

These four types of tools handle the basic tasks that visualization software must carry out. The way that the architect implemented some of the basic functions may not be obvious.

For instance, many images include axes with tick marks that indicate the scale of a picture. The rendering tool might draw axes, or a transformation tool might create them as a separate data set, in much the same way that the coldest point was found and marked. In this situation, the rendering tool would combine the image data with the new axes' data.

In most cases, both of these techniques are probably just as useful, but the second method is more flexible. If the axes are just another data set, the other transformation tools can be used to color, bend, or transform the axes as they would with regular data.

Software architects must anticipate all these issues when they design tool sets and distribute the various tasks among the individual tools. If they aggregate too much functionality in one tool, you will not be able to link the tools in certain ways. But if the architects split the functionality too much, they create software with thousands of tools that no one can remember.

Many implementations of visualization software are designed to be readily portable to different machines with different configurations of processors. This allows you to run a visualization routine on more than one platform without recompiling it. Some software architects take this flexibility one step further and allow the software to split up the computation tasks necessary to create an image. If a parallel processor is available, the system is able to divide each tool's responsibilities into a number of parts so that you can quickly perform the visualization.

continued

Visualization Architectures

Object-Oriented

- ease of use
- consistent internal data structure
- visually programmed

WYSIWYG

- see changes as they occur
- high data contact

World Radio History

The Worlds First Universal File Editor

Edit Any Text/Data/Binary File Up To 2 Gigabytes

- ❑ Unique multi-mode, multi-file editor handles any text, data or binary file.
- ❑ Edit DOS, Unix and Mac text files, fixed and variable length data records.
- ❑ Edit in ASCII, Hexadecimal or EBCDIC, or combination of modes.
- ❑ Edit database, mainframe, Postscript, .EXE and other non-standard files.
- ❑ Hyper-browse CD-ROM files.
- ❑ Full featured program editor.
- ❑ Convenient word processing.
- ❑ Also VEDIT for only $89.

Until now, data files, such as database files, downloaded mainframe files, Postscript and plotter output, .EXE executables and other non-standard files were a real headache if you ever had to view, patch, search, search/replace or extensively edit them.

Traditional text editors can't handle these files because they are non-standard or too big. Traditional disk utilities allow only the most primitive viewing and patching. Just a single corrupted data file could take days to fix, and you sweated and cursed the whole time.

A new way to handle data files

VEDIT lets you edit data files as effortlessly as text files. Its secret is incredible speed, huge file capacity and special editing modes.

File modes support DOS, Unix and Mac style text files plus data files with fixed length or variable length records. Display modes include five ASCII modes, Hexadecimal and EBCDIC, or split the screen for any combination. Search using pattern matching or regular expressions, cut and paste data files, and much more. Long lines can be horizontally scrolled or wrapped onto multiple screen lines.

Handle nasty "text" files too

Text files may sound easy to edit, but other editors choke when they hit embedded control (null) characters, very long lines or the 400 Megabyte file you are trying to put onto a CD-ROM. VEDIT handles all text files effortlessly and automatically detects the correct file type. With VEDIT you can conveniently edit any file you will ever encounter.

Speed, speed, speed

Only VEDIT has the speed to edit multi-megabyte files. Traditional text editors such as Brief(tm) and Sage(tm) are much too slow to edit files much larger than memory; and Multi-Edit(tm) is 7 times slower than VEDIT. And none of them can efficiently edit data files.

	VEDIT	Brief	Multi-Edit	Sage
Edit data/binary files	Yes	No	Some	Some
Support fixed-length records	Yes	No	No	No
Maximum line length	Unlimited	512	2048	65K
Maximum file size	2000 Meg	32 Meg	32 Meg	100 Meg
Hex/EBCDIC editing	Yes/Yes	No/No	No/No	No/No
Multiple display modes	Yes	No	No	No
Fast browse of CD-ROM	Yes	No	No	No
Global search/replace in 10 Meg file	2:49 min	>24hours	20.0 min	2:10 hour

Ultimate programmer's editor

Long a favorite among programmers, VEDIT has every advanced feature you might expect. Simultaneously edit numerous files, split the screen into windows, search/replace with regular expressions. Automatic indent, block indent, parentheses matching and block operations by character, line, file or column speed program development. Word wrap, paragraph formatting, justification, centering and many printing options are ideal for text processing.

Its unique compiler support integrates tools from different vendors and fully supports "make". VEDIT PLUS has the most powerful macro programming language of any editor. It's ideal for translating files from one format to another.

Easy to learn, easy to use

An intuitive user interface with drop down menus, hot keys, mouse support, optional scroll bars, context sensitive help, point and shoot file selection and unlimited keystroke macros make VEDIT PLUS easy to use, easy to learn. Safety features include 1000 level undo, auto-save and optional backup files.

The entire keyboard layout and everything in VEDIT is configurable with easy to use menus. With over 100 configuration parameters you can fine-tune VEDIT to your exact needs and preferences.

Installation is trivial. Only the 85K VEDIT.EXE is required (no overlays) and a full installation is only 500K.

DOS **UNIX** **QNX**

FREE Fully Functional Demo! Call 1-800-45-VEDIT

Confidently order your VEDIT PLUS today; it comes with a 30 day money-back guarantee. VEDIT has been the choice of 100,000 programmers, writers and engineers since 1980.

VEDIT PLUS - DOS single user license: $185; DOS network 5 user license: $385; UNIX/XENIX, QNX, FlexOS/IBM 4680: $285.

A new, fully functional demo of VEDIT PLUS and a shareware VEDIT Jr. are available on our BBS at (313) 996-1304.

Toll Free: 1-800-45-VEDIT (1-800-458-3348)
Telephone: (313) 996-1300, Fax: (313) 996-1308
Mail: P.O. Box 1586, Ann Arbor, MI 48103

Greenview Data

VEDIT is a registered trademark of Greenview Data, Inc. All other product names are trademarks or registered trademarks of their respective holders.

VEDIT PLUS - Universal File Editor

Big Blue and Indigo Sky

The IBM Data Explorer is a good example of full-featured, tool-oriented software. The application runs on several platforms—from low-end IBM RISC System/6000 workstations to specialized IBM power visualization computers that feature 32 860 chips and fast 256-bit buses.

Software running on the high-end computer can take advantage of its extra processors and break down the work of each tool into multiple sections. But software running on the low-end machine must use its sole processor to perform all the work. Speed is the only difference that you would notice in the performance of programs running on these machines. The algorithms are easy to express in parallel form, and often a machine with n processors performs n times faster.

The Iris Explorer 2.0 is an object-oriented, tool-based architecture that Silicon Graphics (Mountain View, CA) ships with its workstations, including its Indigo and Personal Iris. The Iris series can include up to eight processors, and on this platform, the Explorer configures itself to use the maximum amount of power available.

Both the IBM and Silicon Graphics software packages allow you to use a visual program editor to create a program for converting data into images. In this editor, one window has boxes that represent the tools, and the lines between them represent the data flow. With this kind of editor, you can easily create images from data, because it allows you to choose the tools that you need and connect them in a proper chain. If you want to add more sophisticated features, you can use the appropriate tools and draw more lines.

A second window includes the control tools, which have input fields, sliders, and other input interfaces that allow you to control an image on the screen by sending messages to the transformation tools that dictate the parameters. For example, a control tool might send messages to a slice tranformation tool telling it on which plane to slice the data. Another control tool might manipulate the contour-finding selection.

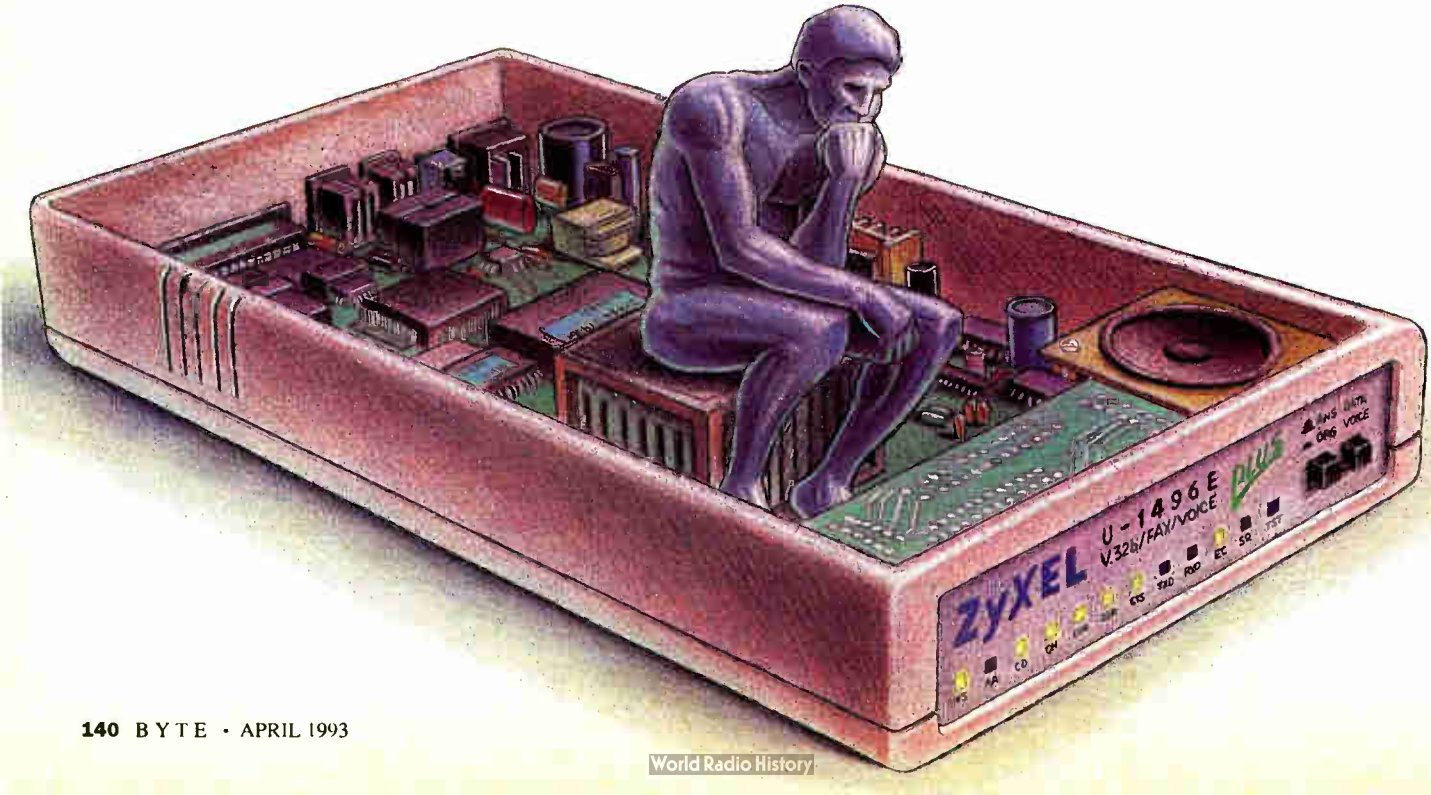
Creating an image from data with an object-oriented tool is similar to programming in a standard language. The format is easy to use because the steps of the process are laid out with boxes and lines instead of in a text file with procedure headers. A consistent internal data structure adds to the simplicity of the process because you can connect any tool to any other.

An example of this process can be seen on the screen, which shows a CT (computer tomography) image of a tooth and the program that created it. First, the CT scanner creates a 3-D matrix filled with the density of the tooth at the grid points. Next, a color-map tool changes these densities into colors (yellow for the boundary, red at the crown, and blue at the root). Then a slice tool cuts away half of the tooth so that you can see the interior densities. This kind of view is useful to dentists because the 3-D information can be much more revealing than a 2-D x-ray. The Iris Explorer created this image, which shows how several simple, abstract tools can be joined to produce rich images.

WYSIWYG for Free

NIH Image software for the Mac implements the four sets of tools differently. It was written by Wayne Rasband of the National Institutes of Health (Bethesda, MD) to provide scientists with a free and easy method of manipulating and analyzing 2-D images. It is similar in structure to products like Dicer from Spyglass (Champaign, IL)

WHY OUR INTELLIGENT MODEMS ARE A WISE INVESTMENT.

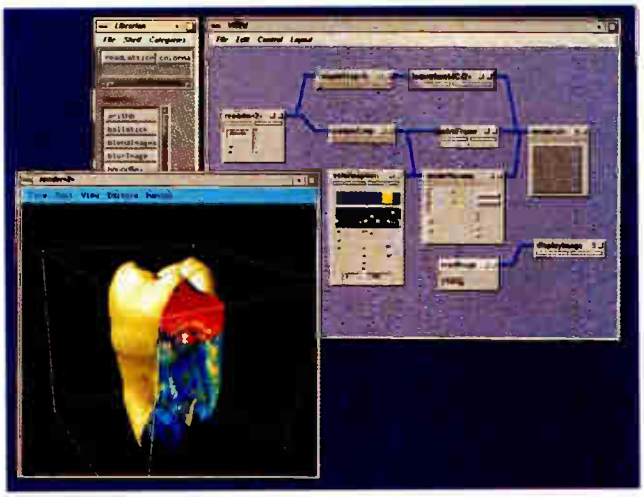


World Radio History

or several tools produced at the National Center for Supercomputing Applications (Urbana-Champaign, IL).

The architecture of the NIH Image software is built in the spirit of Mac-based WYSIWYG word processors. You see the data at all times, and changes appear on the screen as each operation modifies the data. You don't build a program or a chain of tools; you execute a set of commands. The main advantage of this approach is high data interaction. You constantly see the intermediate views of your data and can discover other facets along the way.

Object-oriented, tool-based architectures do not show the image until all the tools have finished their work. Serendipitous results are happenings that visualization software is meant to facilitate. There are many ways to examine data, and you don't have to use the tools in any particular order. The interactive, visual program editors of IBM and Silicon Graphics provide almost the same level of interactivity and experimentation because of the flexibility they have.



Dentists can use 3-D computer tomography imaging to identify and analyze problems. Slicing the data can reveal abnormalities in the internal structure of a tooth.

Best of Both Worlds

Good visualization software provides simple methods that work together efficiently. Both approaches to visualization—object orientation and WYSIWYG—provide you with a chance to experiment with data.

In the future, you'll see hybrid visualization software emerge, as the two structures grow to imitate each other. WYSIWYG programs will allow you to link many different steps and small programs in much the same way that object-oriented systems now do. How will all this end? When you can get the picture on your computer's screen as fast as you can imagine what you want to see. ■

Peter Wayner is a BYTE consulting editor based in Baltimore, Maryland. You can contact him on BIX as "pwayner" or on the Internet at pcw@access.digex.com.

With the ZyXEL U-Series modems, 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.

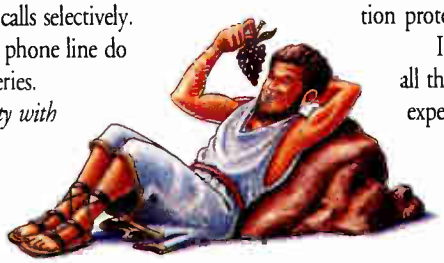
Like *Fast Retrain* with *Auto Fall-Forward/Fall-Back.* And multi-level security features—*Call-Back Security* and *Password Protection.* With *Caller ID,* you can even answer calls selectively.

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 the new PLUS Series.

Everyone can save with the U-Series modems. Because they're smart enough to work in all environments—including DOS™, Windows®, OS/2®, Macintosh®, NeXT®, UNIX®, and Amiga™. The U-Series modems support V.32bis/V.32, as well as industry-standard data compression and error correction protocols.

In case you believe all this intelligence is expensive . . . relax.



The U-Series are the lowest-priced, high-performance modems around. And they come with free ZFAX software and a 5-year warranty.

Which means now is the perfect time for smart people to save—by getting the ZyXEL U-Series modems.

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) 693-8811

*Available April 1993. All trademarks are the property of their respective owners.

World Radio History

Unleash Your 486!

NDP Fortran is now six years old, yet people still call with 486 performance questions related to their use of 16-bit compilers. Therefore, we decided this was a good time to remake the case for 32-bit tools and languages.

To get full access to a 386 or 486 requires that it be placed in 32-bit protected mode. This is done by 32-bit operating systems and some Extenders. Running in 32-bit protected mode increases the 486's segment size from 64 Kbytes to 4 Gigabytes and breaks the 640K DOS barrier. This makes it possible to access arrays larger than 64K using the 486's 32-bit "flat" model, which runs 2 to 4 times faster than the huge model employed by 16-bit compilers. 32-bit tools also simplify ports. Programs written for mainframes often assume that integers and pointers are 32-bits long or depend on binary representations, especially when written in Fortran 66 and C. Our 32-bit NDP compilers eliminate porting headaches by providing the extensions you need to recompile your VMS, VS, Cray and MS codes. We also sell the IMSL, NAG and VAST II tools that frequently get bundled with mainframes.

Before you give up on your 486, give us a ring. Whether you are looking for the 5 megaflops your 486 produces by itself, the 12 megaflops it delivers with a Weitek 4167 or possibly the 80 megaflops we can coax out of our Number Smasher-860, you owe it to yourself to contact our excellent Tech Support Staff today. Microway has had the answers to your PC performance problems since 1982!

Phone: **(508) 746-7341**
Fax: **(508) 746-4678**

386, 486 and i860 Compilers

Microway's ***NDP*** family of 32-bit compilers generate globally optimized mainframe quality code that runs on the 386, 486 and i860. They require the use of 32-bit operating systems such as OS/2, UNIX, Xenix, Solaris, Coherent, DESQview/X and DPMI and VCPI DOS Extenders.

NDP Fortran[tm] is a full F77 with F66, DOD, VMS and MS extensions.

NDP CIC[tm]**++** includes a full C compiler that runs in both K&R and ANSI modes plus a C++ compiler that is Release 2.1 compliant.

NDP Pascal[tm] is a full ISO Level 1 Pascal with BSD extensions that can interface the NDP C runtime libraries.

NDP Language Pricing

Coherent versions use the Coherent tools and support the x87 family $295

MS-DOS versions include a VCPI virtual memory DOS Extender, a DPMI interface layer, support for the x87 and Weitek coprocessors, NDPLink, NDPLib and GREX - our DOS graphics library. The 486 version adds 486 code generation, royalty free DPMI and VCPI plus ClearView, Microway's symbolic debugger.

386 Release.....$595
486 Release.....$995

OS/2 releases include x87 support, a WorkFrame interface and our 486 extensions. These tools work with the IBM Linker. CIC++ includes the portions of the IBM Tool Kit needed to interface the PM API's $695

UNIX/Xenix 386/486 use the native tools on the system in question. V.3 and V.4 versions are available.....$1195

DESQview/X $1195

Coprocessors

Weitek	4167 25/33 $350/$795	3167 $200/250	
Cyrix	D8733/40..$99/129	S87..$79	EMC $250
Intel	387SX..$80	387DX..$85	287..$80
	OverDrive 25 MHz $475.. 33 MHz $675		

i860 Supercomputers

QuadPuter-860 The world's most cost effective SuperComputer, the QuadPuter comes with four modules each of which has an i860 and two megabytes of local memory. The modules sit on an EISA base board that can be purchased with 8 or 32 megabytes of shared memory. Five QuadPuters have an aggregate throughput of a gigaflop! The card comes with one NDP language plus MAX-860.
From.....$9995

Number Smasher-860 our ISA card can be purchased with 8/32 megabytes of memory running at 33 or 40 MHz. Options include EISA and ISA Fifos, a P version with built-in Fifos for distributed parallel processing and a 24-bit graphics buffer. The card includes one NDP Language plus OS860. From.....$3995

NDP Fortran-860 along with our CIC++ and Pascal utilize advanced scalar code generation techniques designed to optimize the i860's RISC performance. The languages run on DOS, UNIX, OS/2 and i860 UNIX V.4 Workstations.....$1995

PPS-860 postprocessing scheduler, takes assembler output and converts scalar operations into pipelined. It also reschedules using dual instructions. Scalar speed ups in the range of 10 to 40% are produced.....$595

VAST-II from PSR is the same vectorizer that is used with Cray's.....$1495

AT Accelerators

FASTCache-X86/Plus[TM] — The *"Windows Solution"* - easily converts your 286 based PC into a 386/486 powered workaholic. The board takes up a slot in AT bus designs and has sockets for up to 16 megabytes of DRAM. It plugs into your 286 using a cable. The PS/2 version has no memory. All boards have a 16K four way cache and run at 25 MHz. Two processors are available, including the Cyrix CX486SLC.
From.....$399

486 Workstations

A Microway Black Tower is the ideal solution to your 486 needs. They feature industrial grade American power supplies, heavy duty cooling and easy access. All motherboards are carefully burned in before shipping and equipped with heavy duty power connectors. Our BX Towers are ideal for use as desktop workstations, file servers, RAID servers and CAD/CAM stations. They were originally engineered to house i860 arrays, which frequently get attached to SUN Networks as computational servers. We customize each system with the OS of your choice, including UNIX, OS/2, DOS and Windows. The base systems listed include case, 4 MB, tactile response keyboard, supply, floppy and mouse. The B^2T is our tall tower, the B^3 is a larger box that features front and side hinged panels. All but the 386 system use industrial supplies and the B^3 is available with a 12 slot EISA channel. To see why Microway systems have earned an international reputation for outstanding design, price/performance, value and reliability, ask for our **BX Series** Catalogue.

386B^{2}T-40 ISA 64K Cache	200W	$1395
486B^{2}T-33 ISA 64K "	250W	$2495
486B^{2}T-33 EISA 256K "	250W	$3395
486B^{2}T-50 EISA 256K "	250W	$3995
486B^3-50 EISA 256K "	350W	$4495
486B^3-66 EISA 512K & 12 Slots	350W	$5495

386, 486, i860 Libraries

NDP IMSL Microway compiled and validated version of the IMSL mainframe libraries, available for the 386/486 and i860.....$2,000

NDP NAG Microway compiled and validated NAG Workstation library, available for the 386/486 and i860. 386/486.....$995, i860.....$1495

KUCK & ASSOCIATES hand coded i860 libraries. DSP library does 1024 real FFT in 500 microseconds! **DSP**..$750 **BLAS**..$500

LAPACK and BLAS vectorized, sources included. 386/486.....$295 i860.....$495

Microway® *Technology you can count on!*

Research Park, Box 79, Kingston, MA 02364 USA (508) 746-7341 FAX (508) 746-4678
Kingston-Upon-Thames, U.K., 081-541-5466 Spain/Portugal 351-1-604-049
Germany 069-752023 Greece 30 12915672 Italy 02 7490749 Japan 047 423 1322 Poland 22-414115

Circle 106 on Inquiry Card.

World Radio History

THE DIFFICULTY WITH DATA

Handling the basics of visualization data

NAHUM GERSHON AND JEFF DOZIER

The challenges arising when you work with data must be dealt with if visualization is to become simpler and more efficient. Visualization demands that your system handle huge amounts of data quickly. And that data comes in a wide variety of forms. Raw data enters the process in different formats and from different sources, including surveys, simulations, instruments, and photographic or video images (see screens 1 and 2).

Data is usually accompanied by *metadata*, which contains information essential to the visualization process (e.g., the name of the data set, the date of generation, and statistical information about the data). Typically, the metadata contains information that describes the data's format, units of measurement, scale, display-color specifications, and relationship to other data sets (e.g., this image of atmospheric temperature is related to an image of atmospheric humidity produced by the same climate model).

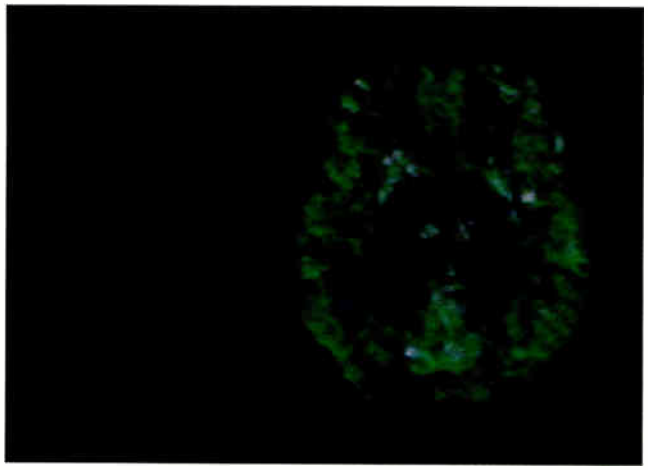
As a result, visualization packages must accept data and metadata input in disparate formats. The data might be expressed as a one-dimensional string of numbers or in multidimensional forms. An image is usually expressed in two dimensions, but data from remote sensing instruments can have as many as six dimensions: x, y, z, time, wavelength, and polarization. And data can be *continuous* (i.e., there are no gaps in the data) or *sparse* (i.e., there are holes in the data). Even data of the same type can have different formats (see the text box "The Faces of Data" on page 147).

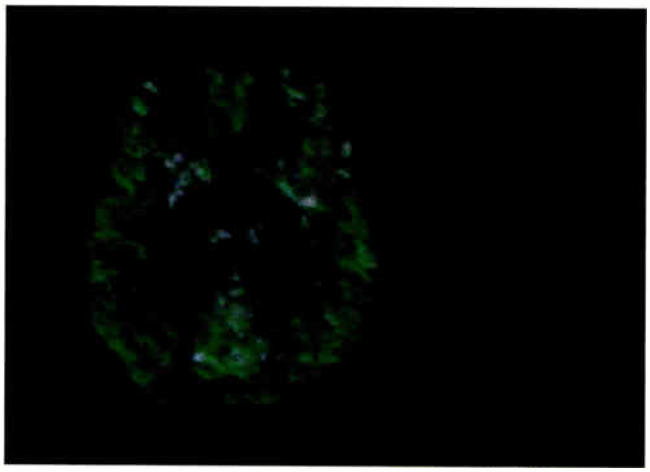
ILLUSTRATION: LYN BOYER-PENNINGTON © 1993

Data Formats

Ideally, there should be standards for data formats and metadata that would enable

World Radio History





Screens 1 and 2: *The information in these screens was generated from data obtained from 14 image slices of the brain. Input data was generated by positron-emission tomography and transformed to a format that could be used with a workstation. Then 14 2-D slices were transformed into a 3-D set with its own format. The white, green, blue, and black specify high, medium-high, medium-low, and low grain activity, respectively. To get a stereoscopic view of these images, hold the page about 20 inches from your eyes and move it toward your face until the effect is achieved. (Data courtesy of NIA, NIH)*

visualization software to import and export data easily, accurately, and quickly. However, because applications require many types of formats, it's unrealistic to expect that all data sets will be converted into a global data format standard.

However, the SDTS (Spatial Data Transfer Standard) is one attempt to develop a universally accepted data-format standard. The U.S. has adopted this spatial-data standard, and the National Institute of Standards and Technology has approved it as a Federal Information Processing Standard. In addition, the Technical Committee on Computer Graphics of the IEEE Computer Society plans to develop standards for visualization data.

But in the absence of a globally accepted standard, there are good visualization packages that support several common data formats. The University of Pennsylvania has created the domain-rendering program *xv*. You can also use toolkits that are able to convert many data formats. For example, SDSC (San Diego Supercomputer Center) has developed a publicly available format-conversion utility that supports almost 30 image formats. And Mitre (McLean, VA) has recently constructed an extensive conversion capability that integrates conversions, libraries, and utilities. It uses a common API and Carnegie Mellon's Fuzzy Pixmap Manipulation library, SDSC Image Tools, and conversion utilities from Paragon Imaging (North Chelmsford, MA).

An alternative approach used by people associated with the University of California's Sequoia 2000 project is to incorporate the format-conversion capabilities in a DBMS. In this process, the DBMS understands a suite of formats and can translate a stored format into a desired output format.

Data Storage

Storing visualization data is another problem. If you have only a few data sets, it's convenient to store them in a file system. But when there are many data sets, it's difficult to search for specific and appropriate data, because only limited amounts of information can be stored under a filename.

Posing appropriate queries against the data requires knowledge of the metadata or the information. For example, to search a large collection of data sets for files containing information about an ozone hole, the system must be able to recognize the subject. In addition, it's essential for the system to understand the context of the subject (e.g., ozone climatology and spatial contiguity of stratospheric ozone depletion).

To be able to pose queries, you must store at least the metadata of the data sets in a DBMS. And the images themselves must also be accessible to DBMS queries. But in many scientific and engineering domains, data is spatially organized and cannot be stored efficiently in most commercial DBMSes. And when the data volume exceeds the available disk space, you must store parts of the data in tertiary memory (e.g., magnetic tape or optical disks), which takes longer to access.

Most commercial DBMSes don't handle queries across multiple storage levels. However, the Teradata Optical Call Level Interface from Teradata Corp. (El Segundo, CA) handles queries across a DBMS and a storage system. But using the product doesn't necessarily permit optimal storage-access times. Therefore, you need a DBMS that can handle large objects (e.g., images), tertiary memory, and file systems. The DBMS must also be able to optimize queries directed at all the available data types wherever they are stored (see the figure).

Data Compression

To save storage space and to shorten the time required to transmit data, visualization software must compress data and then decompress it quickly to yield an acceptable image. Two types of compression methods are used: lossless and lossy.

Why Visualization Data Is Complex

- wide variety of data types and formats
- no format standards
- large memory and storage requirements
- potential need for lossless data compression
- huge data sets
- fast processing-speed requirements

World Radio History

THE DIFFICULTY WITH DATA

With lossy compression, data can be permanently discarded during the process, but files compressed in a lossless fashion retain their data integrity and can be transformed back to their original state. The RLE (run length encoding) and Lempel-Ziv-Welch algorithms are typical lossless-compression techniques.

For some types of analysis (e.g., quantitative examination of scientific data), it's essential that the data remain unchanged. In these cases, you need to compress the data using a lossless compression algorithm. Archiving data ordinarily requires lossless data compression because of the need for an accurate and complete record of the data. Any compression algorithm that you use should also protect against propagation of errors in the compressed data.

Any compression algorithm that you use should protect against propagation of errors in the compressed data.

Lossless-compression algorithms are also required for such tasks as modeling heat transfer that occurs in the ocean. In this case, you must keep the exact values of sea surface temperature as a function of latitude and longitude.

However, there are rare situations in which lossless-compression methods don't produce acceptable results. For example, when such algorithms are applied to satellite-image data, they generally yield minimal compression—usually no better than a 2-to-1 ratio.

The use of lossy compression methods is acceptable when you can tolerate some loss of precision. For example, suppose you want to browse through low-resolution versions of your data. In such cases, you want to check the appropriateness and quality of particular data sets before obtaining a full version of them for detailed analysis.

Among the most common lossy compression algorithms are MPEG (Moving

HOW DO YOU GET A JOB WITHOUT EXPERIENCE? AND HOW DO YOU GET EXPERIENCE WITHOUT A JOB?

Most young people have one answer to this problem. They avoid it until they're out of college. But they could be getting solid work experience while they're still in college. With your company's help. And ours.

We're Co-op Education. A nationwide program that helps college students get real jobs for real pay, while they're getting an education.

But we can't do it without you. Those real jobs have to come from real companies. Like yours.

For more information on how you can participate in this valuable program, write Co-op Education, Box 775E, Boston, MA 02115.

Not only will you be giving students a chance to earn money and pick up the most valuable kind of knowledge, you'll be giving yourselves a chance to pick up the most valuable kind of employee.

Co-op Education.

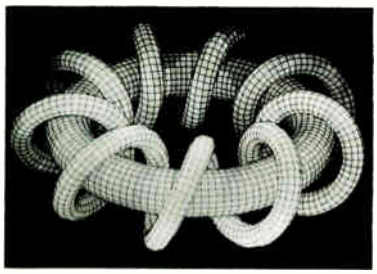
You earn a future when you earn a degree.

Ad Council A Public Service of This Publication ©1987 National Commission for Cooperative Education

World Radio History

Circle 101 on Inquiry Card.

Gain speed in your problem solving and confidence in your answers with Maple V...



3-D Tube Plot created with Maple V.

The symbolic math software for engineering, science, and education professionals.

Maple, developed at the University of Waterloo, is today's most complete symbolic math package, and it's now available from MathSoft, the makers of Mathcad. Maple's comprehensive library of over 2,000 built-in functions and easy-to-use interactive environment delivers a maximum strength program in a surprisingly uncomplicated package.

- **Provides power and flexibility.** You won't believe that something so powerful runs on everything from supercomputers to computers with as little as 1MB of memory. And Maple's flexibility makes it easy to share files across all platforms. It's completely programmable... and Maple's user interface supports natural mathematical calculations, so you can request an infinite variety of computations and graph your output in two or three dimensions.
- **Use for a wide range of applications.** Maple is ideal for a wide range of applications, including helicopter blade design, VLSI design, chemistry, satellite guidance systems, econometrics, electrical engineering, and applied mathematics — to name just a few. Maple frees you from the "bookkeeping" of complex calculations and lets you concentrate on modeling and problem solving.

Call us toll-free at 800-628-4223 or use this coupon to request more information on Maple.

In Massachusetts call 617-577-1017 or fax this coupon to 617-577-8829.

[ ] Yes! Tell me more about Maple.

Name_____

Title_____

Company or institution_____

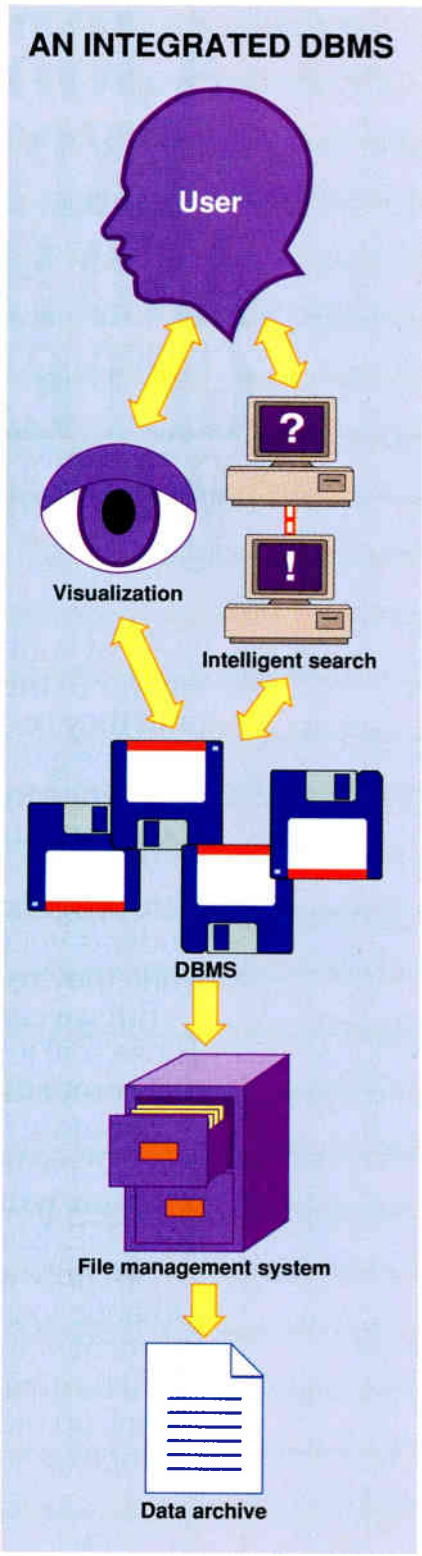
Address_____

City_____ State_____ Zip_____

Phone (____) _____

Mail this coupon to:
MathSoft, Inc.
201 Broadway
Cambridge, MA 02139
USA

B95 Maple



You can search data via an extended DBMS that controls data stored in a traditional DBMS fashion as well as in a file system. You don't have to know where the data is stored.

Pictures Experts Group) and JPEG (Joint Photographic Experts Group) standards, which are specific implementations of the discrete cosine transform. Volume reduction of at least 50 percent is common with lossy compression methods.

Addressing Animation

Animation is a special capability of visualization technology that represents time sequences of data. It's important for applications that describe time-dependent processes.

A typical animation uses large amounts of data. To save space in primary memory, data can be compressed (in space and time) or reduced (e.g., by subsampling). Such compression and reduction schemes are effective only if it's possible to transform the compressed or reduced data back to acceptable images in real time during the animation process.

To further decrease the volume of animation sequencing information that must be placed in memory, you can store just a part of the collection of frames representing the animation loop. To prevent the animation from appearing jerky, real-time fast interpolation algorithms replace the missing frames before or during a viewing. Advanced Visual Systems (Waltham, MA) has created software capable of generating these missing frames.

Visualizing What's Ahead

Visualization data comes in diverse types and formats, and no commonly accepted standard formats exist, making management of visualization data difficult. But efforts to develop standards (e.g., SDTS) and new, flexible format-conversion tools (e.g., SDSC image tools) may alleviate some of the difficulties. Fast, effective compression algorithms and the evolution of integrated systems of DBMSes and storage systems promise additional improvements.

The successful implementation of these efforts depends on widespread cooperation. The support of users, vendors, government agencies, and standards organizations is a necessity. ■

ACKNOWLEDGMENTS

The authors would like to thank Jon Doughty, Jim Green, Steve Hirsch, David Isaac, Don Sawyer, and Ron Zahavi.

Nahum Gershon is a principal scientist at Mitre Corp. (McLean, VA). Jeff Dozier is a professor of geography at the University of California at Santa Barbara. You can reach them on BIX c/o "editors" or on the Internet at gershon@mitre.org and dozier@crseo.ucsb .edu, respectively.

World Radio History

The Faces of Data

DATA TYPES

Analog Video data

Command Data parameters necessary for the execution of a visualization program

Control Data describing a sequence of keystrokes

Derived Data resulting from the processing of raw or simulation data

Digital Digital image

External Input data generated externally, or internal data exported as an output

Geometric Data describing a sphere

Internal Version of the data used in the visualization program

Metadata Information about the data (e.g., data set name or generating instrument)

Nongeometric An image

Raw Data as it comes from surveys or instruments

DATA FORMATS

CDF (Common Data Format) Supports multidimensional scientific data

CGM (Computer Graphics Metafile) Accommodates both graphics and image data

FITS (Flexible Image Transport System) Data standard used in the astronomy community

HDF (Hierarchical Data) Supports multidimensional scientific data

Net CDF (Network Common Data Format) Supports multidimensional scientific data

PICT Bit-mapped graphic format for the Mac

PostScript A page-description language

SDTS (Spatial Data Transfer Standard) Supports vector spatial data

TIFF (Tagged Image File Format) For raster images, including color and subimages

Ever seen a grown pirate cry ? Just plug this in ... and watch

MEMOPLUG™
The amazing Software protection system based on a hardware plug. Contains read-write programmable memory. This system is practical and easy to use for both programmer and end-user. Supports various programming languages, operating systems and types of computers.

U-PLUG™
The premiere protection plug for UNIX systems that connects the standard serial port of computers and workstations.

LANPLUG™
Comprehensive network protection starts with a single plug. The LANPlug lets you operate protected software from any workstation on the network, while supervising a number of authorized simultaneous operation applications.

Design: Zamir studio

CLOCKPLUG™
This unique Time-limited software protection system is based on a plug containing a real-time clock. It allows users limited execution times for leasing and demonstration applications.
A password system allows you to rewind the clock by telephone

U.S. office: Tel: 1 (800) 677 1587
Tel: (407) 682 1587 Fax: (407) 869 1409
South Africa: LionSoft Tel: 011 640 6002
Holland: M.H.P Tel: (31) 440612916
France: C.T.I Tel: (1) 47 38 16 17
Spain: Economic Data Tel: (34) 1 442 28 00
Czeck Republic: PC Kompas Fax: (42) 2 43 11 88

EliaShim
MICROCOMPUTERS LTD
5 Haganim, P.O. Box 8691
Haifa 35022 ISRAEL
Tel: 972-4-516111, Fax: 972-4-528613

Currently looking for international distributors

Circle 81 on Inquiry Card.

If you're serious about computer programming, don't let tommorrow's technology pass you by.

Now is the Time to...

LEARNADA™

Everything You Need to Learn Ada...

Including the Compiler!

LearnAda provides a complete college-level, "hands-on" course integrated with a special Ada-oriented editor, on-line training exercises and sample programs, and a validated Ada Compiler — all in a full-color, user-friendly environment! *LearnAda* runs on standard PC's, which makes it the training tool of choice for office, classroom or home use.

Special Introductory Price

$99.00!

Why Learn Ada?

Ada, the most important new programming language today, will be the dominant programming language in the future! Ada was designed and developed by the U.S. Government and is now mandated by Congress for use in all new software applications for the Federal Government. Ada is currently being used in hundreds of new systems, including the Space Shuttle, the Space Lab Space Station, the Strategic Defense Initiative, the FAA National Aerospace System, and many more!

AETECH
Ada Software Development Tools

5841 Edison Place, Suite 110
Carlsbad, CA 92008
(619) 431-7714 FAX (619) 431-0800

Call for Complete Product Line!

Circle 63 on Inquiry Card (RESELLERS: 64).

World Radio History

Visualization Software

Visualization products for PCs and workstations are available from a number of companies. The following is a sampling of software to perform scientific, engineering, and business applications.

AVS
Price: $6500
AVS ANIMATOR
Price: $1800
DEVELOPERS AVS
Price: $25,000
(*Unix*)
Advanced Visual Systems, Inc.
300 Fifth Ave.
Waltham, MA 02154
(617) 890-4300
fax: (617) 890-8287
Circle 1146 on Inquiry Card.

COVIS
Price: $395
(*PC, PS/2*)
CoHort Software
P.O. Box 1149
Berkeley, CA 94701
(800) 728-9878
(510) 524-9878
fax: (510) 524-9199
Circle 1147 on Inquiry Card.

DADISP 3.0
PC Price: $1895
Workstation Price: $4495
(*PC, most workstations*)
DSP Development Corp.
1 Kendall Sq., Building 100
Cambridge, MA 02139
(800) 424-3131
(617) 577-1133
fax: (617) 577-8211
Circle 1148 on Inquiry Card.

DATA DESK 4.0
Price: $595
(*Mac*)
Data Description, Inc.
P.O. Box 4555
Ithaca, NY 14852
(607) 257-1000
fax: (607) 257-4146
Circle 1149 on Inquiry Card.

DATA VISUALIZER
Price: $9500
(*most workstations*)
Wavefront Technologies, Inc.
530 East Montecito St.
Santa Barbara, CA 93103
(800) 545-9283
(805) 962-8117
fax: (805) 963-0410
Circle 1150 on Inquiry Card.

DICER
Price: $695
TRANSFORM
Price: $595
(*Mac, most workstations*)
Spyglass, Inc.
P.O. Box 6388
Champaign, IL 61820
(217) 355-6000
fax: (217) 355-8925
Circle 1151 on Inquiry Card.

EASY5X
Price: $8900
(*Unix*)
The Boeing Co.
P.O. Box 24346, MS 7L-46
Seattle, WA 98124
(800) 426-1443
(206) 865-3622
fax: (206) 865-2966
Circle 1152 on Inquiry Card.

IDL
Price: $1500
(*PC, Unix, VMS*)
Research Systems, Inc.
777 29th St., Suite 302
Boulder, CO 80303
(303) 786-9900
fax: (303) 786-9909
Circle 1153 on Inquiry Card.

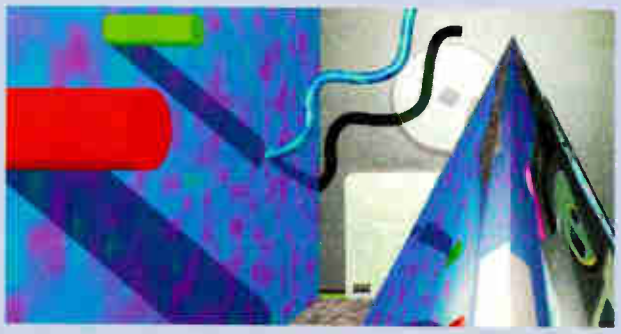
IPLAB SPECTRUM 2.2
Price: $1000
(*Mac II, Quadra*)
Signal Analytics Corp.
374 Maple Ave. E, Suite 204
Vienna, VA 22180
(703) 281-3277
fax: (703) 281-2509
Circle 1154 on Inquiry Card.

MAPS&DATA
Price: $395
(*Windows 3.x*)
MapInfo Corp.
200 Broadway
Troy, NY 12180
(800) 327-8627
(518) 274-6000
fax: (518) 274-6066
Circle 1155 on Inquiry Card.

MATLAB 4.0
Price: $1695
(*PC, Mac, most workstations, some supercomputers*)
The MathWorks, Inc.
24 Prime Park Way
Natick, MA 01760
(508) 653-1415
fax: (508) 653-2997
Circle 1156 on Inquiry Card.

PVWAVE COMMAND LANGUAGE
Price: $4950
PVWAVE POINT AND CLICK
Price: $2495
(*Unix, VMS*)
Visual Numerics
6230 Lookout Rd.
Boulder, CO 80301
(303) 530-9000
fax: (303) 530-9329
Circle 1157 on Inquiry Card.

SLIDERS AND DIALS
Price: $99
(*Microsoft Excel subapplication*)
Golden Technologies, Inc.
14251 Camden Lane
Lake Oswego, OR 97035
(800) 653-2201
(503) 620-2201
Circle 1158 on Inquiry Card.



SYNCHROWORKS
Price: $29,000
(*Sun Sparcstation*)
Oberon Software, Inc.
1 Memorial Dr.
Cambridge, MA 02142
(617) 494-0990
fax: (617) 494-0414
Circle 1159 on Inquiry Card.

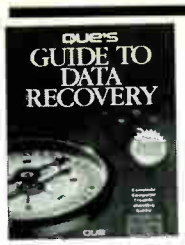
TECPLOT 5
Price: $649 to $3000
(*PC, Unix, VMS*)
Amtec Engineering, Inc.
P.O. Box 3633
Bellevue, WA 98009
(800) 676-7568
(206) 827-3304
fax: (206) 827-3989
Circle 1160 on Inquiry Card.

VISUALIZATION DATA EXPLORER
Price: $5900
(*most workstations*)
IBM Research
8 Skyline Dr.
Hawthorne, NY 10532
(800) 388-9820
(914) 784-5110
fax: (914) 784-5077
Circle 1161 on Inquiry Card.

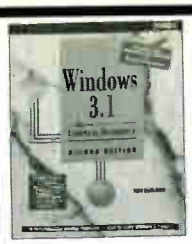
VOXELBOX
Price: $495
(*Windows 3.x*)
Jaguar Software
573 Main St., Suite 9B
Winchester, MA 01890
(617) 729-3659
Circle 1162 on Inquiry Card.

Inclusion in the resource guide should not be taken as a BYTE endorsement or recommendation. Likewise, omission from the guide should not be taken negatively. The information here was believed to be accurate at the time of writing, but BYTE cannot be responsible for omissions, errors, or changes that occur after compilation.

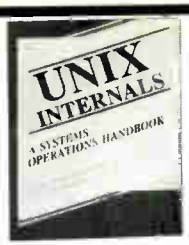
World Radio History



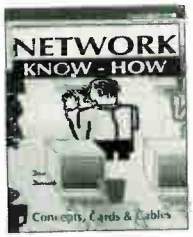
586104P $29.95
Softcover



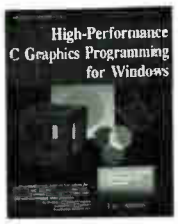
881889P-XX $29.95
Counts as 2/Softcover



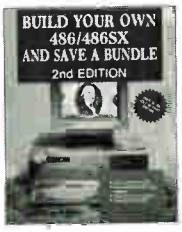
2951P $19.95
Softcover



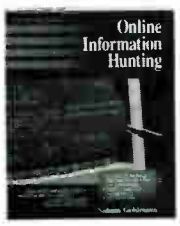
881833P $19.95
Softcover



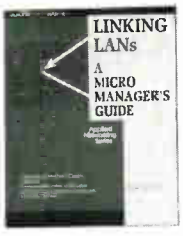
4103H $34.95



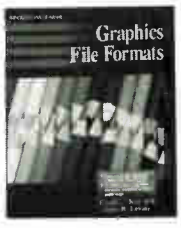
4270H $29.95



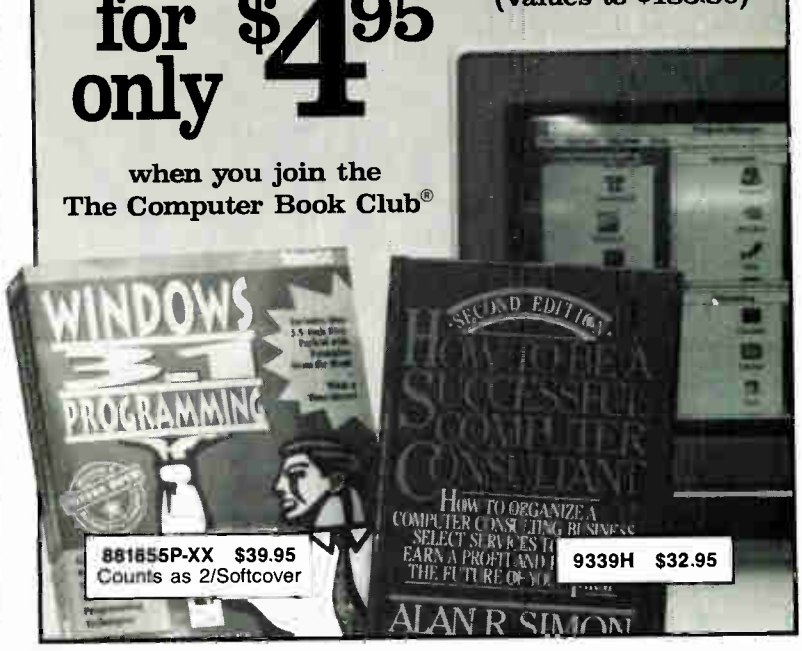
3943P $29.95
Softcover

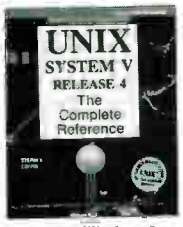


3755H $34.95

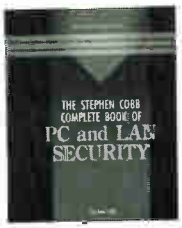


3969H $36.95



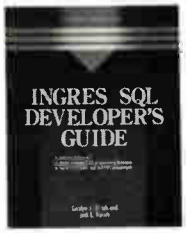


881653P-XX $29.95
Counts as 2/Softcover

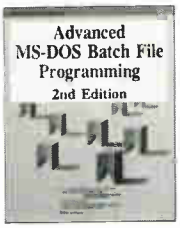


3280H $36.95

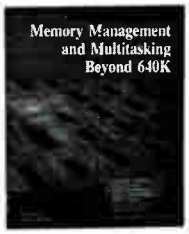
043297H-XX $39.95
Counts as 2



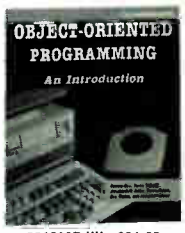
3941H $32.95



3745H $36.95

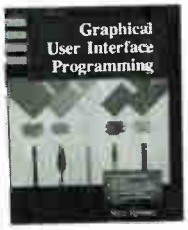


4069H-XX $39.95
Counts as 2

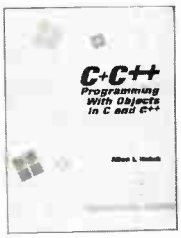


881682P-XX $24.95
Counts as 2/Softcover

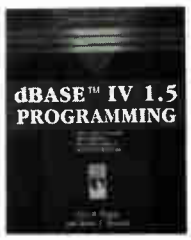
3971P $24.95
Softcover



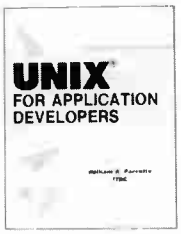
3875P $24.95
Softcover



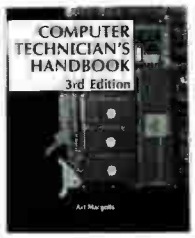
029662P $24.95
Softcover



4187P-XX $36.95
Counts as 2/Softcover



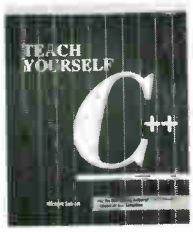
031700H $38.00



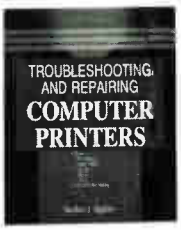
3279H-XX $36.95
Counts as 2

057574P $24.95
Softcover

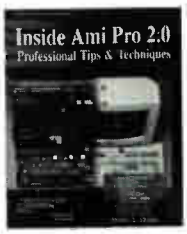
031541P-XX $33.61
Counts as 2/Softcover



881760P $24.95
Softcover

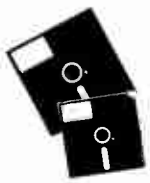


3923H $32.95



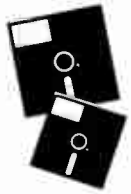
4078P-XX $24.95
Counts as 2

Special Book/Disk Offer



4239H-XX $44.95
Counts as 2

4341P-XX $34.95
Counts as 2



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 our 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' prices 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/handling charge & sales tax will be added to all orders

©1993 CBC

If card is missing, write to:
The Computer Book Club, Blue Ridge Summit, PA 17294-0820
BY493

World Radio History

SHRINK TO FIT

On-the-fly compression software for PCs and Macs fits more data on less hard disk space

RICK GREHAN AND
STAN WSZOLA

Hard drives keep getting cheaper but for some reason, disk real estate still seems as rare and precious as San Francisco street parking. Data accumulates, bit-map graphics proliferate, and what you need to store grows faster than hardware costs can shrink. On-the-fly data compression offers a real alternative to hardware upgrades, off-line storage, and constant file pruning.

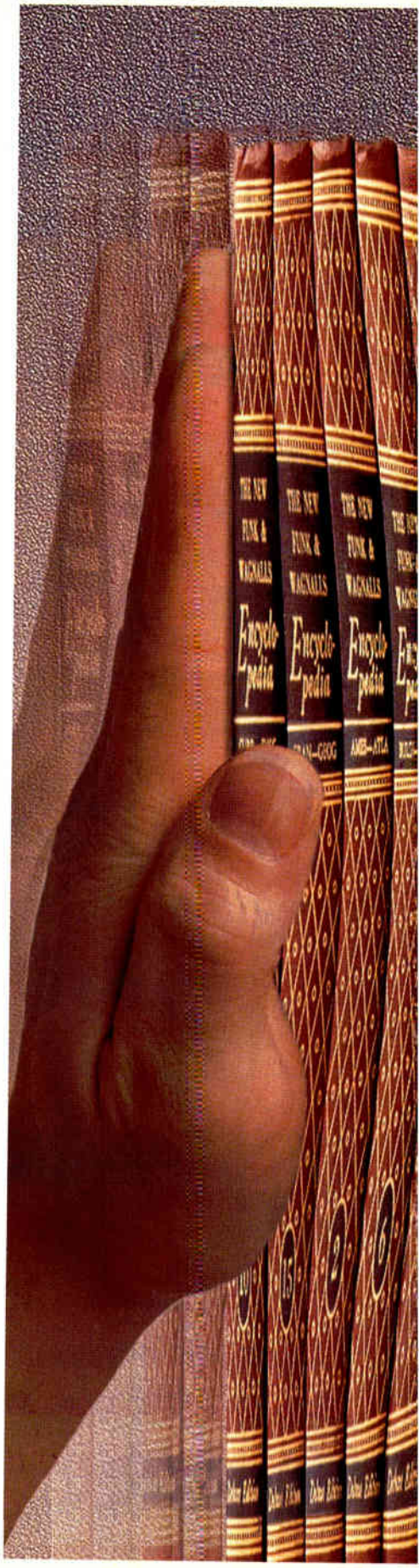
Software compression is nothing new. PKZip, ARC, and LHARC are just a few common utilities for archiving files. These archivers shrink files to conserve space, but you need to manually decompress a file before you can use it. With on-the-fly compression, you can expect to double effective disk space almost invisibly. You're simply presented with the illusion of a standard file system that takes less space.

This month's Solutions Focus concentrates on eight on-the-fly compression packages for PCs and Macs: DoubleDensity 1.0 from Abacus Software, Stacker 3.0 from Stac Electronics, SuperStor Pro 1.0 from AddStor, XtraDrive 1.0 from Integrated Information Technology, AutoDoubler 2.0.1 from Fifth Generation Systems, StuffIt SpaceSaver 1.0.3 from Aladdin Systems, SuperDisk 2.1 from Alysis Software, and TimesTwo 1.0.1 from Golden Triangle Computers. The packages differ a little in their approach: The PC packages trap sector reads and writes to compress data, while most of the Mac packages work on a file basis. However, all eight packages deliver a compression ratio of around 2 to 1 with an average mix of data.

Besides these eight packages, we also took an early look at the compression capabilities of DOS 6. Microsoft's latest DOS release includes a bevy of new features, but on-the-fly compression as an operating-system component is among the most intriguing. For more details, see the text box "Doublespace and DOS 6" on page 156.

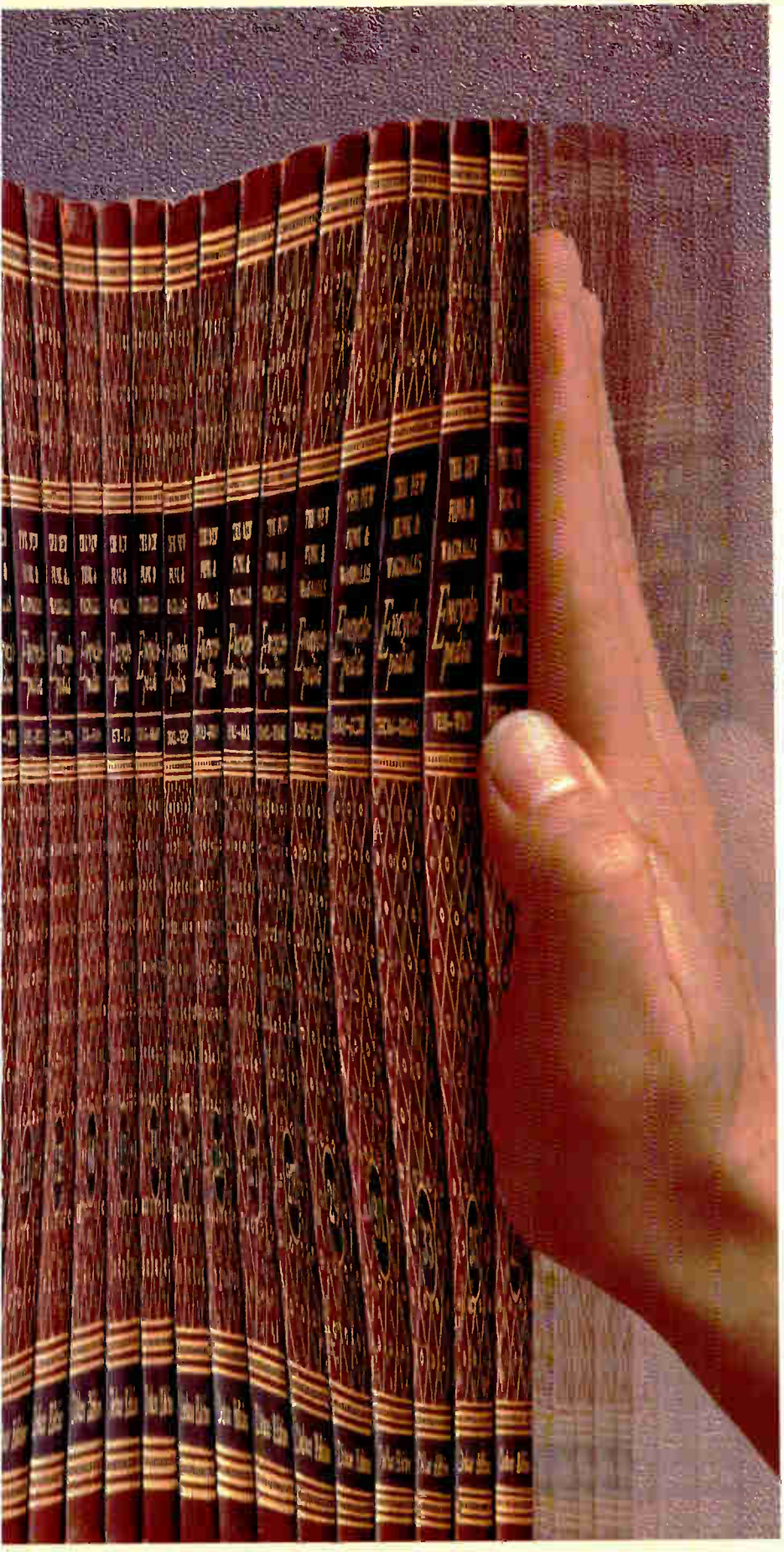
Two Advantages

Software compression isn't quite as good as a new hard drive. Your performance will probably drop (although there are exceptions), and you will end up using an



PHOTOGRAPHY: DANIEL MORDUCHOWICZ © 1993

World Radio History



BYTE ACTION SUMMARY

- **WHAT ON-THE-FLY COMPRESSORS ARE**
  Software packages that increase apparent storage by automatically compressing and decompressing data.
- **LIKES**
  Good compression ratios and good speed. Compression is an inexpensive alternative to hardware upgrades.
- **DISLIKES**
  Data recovery is more difficult, especially with XtraDrive and TimesTwo. PC setups can require a lot of tweaking of configuration files.
- **RECOMMENDATIONS**
  Choose Stacker on the PC and Stuffit SpaceSaver on the Mac.

unusual disk data format that might make recovery more difficult.

But software compression has two big advantages over hardware upgrades. First, it's inexpensive. These software compression packages range in price from $59 to $149, and even the most expensive among them is considerably less expensive than a modest hard drive. If you can get reasonable performance, be assured of data integrity, and double the effective capacity of a 200-MB disk, you have obviously saved a bundle.

Software compression's second advantage makes it an especially effective technology for notebook users. It's not always practical to upgrade or add storage to portable machines, but portables are often where the capacity crunch hits hardest. Software compression doesn't require space for additional hardware.

If software compression is the right solution, how do you choose from among the packages on each platform? The measure of effective software compression comes down to the compression ratio and the speed of compression and decompression. We used these two criteria in designing the tests used to evaluate these packages (see the text box "Measuring Compression" on page 153 for a complete description of the tests we carried out). The compression ratio is a function of the type of data and the effectiveness of the compressor; for example, text files might be compressed at a ratio of 2 to 1, while bit-map graphics files (e.g., .BMP) may be squeezed at a ratio of 8 to 1.

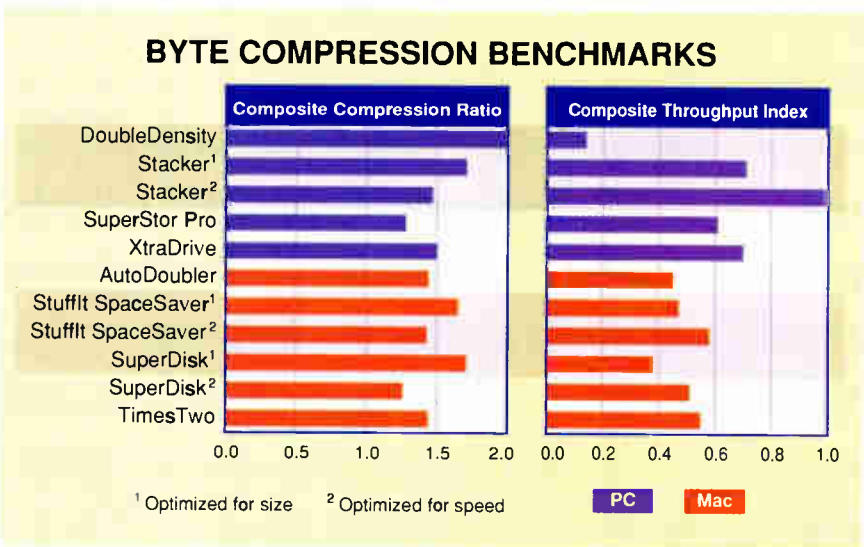
Compression and decompression speed will affect how invisibly each on-the-fly

World Radio History

BENCHMARK RESULTS

Table 1: *Compression ratios and throughput indexes for three major application categories. For each application type, the compression ratio describes compression on representative data. Throughput indexes for Word Processing and Database are a combination of results from BYTE's application benchmarks and low-level tests (see the text box "Measuring Compression" for details). Higher numbers are better.*

	WORD PROCESSING		DATABASE		GRAPHICS	
	Compression ratio	Throughput	Compression ratio	Throughput	Compression ratio	Throughput
PC products						
DoubleDensity	2.00	0.38	2.00	0.26	2.00	0.37
Stacker	2.06	1.05	1.92	0.95	2.10	1.02
SuperStor Pro	1.50	0.62	1.40	0.64	1.30	0.56
XtraDrive	1.70	0.73	1.70	0.62	1.72	0.73
Mac products						
AutoDoubler	1.66	0.46	2.06	0.46	1.20	0.42
StuffIt SpaceSaver	2.18	0.60	2.25	0.61	1.30	0.61
SuperDisk	2.28	0.46	2.04	0.46	1.49	0.54
TimesTwo	1.79	0.52	1.70	0.46	1.20	0.40



Composite compression ratios (left) and throughput indexes (right). In the composite compression graph, a score of 2.0 indicates a 2-to-1 ratio—disk space is effectively doubled. We tested products that offered a range of settings at their extremes: optimized for speed (i.e., best speed, worst compression) and for size (i.e., worst speed, best compression). For the PC products, throughput scores are normalized against a Compaq Deskpro 386/33L with no compression. Mac scores are normalized against an SE/30 running System 7.0 without compression. Higher numbers are better.

compressor operates. The results of our benchmark tests, which are listed in table 1 and summarized in the figure, illustrate the speed and compression capability of each package.

After these two main factors come considerations such as price, ease of use, minimum system and memory requirements, and the utilities that each compressor includes. We have considered these in each evaluation. For a summary of features, see table 2.

On-the-Fly Compression

Data compression works by translating a representation of data from one set of symbols to another, more concise, series of symbols. On-the-fly compressors use a variety of lossless compression algorithms, and most manufacturers are tight-lipped about the exact techniques. However, the most common algorithms for general lossless compression are variations on dictionary-based schemes such as LZ (Lempel-Ziv) and its patented cousin LZW (Lempel-Ziv-Welch). For example, Stacker uses a compression algorithm that Stac Electronics calls LZS, for "Lempel-Ziv-Stacker."

Dictionary-based compressors use symbols to represent recurring strings in the uncompressed input. An encoding dictionary maps these symbols to the strings they represent. With most dictionary algorithms, the decompressor can completely reconstruct the encoding dictionary from the compressed data stream—the compressor doesn't need to explicitly include a decoding table.

LZ and similar techniques make for fast compression and decompression, although decompression is usually somewhat faster. Both attributes serve on-the-fly compressors, since speed is critical for invisible operation and read accesses are often far more common than writes.

Like all lossless compression, on-the-fly compression works by removing redundancy in the source data; therefore, it's highly dependent on the input data type. Source data with a high degree of redundancy (e.g., bit maps or mostly empty databases) compress very well, while more random data (e.g., executable binaries or precompressed archives) don't compress well at all. Text files usually land somewhere in the middle.

To complete the illusion of invisible operation, some on-the-fly compressors "lie" to the operating system about used and available disk storage. The accuracy of a compressor's estimate of effective available space depends on the compressibility of the data you'll be adding; if a disk is half full of text files, adding executable files or bit maps to the other half will probably lead to some weird results.

World Radio History

Measuring Compression

We tested each of the eight software packages reviewed here for speed and compression ratio (see the figure in the main text). Our goal was to come up with accurate tests that were as similar as possible for both PC and Mac compression packages.

To test speed, we ran a mix of application benchmarks and low-level tests. We ran the Word Processing and Database elements of BYTE's application benchmarks. For raw speed measurements, we ran random and sequential file I/O operations on various data representing the most common files: text, executable, bit-mapped graphics, database, and precompressed data. On the PC side, our graphics data came from PCX files and our compressed data came from ZIP files; on the Mac side, our graphics and compressed data came from PICT and StuffIt files, respectively. We kept the Mac's disk cache to a minimum during throughput tests.

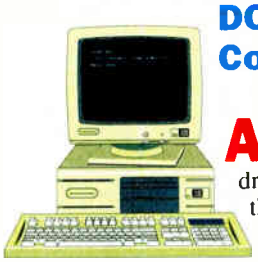
We also measured compression ratios for each of the five data types. On the PC side, where the compression applications spanned an entire partition, we filled the partition with data until the system ran out of room. The amount of data we wrote, compared to the physical space on the disk, provided the compression ratio.

It was relatively easy to check the compression ratios for the three file-at-a-time Mac packages. We just moved the representative data into a file tagged for compression and then rebooted the Mac with extensions disabled; thus, we revealed the file's true sizes. This trick didn't work on Alysis Software's SuperDisk, which apparently made more permanent alterations to the file's directory information. However, we found that we could get the file's true size if we moved it into the Trashcan. Apparently, SuperDisk has to report the true size of the file while the file is in the Trashcan; otherwise, throwing away the trash would result in botched volume and directory data.

Golden Triangle Computers' TimesTwo acted more like the packages we reviewed for the PC; therefore, we ran a ported version of the tests we used on the PC to determine TimesTwo's compression ratio. We should point out that the compression ratios shown for TimesTwo aren't as exact as those shown for the other Mac packages. A Macintosh creates a desktop database file, and since it's virtually impossible to gauge that file's compression, we cannot know for sure how much space was actually left over for user data.

The figure shows the composite compression ratio—the unweighted average of compression ratios for each file type—and the composite throughput index. We derive the latter figures by taking the ratio of each package's throughput to the throughput the test systems achieved without compression. We used a Compaq Deskpro 386/33L as our test PC; our test Mac was an SE/30.

Table 1 in the main text shows extracted compression ratios and throughput for three specific application areas: Word Processing, Database, and Graphics. The Word Processing and Database throughput figures include the low-level tests and the application benchmarks.



DOS Data Compression

All four packages for the PC use a device driver to fool DOS into thinking it has extra or larger logical drives. When DOS accesses a compressed disk, the device driver intercepts the data stream and compresses or decompresses it on the way to or from the disk.

The compressed disk is actually a single compressed file in the normal DOS file system. With products such as Stacker or SuperStor Pro, the compression file usually takes up most of the available hard disk space. In addition to the compression file, there is usually only one copy of the CONFIG.SYS file, a compression driver, and some other device drivers in the normal file space.

One potential problem is that the compressor requires an additional logical drive letter that refers to the compressed file. Unless the compression package provides a driver that swaps drive letters for you, you may need to adjust all your paths to handle the new drive.

Compression occurs when a number of sectors written to disk are compressed to fewer sectors in the compression file. In addition to compressing, on-the-fly compressors are more efficient in their use of disk space. DOS allocates space to files in clusters, where each cluster is composed of two to 32 512-byte sectors. A cluster is the minimum allocation unit—no matter how little data is in a file, each file must be made up of a whole number of sectors. Typical hard drives have 4-KB clusters, which means that DOS wastes 3 KB of space in storing a 1-KB file. Since all the compressor's interaction with DOS is in a single normal file, the compressor can allocate space on a thriftier sector basis.

There are some drawbacks to the single-file, sector-based compression method. Just reading a single byte requires the compressor to decompress a full physical sector. The decompressor needs some sizable decompression buffers to work efficiently. Also, the compressor must handle the mapping of logical clusters to physical sectors on its own. All this reading and decompression requires some CPU time, system RAM, and time for disk accesses. On a reasonably fast system with fast drives, such as those we used for our benchmark tests, speed is not really an issue. Fortunately, most of the products include built-in caching and can actually provide better performance than an uncompressed disk.

A word of caution for Windows users: None of the programs we looked at could deal easily with Windows permanent swap

World Radio History

ON-THE-FLY DISK COMPRESSORS

Table 2: *All the PC products were sector-based (i.e., they compressed an entire volume), while three of the Mac products let you mix compressed and uncompressed files on the same volume. Beyond this fundamental difference, most of the packages share a common set of features. (N/A = not applicable.)*

	PC				MAC	
	DoubleDensity 1.0	Stacker 3.0	SuperStor Pro 1.0	XtraDrive 1.0	AutoDoubler 2.0.1	StuffIt SpaceSaver 1.0.3
Company	Abacus Software	Stac Electronics	AddStor	Integrated Information Technology	Fifth Generation Systems	Aladdin Systems
Price	$79.95	$149	$149	$99	$89.95	$59.95
Minimum system requirements	MS-DOS 3.2	MS-DOS 3.2	MS-DOS 3.2	MS-DOS 3.0	Mac Plus	None specified
Minimum memory requirements	512 KB	640 KB	640 KB	512 KB	1 MB	2 MB
File-/sector-based	Sector	Sector	Sector	Sector	File	File
Passwords	Yes	Yes	Yes	No	No	No
Adjustable ratio	No	Yes	Yes	Yes	No	Yes
Self-extracting files	No	Floppy-based	Floppy-based	No	Yes	Yes
Deinstallation	Yes	Yes	Yes	Yes	N/A	N/A
Utilities						
Defragmenter	No	Yes	Yes	Yes	No	No
Diagnostics/repair	No	Yes	Yes	Yes	Yes	No
Other	N/A	Removable media; Windows utilities	Removable media; Windows utilities; JPEG Workshop	Optional cache	Finder enhancement (CopyDoubler)	N/A

files. In installing each of these packages, we had to switch to a temporary swap file or make an uncompressed partition that did not interfere with the permanent swap file.

Crashes are somewhat more serious on a compressed disk than they are on an uncompressed one, because it's easier to lose more data. However, if you regularly back up your disk, you shouldn't have much cause for concern. In any case, you should do a complete backup before you proceed with the initial compression process.

DoubleDensity 1.0

Abacus Software's DoubleDensity is a simple, inexpensive compression utility. It is DOS-based, and although it will run with Windows, it has no Windows-related features, as do some of the other packages reviewed here.

To install DoubleDensity, you must first type in the registration number on the floppy disk to get by copy protection. Next, you select an installation subdirectory and the disk you want to compress. (The maximum size of a DoubleDensity volume is 250 MB.) You also have the option of specifying an eight-character password for data protection. DoubleDensity uses `chkdsk` to scan the disk for lost clusters before beginning the compression process.

DoubleDensity's installation automatically modifies your CONFIG.SYS file. If you want DoubleDensity to load high, however, you need to make some manual adjustments. The device driver takes up 47 KB of RAM.

The installation doesn't let you select the default compression ratio. DoubleDensity increases capacity by creating a hidden file called D_D_VOL that uses all the available storage space. The device drivers create a new compressed disk that's almost twice the size of the original volume. On our test system, DoubleDensity created a 20-MB E drive out of a 10-MB D drive. When the installation process was through, all the software that was on the D drive ended up on the larger E drive , and we had to fiddle with paths by hand.

DoubleDensity is the leanest package in terms of utilities. Its `chkddv` utility is similar to DOS's DIR, but it supplies extra information regarding compression and space availability. Also, a `ddexist` utility tells you whether a disk is a DoubleDensity volume, and a `dall` utility shows a list of all the DoubleDensity volumes installed on your system.

DoubleDensity is inexpensive ($79.95) and more or less easy to use. It has the best compression of any package we tested. Unfortunately, it's also much slower than any of the other compressors and lacks utilities for determining space usage by file type and error-correction features. Despite its compression prowess, its lack of speed and utilities make it barely usable.

Stacker for Windows and DOS 3.0

Stacker for Windows and DOS, from Stac Electronics, is almost transparent in operation, and it's fast enough that you probably won't notice any degradation in performance. The program has an easy-to-use interface for both DOS and Windows. At $149, it's not exactly bargain-basement, but for speed and sheer usability, Stacker is unmatched.

Stacker has two installation methods, one for DOS and one for Windows. When installing Stacker, you can tune it to optimize compression and speed or choose a middle setting.

Stacker creates a STACVOL file. This invisible file contains all the compressed files in the "Stacked" drive. The STACVOL file on our benchmarking partition used 10,376,192 bytes, leaving approximately 100 KB for Stacker to use as a temporary storage area. There are no significant size restrictions—the uncompressed disk can be up to 1 GB in size, and you are only limited to 10 Stacker drives per system.

Two Stacker device drivers map a drive letter to the compressed file and swap drive

World Radio History

	MAC	
	SuperDisk 2.1	TimesTwo 1.0.1
	Alysis Software	Golden Triangle Computers
	$59	$149
	Mac Plus	Mac Plus
	1 MB	2 MB
	File	Sector
	Yes	No
	Yes	No
	Yes	No
	N/A	Manual (reformat disk)
	No	No
	No	Yes
	N/A	N/A

letters. If you compress the C drive, the compressed drive will still be C, while the uncompressed drive will become D. The device drivers can detect a permanent Windows swap file and configure themselves to avoid the swap file every time you start up the system. The device drivers use from 36 KB to 64 KB of system RAM. You can load the drivers into high memory or configure Stacker to use EMS, reducing system RAM requirements in either case.

Stacker uses a default compression ratio of 2 to 1, but you can set the ratio to a maximum of 16 to 1. Included in the Stacker package is a version of the Norton Speed Disk. Stacker uses Speed Disk to defragment the files. When Speed Disk finishes its job, the setup program scans the entire compressed disk looking for bad sectors.

One nice bonus is Stacker's Windows capability. After compressing the disk, you can create a Stacker Program Group, which gives you icons for the Stacker Tuner, setup options, a readme file, and a utility called Stackometer. Stackometer uses three gauges to display a compression-ratio summary for the compressed disk. A bar chart shows the amount of disk space needed to store files without compression, compared to the space required to store the same files on a compressed disk. A Disk Space gauge displays used and available capacity on the compressed disk. There's also a graphical display of disk fragmentation levels.

However, DOS users aren't left out in the cold. You can get to all the Stacker utilities from the command line. For example, for detailed information on disk usage, you can use the report utility to display a list of all files on the selected drive and their current compression ratios. You can also use a built-in optimizer to rearrange the files on the disk with either a quick optimize, which rearranges only fragmented files, or a full optimize, which optimizes the entire disk.

The Stacker Tuner lets you change the balance between how fast Stacker works and how tightly it compresses the data. Stacker was fast in both configurations. On our tests, when Stacker was optimized for speed, it actually outran an uncompressed disk. Stacker's compression ratio wasn't as good as DoubleDensity's, but it was better than that of the other packages when set for high compression.

A handy Stacker feature is that you can compress floppy or other removable-media disks. You just use the Stacker setup options to mount and compress the selected disk. You can take the compressed removable disk to any other computer, even one that is not running Stacker, and read and write the data. The compressed disk or cartridge will have two visible files on it: instructions in README.STC and the Stacker Anywhere program (STACKER.EXE). You run the Stacker Anywhere program to access the files on the removable media.

Stacker is fast, provides good compression, and is a comfortable package to use. Stacker's utilities provided accurate information on hard disk space use, data-compression ratios, and error-correction functions. Also, the program's documentation is the best of the four DOS packages we tested.

SuperStor Pro 1.0

If Stacker is the DOS compression utility against which others are measured, SuperStor Pro from AddStor is the next best thing. Although SuperStor Pro shares Stacker's price ($149) and is more Windows-capable, it's not quite as quick, flexible, or powerful.

Before you install SuperStor Pro, you must disable memory-resident programs (e.g., memory managers such as EMM386 or Compaq's CEMM). The installation program copies the device driver and utility programs to disk. The installer also modifies the CONFIG.SYS file to run the device driver at boot-up.

You continue the installation by running SuperStor Pro's main user program, `sstor`. With `sstor`, you can preview compression results by viewing the uncompressed and compressed disk statistics. You then prepare the disk for compression. During this preparation, the program will recognize a Windows permanent swap file, and it will give you the option of keeping the swap file on a reserved partition or deleting it.

Next, the `sstor` program asks if you want to compress all or part of the disk. You can select the compression ratio—ranging from 2 to 1 to 8 to 1. We picked the default 2 to 1.

Because we chose to compress a nonbooting partition, we had to create a separate mountable drive. The instructions for this custom installation weren't clear; we had to get information from three separate sections of the user's guide. To compress the 10-MB D drive partition, first we had to prepare the disk by making it mountable. Then we had to give the hidden file a unique name. To make the compressed partition automatically mountable, we had to manually change the AUTOEXEC.BAT file.

Like Stacker, SuperStor Pro can swap drive designations, so your compressed drive maintains its old drive letter. Even with the problems we had with the custom installation, we had no problems booting or running the system. Our original uncompressed D drive became a compressed D drive.

The device driver uses 52 KB of system RAM for a simple installation. You can load the driver into high or extended memory, which reduces the system RAM requirements to only 10 KB.

SuperStor Pro also works with floppy disks or other removable media. You just use the `sstor` menu options to mount and compress the selected disk. The `sstor` program lets you choose to make files on removable media read-only or read-write. Read-write compressed media include a driver each for DOS and Windows, as well as a Windows DLL. When you get your removable disk to another machine, you only need to run the appropriate driver, depending on whether you are running Windows.

SuperStor Pro has various utility programs, mostly under a single `ssutil` shell. The `ssutil` shell provides a variety of essential maintenance functions. The shell's analysis function is similar to that of `chkdsk`: It analyzes and repairs damage to compressed disks. A disk tune-up component performs fragmentation analysis and a full or partial defragmentation of compressed files. The `ssutil` shell can also recompress, raising the compression ratio by up to 25 percent by (more slowly) compressing files still further.

continued

World Radio History

Doublespace and DOS 6

We took an early look at DOS 6, Microsoft's heir to the single-user-PC throne. DOS 6 has data compression built into the operating system in the form of a utility called Doublespace. In fact, Doublespace is the subject of a lawsuit filed by Stac Electronics against Microsoft; Stac Electronics alleges that Doublespace infringes Stac Electronics' patents.

From a user perspective, DOS 6 works much like Stacker and SuperStor Pro. Once you install DOS 6, you type in `dblspace`. Doublespace creates what Microsoft calls a CVF (compressed volume file). It also installs a driver that tricks DOS into seeing a CVF as a logical drive. One key difference between Doublespace and the other PC compressors is that the compression driver is actually an operating-system kernel file—its routines become part of the MS-DOS operating system at boot time.

When you install Doublespace, you are faced with two options: You can compress all your existing files in place, or you can simply create an empty compressed logical drive. The former option causes Doublespace to scan your entire partition, compress uncompressed files, move them into the CVF, and delete the original copy of the file from the regular partition.

Also included in DOS 6 is the MRCI (Microsoft Real-Time Compression Interface). The MRCI allows an application to query the operating system for the presence of a compression server. If a compression server is present, the application can call the server's compression and decompression routines. For example, if your telecommunications application is about to transmit a large amount of data across a network, it can first pass the data off to the compression server and then transmit the compressed information.

Within DOS 6 is an LZ (Lempel-Ziv)-based compression server, which is more or less the compression engine that Doublespace uses to do its work. Although we ran a beta release of DOS 6 (and therefore couldn't produce any conclusive test results), we got a good picture of what the new operating system intends to offer. Our preliminary tests show that the DOS 6 compression engine yields compression ratios that score around the middle of the pack of the DOS products in this review, and throughput performance that scores near the top. Look for tests of the final release of DOS 6 in an upcoming issue of BYTE.

Finally, you can adjust the size of SuperStor Pro's compressed partition. Besides the utilities in the `ssutil` shell, there is also the simple command-line `ssdir`, which lists the files on the mounted drive, their sizes, the compression ratio, and the time and date.

Some of SuperStor Pro's utilities are available through a well-designed Windows interface. SuperStor Pro's SSWINPRO Windows application is more informative than the Stacker equivalent. In addition, SuperStor Pro has a bundled program called the JPEG Workshop, which is a nice Windows application for image compression and light image processing. The JPEG Workshop is not integrated in SuperStor Pro and runs as a separate program.

Unfortunately, SuperStor Pro is weakest where it matters most—in compression ratio and compression speed. SuperStor Pro turned in below-average scores on both of our measures of performance. Although its good utilities and Windows capability makes SuperStor Pro a strong contender, its performance keeps it from outgunning Stacker.

XtraDrive 1.0

XtraDrive from Integrated Information Technology takes a strange approach to increasing capacity. IIT's XtraDrive doubles the capacity of a hard disk by altering the boot track, replacing the DOS boot record at the BIOS level, and routing disk function calls through its own device driver and interrupt handler. This has its pros and cons: It is easy to use, but data recovery can be considerably more difficult.

XtraDrive runs under DOS. There are no Windows programs in the package, although the software operates fine with Windows. Advanced installation options let you select expected compression ratio. We selected a ratio of 2 to 1, but you can go as high as 8 to 1. You can also select the EMS cache size, between one and four 16-KB blocks, and an optional system RAM cache of the same size. For the benchmarks, we selected a 16-KB block for the system RAM cache and no EMS cache. Depending on the options, the drivers and cache can use from 40 KB to 90 KB of system memory, although you can load them in high memory.

The program creates two compressed disks equal in size to the original uncompressed disk. In our test system, the 10-MB D drive became a 10-MB D and a 10-MB E drive. XtraDrive keeps all the original data on the new D drive, so paths are retained.

The original disk contains an invisible file called IITV3.VOL, which is about 160 KB in size. IITV3.VOL is the proprietary FAT (file allocation table) and drive information file for the XtraDrive virtual drive. It is one of two copies; the other copy is saved in a protected location outside of the compressed partition. If the IITV3.VOL file is damaged or destroyed, an XtraDrive utility program can rebuild the file.

XtraDrive is a slim package. It features three utilities: an `xdir` utility that is similar to DIR, which supplies information regarding compression and space availability, a `chkdsk` equivalent, and a defragmentation utility.

Because of the unique way in which XtraDrive modifies your hard disk, loss of or damage to the XtraDrive device driver will prevent access to the entire hard disk. With the other packages, such as SuperStor Pro or Stacker, loss or damage to the drivers prevents access to only the compressed disk space. Consequently, it is vitally important for you to follow the correct procedure for deinstalling XtraDrive.

XtraDrive provides fair compression and speed. Its technique of directly altering the boot track is unusual. Unlike Stacker and SuperStor Pro, the $99 package has few utilities and no Windows interface. (Version 2.0. with a larger set of utilities, will soon be available.) XtraDrive also has a no-bells-and-whistles approach to data compression that's easy to work with but its boot-track modifications make us uneasy.

continued

World Radio History

20 Years of Jameco Quality, Value and Service.

You Get it All.

Select these products or any of the 5000 in our Catalog:

KEYBOARDS	Fujitsu 101-key enhanced keyboard Part No.4B17128	$79.95
FLOPPY DISK DRIVES	Toshiba 1.44MB 3.5" Internal Drive Part No.4B40774	99.95
COMPUTER CARDS	Jameco 16-Bit VGA card Part No.4B67459	99.95
CABLES	Jameco 6' parallel printer cable Part No.4B28716	7.95
HARD DRIVES (IDE)	Conner 120MB, 19ms Part No.4B14074	249.95
POWER SUPPLIES	Jameco 150W 8088 Part No.4B19465	69.95
MEMORY	SIMM Module 1MB 80ns Part No.4B41769 Product No.[illegible]	47.95
	18-pin DIP 1MB 80ns Part No.4B42251 Product No. 511000[illegible]	4.99
DIGITAL MULTIMETERS	Meets 4.5 digit w/frequency, capacitance & data hold Part No.4B27158	99.95
EPROM	128K EPROM Part No.4B39784 Product No. 27128A-25	2.75

Call for your free Jameco Catalog
1-800-637-8471

JAMECO™
ELECTRONIC COMPONENTS
COMPUTER PRODUCTS

1355 Shoreway Road, Belmont, CA 94002
Sales [illegible]
Jameco ServiceLine [illegible]
Technical Support [illegible]

Circle 92 on Inquiry Card.

Same-Day Shipping

Priority orders before 2:00PM PST are shipped the same day.

V.I.P.#4B3

Always Prompt Courteous Service

Jameco phone staff quickly connect you with the products and services you seek.

© World Radio History

QUALITY

Guaranteed Top Quality

Products tested & backed by 30-day money-back guarantee.

Over 5000 Products in Stock

20 YEARS OF EXCELLENCE 1973-1993

20 Years of Full-Service

Product selections & customer services based on solid business experience.

24-Hour Toll-Free Ordering

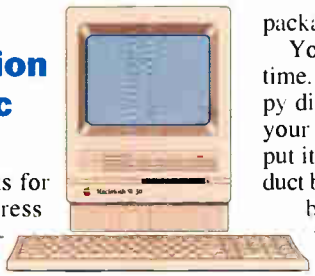
Shop day or night by phone or FAX.

JAMECO ServiceLine UPTIME

Computer & Printer Repair

ServiceLine quick-turn repairs, parts installation & tech assistance.

Data Compression on the Mac



All the products for the PC compress whole disk volumes, but with the products for the Mac, it's a different story. Three of the four Mac products we tested—AutoDoubler, SuperDisk, and StuffIt SpaceSaver—use what's best described as "file-at-a-time" compression. Whenever you open a compressed file or launch a compressed application, the compression utility jumps into action and decompresses a copy of the file. As long as the file remains open, any application accessing it works with a decompressed image of that file. When you close the file, the utility reactivates and recompresses the file.

All three of the file-at-a-time compressors enhance the basic scheme with varying degrees of intelligence; for example, they all watch the uncompressed file for updates, and if none occurs, they simply discard the uncompressed image at close time. All three packages are also smart enough to recognize a .SIT file (i.e., a file compressed with the popular StuffIt utility) and don't bother trying to compress it.

This file-at-a-time technique has several advantages. Installation is painless, and you can freely mix compressed and uncompressed files on the same volume. In addition, it means that once a compressed file is open, you're working with an uncompressed data stream, and there's no time penalty for each read and write. However, the packages must play games with the Mac's file system so that, for instance, a Get Info selection returns the file's uncompressed size rather than its compressed size (i.e., its true size as seen by the File Manager).

Our fourth Mac product, TimesTwo, is a more traditional on-the-fly compression package. It operates beneath the Mac's File Manager, deluding your system into believing it has twice as much space as it really has.

AutoDoubler 2.0.1

Once installed on your Mac, Fifth Generation Systems' AutoDoubler waits silently for idle machine time. When such time is available, AutoDoubler begins scanning disks, looking for uncompressed files. It goes to work on any files it finds, turning the Mac's arrow cursor into a miniature *AD* (for AutoDoubler) so that a quick glance at your screen tells you that the package is busy.

You can interrupt AutoDoubler at any time. If you move the cursor, insert a floppy disk, or do anything else that requires your Mac's attention, AutoDoubler will put its work aside and permit you to conduct business as usual. When your machine becomes idle again, AutoDoubler picks up where it left off. Your only clue that the package has been active at all (besides the increased disk space) is a small, reverse-video *DD* stamped in the lower left corner of the icons for those files that have been compressed. (AutoDoubler has a companion product, DiskDoubler, which is a less automated file compression utility. Auto-Doubler uses the same compression technology as DiskDoubler; hence the *DD* stamp.)

Whenever you open a compressed file or launch a compressed application, AutoDoubler sneaks in and decompresses the file. Depending on how big the file is and how you call it up (e.g., whether you open it as a read-only file or as an update file), AutoDoubler attempts to expand the file in RAM and keep its compressed image on disk unchanged. Consequently, the package does its best to keep access as swift as possible.

AutoDoubler carries on its compression in the background, but you can make all sorts of adjustments to its operation through AutoDoubler's control panel. For starters, you can target which volumes you want the package to ignore, so if you have a disk that you keep your immediate work on and you don't want to wait around for decompression when you open a file, you can tell AutoDoubler to skip it. You can also tell AutoDoubler how much idle time it should let pass before it goes into action.

AutoDoubler will decide whether to go to work on a volume based on a free-space target that you set after installation. If after one compression pass it finds that the free-space target is not met, it makes another pass, attempting to compress the files even further. The target and the other settings that the control panel provides help you control AutoDoubler's enthusiasm about compressing files.

If you're running System 7.0, AutoDoubler installs a CopyDoubler utility on your disk. This program is integrated into the Finder and provides a number of useful enhancements. These enhancements include faster file copy (around two times faster) and file deletion (emptying the trash—about 10 times faster), as well as the ability to completely erase deleted files so they can't be illicitly recovered using a file recovery utility.

Fifth Generation Systems also includes the DD Expand utility with AutoDoubler. DD Expand is an application that can expand any AutoDoubler-compressed file. Since you can freely distribute DD Expand on a noncommercial basis, you can simply copy it onto a floppy disk with your AutoDoubler-compressed files and pass the whole package to others who don't run AutoDoubler.

AutoDoubler provides compression that is as good as that of any of the other Mac packages not optimized for high compression. But AutoDoubler's compression speed was average. Although the $89.95 AutoDoubler is complete and easy to use, you can find more capability in less expensive Mac packages reviewed here.

SuperDisk 2.1

SuperDisk from Alysis Software is a $59, item-at-a-time compression program that is more obvious in operation than is AutoDoubler. SuperDisk doesn't operate during idle time; instead, it compresses a file when you close it and decompresses the file when you open it.

To make SuperDisk even more obvious when it kicks in, a pop-up window appears. The window plays a moviola whose main character is a soda can: If SuperDisk is compressing a file, you watch the soda can get crushed; if the package is expanding a file, the can reinflates. This display is charming the first few times, but its charm can rapidly transform into annoyance, particularly in the midst of compressing or decompressing a large file. Fortunately, you can disable this feature.

SuperDisk does not browse whole volumes, as AutoDoubler does. Rather, you tag those items that you want compressed by appending a .S to their names. This is not as arduous as it sounds: You can tag an entire folder, and anything moved into that folder will get compressed. You can also adjust SuperDisk's activity to your own workstyle: Files that you access frequently (and where you don't want to wait for decompression to take place) you simply leave untagged, and you move less active files into a tagged folder.

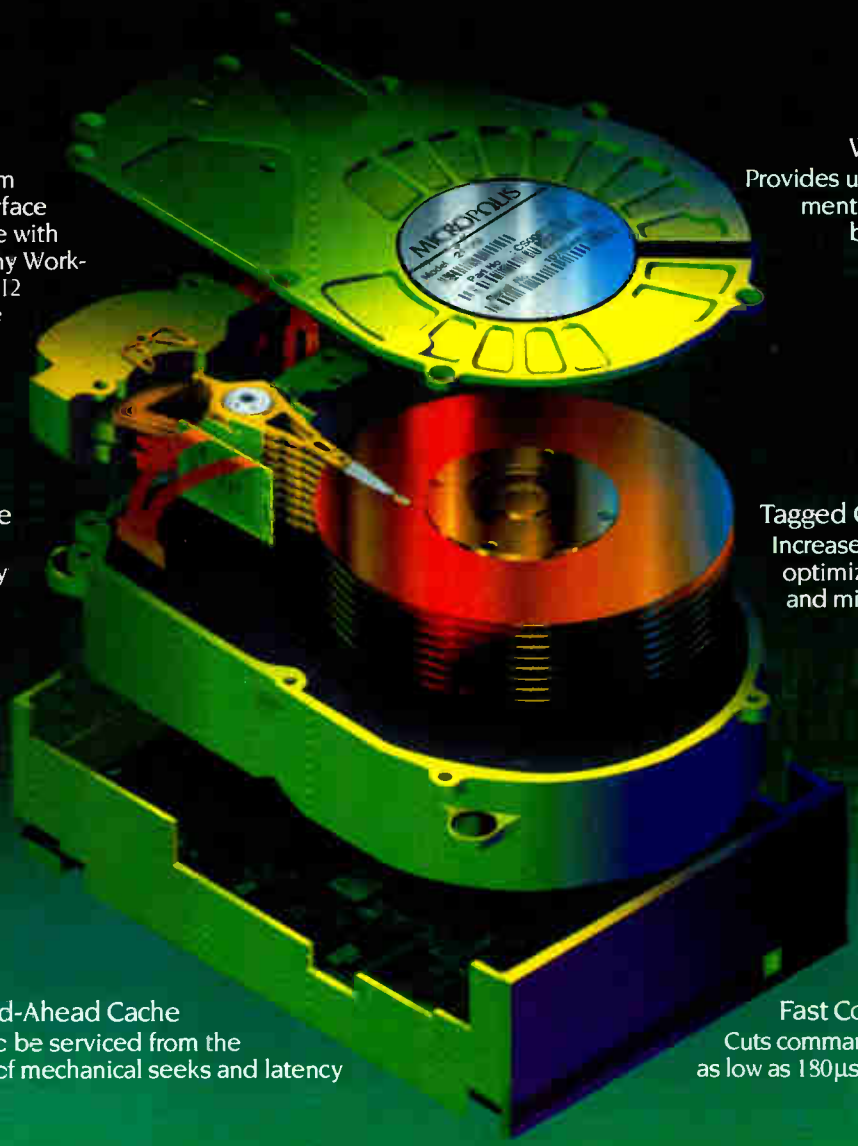
SuperDisk allows two levels of compression that are more or less a trade-off between speed and size. If you want maximum compression, then you'll pay a speed penalty. If you're happy with a less compact version of the compression algorithm, your system will open and close files more rapidly. Higher compression ratios consume more memory. (Just how much more is difficult to measure, since Mac memory is allocated and deallocated on the fly.) SuperDisk delivers great compression, but unfortunately, it's not very fast, even when set for maximum speed.

SuperDisk's control panel is as animated

World Radio History

THE BENCHMARK FOR HIGH PERFORMANCE

3.5-Inch Disk Drives



Have It Your Way
Upgrade your AT™ system without changing the interface using a Model 2112A drive with IDE interface; upgrade any Workstation with the Model 2112 with Fast SCSI-2 interface

Write-Behind Cache
Provides up to a 300% improvement in write performance by managing writes to the disk

Super Fast Performance
A 10ms Average Seek, a 5.56ms Average Latency and a 512K Buffer with Advanced Cache Management (SCSI models only)

Tagged Command Queuing
Increases data throughput by optimizing seek and latency and minimizing other delays (SCSI models only)

Multi-Segmented, Read-Ahead Cache
Permits multiple seeks to be serviced from the buffer without the delay of mechanical seeks and latency

Fast Command Processing
Cuts command processing time to as low as 180µs (IDE) or 350µs (SCSI)

Call 1-800-395-3748 for the name of your nearest Micropolis Authorized Distributor

IDE (AT) INTERFACE

Model Number	Formatted Capacity	Average Seek	Transfer Rate (MB/s)	5 Year Warranty
2105 A	560 MB	10 ms	5 max*	Yes
2112 A	1,050 MB	10 ms	5 max*	Yes

*Asynchronous

CERTIFICATE OF AWARD

FAST SCSI-2 INTERFACE

Model Number	Formatted Capacity	Average Seek	Transfer Rate (MB/s)	5 Year Warranty
2105	560 MB	10 ms	10 max	Yes
2112	1,050 MB	10 ms	10 max	Yes

MICROPOLIS®

Micropolis is a registered trademark of Micropolis Corporation. AT is a registered trademark of IBM

Circle 103 on Inquiry Card.

World Radio History

as its crushing-soda-can pop-up. To alter the package's compression options, you proceed to a dialog box that contains three subpanels: one showing the soda can, another showing a leaping rabbit, and the third showing an elephant. If, for example, you select the most compact compression, the bunny leaps more slowly (showing a speed penalty) and the elephant's girth swells (showing more memory consumption).

Another dialog box from the control panel lets you create *auto-expanding* files. These files are SuperDisk's answer to AutoDoubler's DD Expand utility. An auto-expanding file is compressed like any tagged SuperDisk file, but attached to it is a small piece of executable code that knows how to expand SuperDisk files. You can give an auto-expanding file to a Mac user who does not have SuperDisk, and he or she can decompress the file by simply double-clicking on it.

Finally, SuperDisk lets you password-protect files. When you attempt to open a protected file and the soda-can window pops up, you're prompted to enter the password before the open operation proceeds. This also occurs if you try to launch a protected application.

StuffIt SpaceSaver 1.0.3

StuffIt SpaceSaver ($59.95) from Aladdin Systems is a direct descendant of StuffIt, the premier data-compression utility for the Mac. The StuffIt utility originally appeared around 1987 as a shareware utility, and since then it has set the standard for BBS compression and has become a commercial product. The commercial version is StuffIt Deluxe 3.0, which includes SpaceSaver.

Interestingly, SpaceSaver and StuffIt Deluxe do not use the same compression algorithm. SpaceSaver is geared for speed; thus, it uses an LZ variation, while Stuffit Deluxe uses a proprietary technique designed for maximum compression.

SpaceSaver operates like a hybrid of AutoDoubler and SuperDisk. Like AutoDoubler, SpaceSaver compresses files during your system's idle time. Decompression takes place when you open or launch a compressed file. As with SuperDisk, SpaceSaver lets you tag files and folders that you want compressed. However, SpaceSaver is not restricted to a predefined tag; you can modify the string that SpaceSaver looks for in file and volume names. Additionally, SpaceSaver will respond to the tag at the beginning or end of the name.

As with AutoDoubler, you can adjust the amount of idle time SpaceSaver lets pass before it scans your disk. If you need to have files compressed immediately, you can completely disable idle-time compression, and SpaceSaver will work like SuperDisk—compressing when the file closes. If you frequently use more recent files and tend to keep older files around in archives, then you can configure SpaceSaver to only compress those files that have not been modified within a certain amount of time. In this way, SpaceSaver will pass over recently used files as it scans the disk.

SpaceSaver provides the same trade-off between space and speed that we saw in SuperDisk. You can choose "fastest" or "smallest" compression. SpaceSaver was the fastest among the Mac packages and came in second for high compression.

One of the package's unique features is its magic menu. This is a miniature menu icon that appears to the right of the Special selection on the Desktop's menu bar. Clicking on the magic-menu icon activates a pull-down menu that lets you directly expand or compress files. The magic menu

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 uncompresses when run. Only $47.00

PKWARE® INC.
THE DATA COMPRESSION EXPERTS®

9025 N. Deerwood Dr.
Brown Deer, WI 53223
(414) 354-8699
Fax (414) 354-8559

BY493

Circle 122 on Inquiry Card.

World Radio History

Discover the basic principle of connectivity...

Defy the gravity of your connectivity problems.

It's a basic principle worthy of Newton:
When the complexities of multiple platforms weigh you down, discover superior PC-to-host connectivity solutions from SmarTerm.®

Take emulation to new highs.
SmarTerm provides PC users with advanced DEC and Dasher terminal emulation (including VT420, VT340, and D470) and connectivity to VAX/VMS, UNIX, and Data General hosts. Whether you need precise emulation for text or graphics (including full ReGIS, Tektronix, and sixel capabilities), or for Windows, DOS, and soon Windows NT, SmarTerm connects on the highest levels.

Break free under your own power.
Escape from high support costs with SmarTerm's pioneering tools and utilities, including simplified keyboard remapping, pop-up keyboard, on-screen toolbox, user-definable button palettes, and customizable help system. You'll reduce calls to the help desk and standardize your site's connectivity.

Discover SmarTerm.

It's the only emulation software that includes a multiprotocol kit FREE in every package. Get implementations of LAT, TCP/IP, Token Ring drivers, and support for a variety of third-party TCP/IP, all designed and supported by Persoft, and all at no extra cost! Discover the basic principle of connectivity today. Call **1-800-EMULATE.**

persoft®
CONNECTIVITY SOLUTIONS
DOS • Windows • Ethernet • Token Ring

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 DE Rotterdam, The Netherlands • Phone +31 10 405.3560 • FAX +31 10 405.5073

©1993 Persoft, Inc. All rights reserved. Persoft and SmarTerm are registered trademarks of Persoft, Inc. All other trademarks mentioned are properties of their respective companies.

Circle 118 on Inquiry Card.

World Radio History

also allows you to alter some of SpaceSaver's more important configuration parameters (e.g., fast or tight compression) without having to call up control panels.

It's simple to create a self-extracting file (or folder) within SpaceSaver. You can either move the files you want to compress into a folder and append a .SEA extension to the folder name—at which time SpaceSaver compresses that folder into a self-extracting archive—or use the Make Self-Extracting selection from the magic menu. Similarly, SpaceSaver can create .SIT files directly. If you're transferring files and the destination machine has a copy of StuffIt available, .SIT files offer the best compression since there's no executable code to carry for decompression.

TimesTwo 1.0.1

TimesTwo is an unusual, $149 compression package from Golden Triangle Computers that provides sector-based data compression. When you install TimesTwo, it covers an entire disk volume. In fact, TimesTwo takes over entire disks; you cannot run TimesTwo on a multiply partitioned drive. The company says that it is working to remove this limitation.

TimesTwo's installation is lengthier than those of the other Mac compression products, because it compresses your whole disk at installation time. Although the documentation recommends that you back up your hard disk prior to installation (sound advice), the TimesTwo installations we performed resulted in no lost or corrupted files. Anything on the partition at installation was compressed where it stood.

TimesTwo installs itself beneath the Mac's Finder, and once it's in place, you don't need to make any adjustments to it. Consequently, TimesTwo doesn't have a control panel for selecting compression ratio or speed. If you install TimesTwo on an empty drive, the package simply makes your disk seem twice as large as its physical capacity. As you move files onto the disk, the actual ratio varies depending on what sort of data you're storing.

The TimesTwo disk has no attendant utility programs. A TimesTwo volume looks to the outside world like an ordinary volume, so there are no self-extracting compressed files to be made.

Because TimesTwo affects the entire disk volume, the only way we could get a good idea of compression ratios was to run a file copy program that filled up the compressed disk—the same technique we used to gauge the compression ratios of the PC products. The test results were pretty good: TimesTwo was fastest among the packages not specifically set for speed, and it gave the best compression for a package not tuned for file size.

However, running our test meant that the TimesTwo driver had to contend with a disk-full condition. When the disk filled, TimesTwo's response was a series of alert dialog boxes that began with strident warnings and concluded with the package telling us that the volume was unusable. It then threw the icon of the compressed disk into the trash.

We got the icon back by rebooting the system. It took the Norton Utilities' Disk Doctor to recover the disk. Since the system chucked the disk into the trash without properly closing any open files, the volume's bit-map and information block were awry. Sometimes even the Disk Doctor couldn't resurrect the disk. It would tell us there was 75 MB of free space on the disk; however, TimesTwo kept complaining that we had less than 1 MB of space left and warning that we'd better not write any more files to the disk. Running the Verify option from TimesTwo's installer usually fixed the problem; in the most severe cases, we just had to reinstall TimesTwo.

Best to Compress

On the PC side, the overall winner was easily Stacker. It provided everything: the best performance, good data-compression ratios coupled with fast operation, a good user interface for Windows and DOS, an informative set of utility programs, and a well-written manual.

On the Mac side, all the packages were close on both the throughput index and the compression ratio. In the throughput index, SpaceSaver won out, although in compression ratios, there was no clear champion. SpaceSaver and SuperDisk ran a close race even down to the price; however, we chose SpaceSaver based on a mixture of price ($59.95 is easy to swallow), performance (SpaceSaver always scored at or near the top), and the comfort that comes from a trusted name in compression. ■

Rick Grehan is technical director of the BYTE Lab. He has a B.S. in physics and applied mathematics and an M.S. in mathematics/computer science. Stan Wszola is a testing editor for the BYTE Lab. You can reach them on BIX as "rick_g" and "stan," respectively.

COMPANY INFORMATION

Abacus Software
(DoubleDensity 1.0)
5370 52nd St. SE
Grand Rapids, MI 49512
(800) 451-4319
(616) 698-0330
fax: (616) 698-0325
Circle 976 on Inquiry Card.

AddStor, Inc.
(SuperStor Pro 1.0)
1040 Marsh Rd., Suite 100
Menlo Park, CA 94025
(800) 732-3133
(415) 688-0470
fax: (415) 688-0466
Circle 977 on Inquiry Card.

Aladdin Systems, Inc.
(StuffIt SpaceSaver 1.0.3)
165 Westridge Dr.
Watsonville, CA 95076
(408) 761-6200
fax: (408) 761-6206
Circle 978 on Inquiry Card.

Alysis Software Corp.
(SuperDisk 2.1)
1231 31st Ave.
San Francisco, CA 94122
(800) 825-9747
(415) 566-2263
fax: (415) 566-9692
Circle 979 on Inquiry Card.

Fifth Generation Systems, Inc.
(AutoDoubler 2.0.1)
10049 North Reiger Rd.
Baton Rouge, LA 70809
(800) 873-4384
(504) 291-7221
fax: (504) 295-3268
Circle 980 on Inquiry Card.

Golden Triangle Computers, Inc.
(TimesTwo 1.0.1)
4849 Ronson Court
San Diego, CA 92111
(800) 326-1858
(619) 279-2100
fax: (619) 279-1069
Circle 981 on Inquiry Card.

Integrated Information Technology, Inc.
(XtraDrive 1.0)
2445 Mission College Blvd.
Santa Clara, CA 95054
(800) 832-0770
(408) 727-1885
fax: (408) 980-0432
Circle 982 on Inquiry Card.

Stac Electronics
(Stacker 3.0)
5993 Avenida Encinas
Carlsbad, CA 92008
(800) 522-7822
(619) 431-7474
fax: (619) 431-0880
Circle 983 on Inquiry Card.

World Radio History

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

The only product that combines fortified software encryption with the Hardlock™ family of copy protection devices for single user and network implementation. Made in the USA.

For a list of distributors in Europe, contact East Electronic GmbH. Tel: 49-89-539-800-20 Fax: 49-89-539-800-40
In Korea, contact Finecom. Tel: 82-2-690-5811 Fax: 82-2-605-5729
In Brazil contact HT MACR. Tel: 21-257-0314 Fax: 21-235-6808
In Chile contact Datasoft S.A. Tel: 562-246-7443 Fax: 562-208-0591
In Peru contact V.C.H.L. Tel: 51-14-440537 Fax: 51-14-475984
In Uruguay contact Soltec. Tel: 90-60-10-9**30-08 Fax: 0598-2-92-16 18

GLENCO ENGINEERING INC.
SERVING THE SOFTWARE INDUSTRY SINCE 1979

270 Lexington Drive
Buffalo Grove, IL 60089-6930
Phone 708/808-0300
Fax 708/808-0313

For International information circle 83. For Domestic information circle 84 on Inquiry Card.

World Radio History

SYSTEM

Ultraportable PCs: Worth the Trade-Offs?

ROBERT E. CALEM

Relentlessly, personal computers continue to shrink. Early portable units, such as the first Compaqs, were actually more *luggable* than portable—they were about the size of a small suitcase and heavy enough to cause hernias. Luggables were soon followed by machines labeled *laptops* because they could be comfortably placed on your lap without blocking circulation. Soon after, the state of the art evolved to *notebook* computers, named for dimensions that were roughly equivalent to a sheet of notebook paper.

Two other categories—*subnotebooks* and *palmtops*—define a class of computers that can go anywhere you can go. Now you need never leave your computer behind. But has the ultraportability trend gone too far? As always, you must consider the trade-offs.

Smaller than a Breadbox

Subnotebooks are smaller than notebook computers but can still run standard DOS applications. These units have no internal floppy drive, helping them achieve lighter weights but hampering convenience. As the subnotebooks get even smaller, they are moving into the roles once reserved for palmtops. Some are now "instant-on" (i.e., you don't have to wait for them to boot up) and include palmtop-style applications in ROM, such as schedulers and address books. But they still don't fit into a jacket pocket.

Subnotebooks, in fact, come in a wide variety of shapes, sizes, and capabilities (see table 1). At the head of the class are models powered by processors able to run Windows 3.1 and with bright, backlit VGA displays. Lost in the crowd are models with slightly less powerful microprocessors and solid-state memory in place of hard drives, as well as less impressive screens. Often, the same PC companies offering notebook computers sell subnotebook models: Dell Computer, Gateway 2000, and Zeos International, for example.

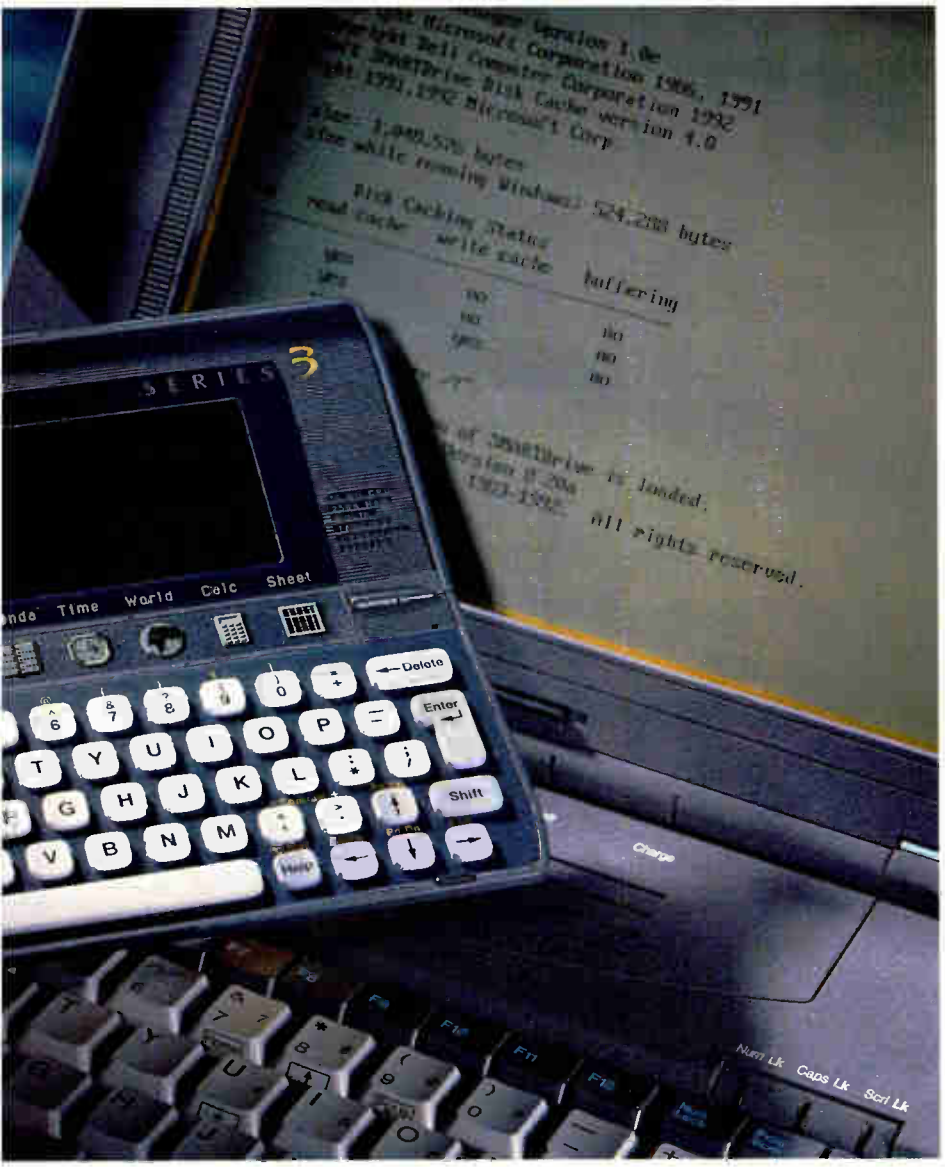
Palmtop computers easily fit into your jacket pocket and are mainly used as personal schedulers, memo-takers, and address books (see table 2). Unlike subnotebooks, a number of palmtops are made by the same consumer electronics companies that sell calculators, organizers, and video games. In fact, palmtop computers are about the same size as some calculators, and they usually weigh only a pound or less.

For this roundup, I used four subnotebooks (see photo 1) and three palmtops (see photo 2). The subnotebooks included the Dell 320SLi, the Gateway 2000 HandBook, the Olivetti Quaderno, and the Zeos Pocket PC. Among the palmtops were the Hewlett-Packard 95LX, the Psion Series 3 256K-s, and the Sharp Wizard OZ-9600.

Photo 1: *Subnotebooks come in ultraportable sizes but still run standard MS-DOS software. The price you pay for compactness is a cramped keyboard or a tiny screen.*

PHOTOGRAPHY: SCOTT PARKER / AVIS STUDIO © 1993

World Radio History



BYTE ACTION SUMMARY

- **WHAT SUBNOTEBOOKS AND PALMTOPS ARE**
  Subnotebooks are significantly smaller than traditional notebooks but still run standard DOS applications. Palmtops fit in a coat pocket and are more suited to personal scheduling and, in most cases, number crunching.
- **LIKES**
  Ultraportability; integrated applications.
- **DISLIKES**
  Touch-typing on subnotebooks is difficult; on palmtops it is impossible.
- **RECOMMENDATIONS**
  The HP 95LX combines impressive power in a palmtop package. Among the subnotebooks, the Gateway HandBook strikes the best mix of power, portability, features, and price. But go with a standard notebook unless portability is your top concern.

SUBNOTEBOOKS

Dell 320SLi

I grew to like the $2148 Dell 320SLi more and more as I used it. At first, like a child-safety cap on a bottle of aspirin, the two briefcase-type latches that sealed the unit shut were difficult to work. And at about 7½ inches deep and 11 inches wide, it's the largest machine tested. Compared to the other subnotebooks, the 320SLi seemed more cumbersome. In the end, however, its size was a major advantage.

Aesthetically, the 320SLi is the best of the lot. The matte-finished plastic case feels nearly like rubber and is pleasing to look at. The same could not be said about the 320SLi's reflective LCD, which, despite being bright, is difficult to look at for a long time. Using a graphical word processor that I installed on the 60-MB hard drive, I often lost sight of the mouse cursor. It sometimes seemed to just disappear. Moreover, the dial for adjusting the display's contrast is located too near the machine's power switch. As a result, it's easy to dim the display accidentally before turning on the computer. The screen is big, though, thanks to the machine's large size.

The supplied external floppy drive is small enough to fit in a shirt pocket, but the 320SLi's best feature is a keyboard that is large enough to permit fast touch-typing. A clever keyboard mouse is designed in as well, although not clearly marked. I discovered it only after reading the plainly written and well-organized user's guide.

Serial, parallel, keyboard/mouse, and VGA display ports are all located together in a convenient rear bay. The 386-class microprocessor that powers the 320SLi provides brisk performance at all times. The machine's larger size sacrifices some convenience, but that trade-off is sufficiently balanced by the advantages of a larger screen and keyboard.

Gateway 2000 HandBook

The $1295 HandBook was the subnotebook I tried first. I like it, despite some drawbacks. Its most outstanding feature is a backlit LCD with blue characters. It's the best screen in the group. Unfortunately, the HandBook's keyboard suffers from unusual placement of certain frequently used keys. The backslash key, for example, is positioned in the lower-right corner in a difficult-to-reach spot rather than in its familiar locale above the Enter key. Moreover, the keyboard, while better than all but the 320SLi's, would benefit from wider key-spacing.

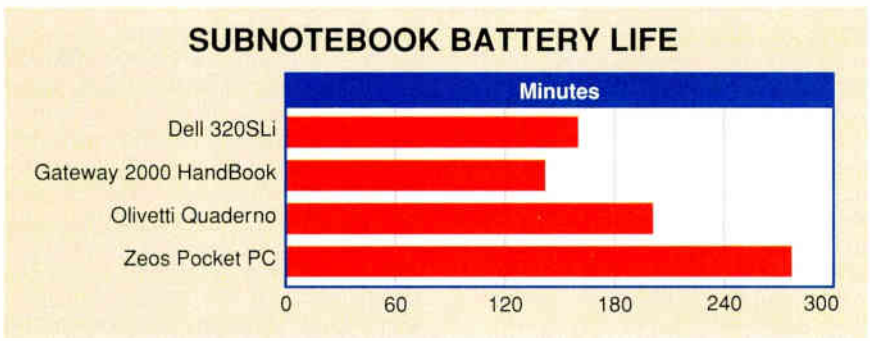
The slightly cramped keyboard contributes to the compact dimensions of the HandBook. It's small enough to fit in your lap with room to spare. But that extra room would be taken up by the HandBook's

World Radio History

SUBNOTEBOOK FEATURES

Table 1: *Subnotebooks come in a range of sizes and capabilities. Of these four, the Gateway HandBook is the only one with a backlit display. The Dell 320SLi sacrifices some portability for a larger screen and keyboard. (● = yes; ○ = no.)*

	Dell Computer	Gateway 2000	Olivetti	Zeos International
Subnotebook model	320SLi	HandBook	Quaderno	Pocket PC
Price	$2148 (with 4 MB of RAM)	$1295	$1195	$595
Processor	20-MHz 386SL	C&T 10-MHz 8680	16-MHz NEC V30HL (8088-compatible)	7.15-MHz NEC V30 (286-compatible)
RAM (standard/maximum)	2 MB/10 MB	1 MB/3 MB	1 MB/1 MB	1 MB/1 MB
Dimensions (D×W×H; inches)	7.8 × 11 × 1.3	5.9 × 9.8 × 1.4	6.0 × 8.3 × 1.2	4.5 × 9.6 × 0.88
Weight	3.6 lbs	2.75 lbs (with battery)	2.0 lbs	1.2 lbs
Display type	Reflective triple-supertwist LCD	Backlit supertwist LCD	Reflective LCD FSTN	Supertwist LCD
Keyboard layout	85 keys	78 keys	94 keys	81 keys
Integrated mouse	●	○	○	○
Battery type	Rechargeable nickel-metal hydride	Rechargeable nickel-metal hydride or six AA	Nickel-cadmium or six AA	Two AA
Battery life (vendor spec.) (without power conservation)	3.5 hours	2.5 hours	2 to 4 hours	10 hours
Recharge time	1.5 to 2 hours	2 hours	3 hours	Not applicable
External floppy drive	Standard	Optional	Optional	Optional (through parallel port)
Hard drive size	60 MB	40 MB	20 MB	IC cards (512 KB, 1 MB, 2 MB)
Ports	PCMCIA, serial, parallel, VGA, keyboard	Parallel, serial	Serial, parallel, PCMCIA	Serial, parallel, two PCMCIA Type 1
Accessories	Tape drive, battery charger, external keypad	2400-/9600-bps fax modem	Cigarette-lighter adapter	Serial and parallel adapters
Included software				
Editor	●	●	●	●
Spreadsheet	○	●	○	●
Database	○	●	○	●
Address book	○	○	●	●
Scheduler	○	●	●	●
File transfer	●	●	●	●
Other	MS-DOS, Windows	MS-DOS, Windows	MS-DOS, audio software	MS-DOS



Tests performed by the BYTE Lab indicate the type of battery life you can expect without power-conservation features. The Zeos Pocket PC used alkaline batteries; the other units were tested with rechargeable batteries.

Combo Unit. This $265 option houses an external floppy drive, as well as serial and parallel ports to supplement the ones found on the HandBook itself.

Microsoft Works for DOS, which comes loaded on the HandBook's 40-MB hard drive, was easy to use from the start. I was up and running with the unit right after unpacking it, and there was little need to read the simple user's guide.

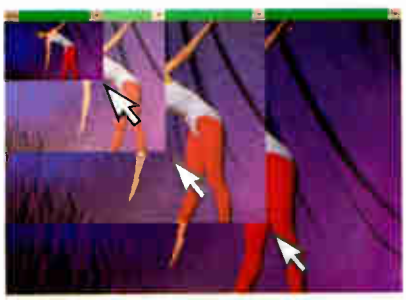
On one occasion, the HandBook slipped into a coma while in suspend mode, and no amount of fidgeting would awaken it. My call to Gateway's support line was answered quickly, though, and I was back up and running in less than 3 minutes. The solution: pressing a reset switch on the bottom of the machine. Another alternative—pressing Fn-Alt-Del to reshadow the BIOS, clear memory, and issue reset commands to some hardware functions—was ineffective, as was attempting to warm-boot the machine.

I was disappointed by the slow performance of the Chips & Technologies 8680 PC/Chip microprocessor that powered the HandBook. Often, something as simple as

World Radio History

Exercise Your Video ... Stretch It!

Why settle for an out-of-shape graphics board? Let ATI's new GRAPHICS ULTRA+ and GRAPHICS ULTRA PRO cards pump up your computer with graphics and multimedia video acceleration.



Only the GRAPHICS ULTRA+/PRO cards come ready to accelerate[1] multimedia applications under Windows. Stretch small video images to partial or full screen for better visibility ... and maintain smooth dynamic motion (when others fall behind).

ATI's *mach32* Accelerator Chip adds the muscle to run Windows, NT, OS/2 and CAD fast ... even faster than other local bus solutions. With 2.0MB of video memory, ATI accelerates 1024x768 in 65,000 colors. Run resolutions up to 1280x1024, colors up to 24-bit, and sit-up to flicker-free graphics at 76Hz refresh rate. Plus, the best software support of ANY accelerator product with ATI, VGA, VESA or 8514/A drivers.

accelerated by mach32 ATI TECHNOLOGIES INC

Exercise your options under Windows with the FlexDesk Control Panel or use DeskScan to pan and zoom across a virtual desktop. And our exclusive CRYSTAL FONTS smooths TrueType for laser-quality text right on-screen.

GRAPHICS ULTRA +

- Accelerated 1024x768 at 65,000 colors
- True color (16.7M) at 800x600
- Multimedia Video Acceleration
- Fast zero wait-state VGA
- Includes three button inport mouse[2]
- Available in 1.0MB or 2.0MB versions
- 5 year warranty
- Priced from $399.00[3]

GRAPHICS ULTRA PRO adds

- Even faster performance with VRAMs
- Accelerated 1280x1024 at 256 colors up to 74Hz non-interlaced
- Available in ISA, EISA and Micro Channel versions
- Priced from $599.00[3]

Avoid low impact graphics. Shape up with ATI Graphics and Multimedia Video Accelerators.

ACCELERATORS · GRAPHICS · MULTIMEDIA · COMMUNICATIONS

MICROSOFT WINDOWS COMPATIBLE · PC MAGAZINE EDITORS' CHOICE · DIGITAL '93 C CADalyst · MVP '92 WINNER · indeo INTEL VIDEO TECHNOLOGY

ATI TECHNOLOGIES INC.

Perfecting the PC

ATI TECHNOLOGIES INC.
3761 Victoria Park Avenue
Scarborough, Ontario
Canada M1W 3S2
Tel: (416) 756-0718
Fax: (416) 756-0720

Copyright © ATI Technologies Inc., 1993. All company and/or product names are trademarks and/or registered trademarks of their respective manufacturers. [1]Accelerates Indeo Video, RLE and Video 1 compressed files under Video for Windows. QuickTime for Windows support is planned. Performance varies depending on system configuration. [2]ISA versions only. [3]Suggested retail prices, dealers may sell for less. Prices and features are subject to change without notice.

Circle 67 on Inquiry Card.

World Radio History

saving a text file within Works took so long it left me wondering if I had stalled the system. Still, I liked this machine and loved the bright, backlit display.

Olivetti Quaderno

Like a fine Italian sports car, the $1195 Olivetti Quaderno is fine to behold. It has some nifty features. But like a sports car, this machine has limited appeal. The unit is highly compact, but the keyboard is too cramped for touch-typing. It also suffers from a dim reflective display.

The XT-compatible Quaderno includes audio features that set it apart from the other systems. Built-in audio-recording software lets you store voice messages in MS-DOS file format on the internal 20-MB hard drive. You can record voice files with a microphone hooked to a port on the computer's side and use them within any of the Quaderno's built-in applications or most word processors. The usual cassette-player controls—fast-forward, rewind, pause, play, and stop—are located on top of the machine, and you monitor functions on a small LCD screen that is always visible. You can use the controls even when the system is closed.

Built-in software includes a word processor, calculator, calendar, business card database, and phonebook. All are easily accessed from a main menu and are simple to learn. The unit is powered by a rechargeable nickel-cadmium battery or six AA batteries. Options include a car cigarette-lighter adapter and an external floppy drive. While the Quaderno is probably the most unique system in this lineup, it falls a bit short when confronted with serious business tasks.

Zeos Pocket PC

The Zeos Pocket PC strikes a middle ground between subnotebooks and palmtops. It's extremely portable, runs on AA batteries, and has built-in palmtop-style software, such as a scheduler and an address book. But the DOS interface and programs will still be familiar to PC notebook users.

As soon as you turn on the juice to the Pocket PC, an attractive main menu greets you, with graphical buttons depicting the eight built-in software applications. The choices include file management, calendar, to-do list, card file, and calculator software, Microsoft Works for DOS, a file transfer utility, and an information base listing international telephone area codes, weight and measure conversion tables, and user-customizable currency exchange rates. The combination of a function-key interface and an underlying DOS interface makes the Pocket PC easy to learn and use. The user's guide, however, is intimidating, with small, dark type and very little white space.

The Pocket PC is an XT-compatible system, making it a relatively slow machine. The keyboard, just wide enough for touch-typing, lacks a solid feel, but it employs an efficient layout with no keys mysteriously placed in awkward locations. The unit houses two PCMCIA card slots as well as a serial and parallel port.

At $595, and without a real hard drive, the Pocket PC comes very close to being categorized as an electronic organizer. In the end, however, it is distinguished from those devices by its 10-inch-wide keyboard size. If you're looking for one machine that doubles as a scheduler and a low-end subnotebook, Zeos offers a clever combination.

Photo 2: *Palmtop computers can usually fit in a coat pocket. They can handle scheduling, note-taking, and some pretty serious spreadsheet work—but forget touch-typing.*

PALMTOPS

Sharp Wizard OZ-9600

The OZ-9600 was the newest and in some ways the best palmtop computer I tested. Still, some improvements are required. The unit sells for $649 and comes standard with 256 KB of RAM.

Although too large and heavy to fit comfortably in any pocket, the OZ-9600 won't occupy too much space in a briefcase or handbag. And despite having the largest reflective LCD in the group, its application screens are often cramped with narrow rows and columns. The interface is sometimes difficult to navigate. At one point, I found myself stuck trying to delete an entry in the to-do list. A search through the user's guide revealed an overly complex menu system. And while the user's guide clearly explains how to use all the OZ-9600's many features, its heft and complexity can be intimidating.

I appreciated some of the unique features. The display, for example, is touch-sensitive. The special pen that ships with the device, when combined with integrated "digital ink" software, turns the OZ-9600 into an electronic notebook where you can write notes on the screen and store them away for later retrieval. This scrapbook might even temporarily substitute for the other integrated applications, such as the appointment scheduler or card file, until you have learned how to use them effectively.

Other interesting features include a built-in infrared system for transmitting data from one OZ-9600 to another (or to a personal computer hooked up to an optional interface device) and a built-in word processing program that is powerful enough to be used on a PC. Unfortunately, its power was difficult to use for very long because the machine's small keyboard is not well suited to touch-typing. Overall, the OZ-9600 is intriguing and powerful, but I found its interface somewhat complex.

Psion Series 3 256K-s

The $545 Psion Series 3 is the smallest, lightest, and best-looking of the three palmtops. It is also the easiest to learn because of its simple interface. I was able to effectively use the Series 3 right away. Icon buttons located just above the keyboard open the built-in applications. These applications include Lotus 1-2-3–compatible software, a personal scheduler, a calculator, a world clock, and a word processor. The keyboard itself is uncluttered, and the light keys are easily distinguished against the darker background. Like the other palmtops, though, it's too small for touch-typing.

A main menu on the reflective LCD lists the data contents of the various multitasking applications. The display itself is small but adequate.

Like Sharp's OZ-9600, the Series 3 is accompanied by a hefty user's guide, but this guide is not as well written. It did not,

World Radio History

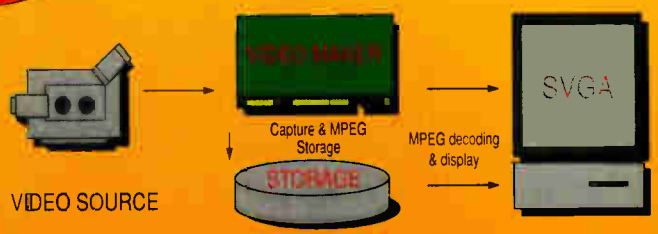
45 SECONDS OF COLOR VIDEO ON 1.44 MB !!!

VIDEO SEQUENCE CAPTURE: 1st MPEG SOLUTION

PROFESSIONAL FRAME CAPTURE: 16 MILLIONS OF COLORS

$695

Dealers are welcome !!



COMPARISON	VIDEO MAKER	THE MARKET
Movies capture	yes	no
MPEG compression	yes (about 30 Kbytes per second)	no
Digital VCR (100 % software)	yes	no
Frame capture	high professional quality	medium quality
Colors	16 millions colors per pixel 4:2:2 (2 times more color samples)	16 millions colors per pixel 4:1:1
Video standard	NTSC, PAL and SECAM	NTSC, PAL.
Spatial definition	768 x 576 (PAL and SECAM) 640x480 (NTSC)	720x512 (PAL) 640x480 (NTSC)
Aspect ratio	square pixel	rectangular pixel
Size of the board	short: compatible with desktop PCs	long
Technology	miniaturized: SMT	classic
Installation	no switches at all	many switches
IRQ, DMA	none: high compatibility	several IRQ and DMA
SVGA modes	all	limited
Video feature connector	not needed	absolutely necessary
RAM limitation in your PC	unlimited	conflict above 8 MB

Cable: 2 meters with RCA, BNC, SCART connectors

VIDEO MAKER™ is delivered with the best software under WINDOWS:

- **IMAGER™** : frame capture, video sequence capture, MPEG compression, image edition (color controls, text overlay, cropping, zoom, vertical & horizontal flip, numerous filters, contour extraction, ...), save images in .BMP (8 bits or 24 bits), .TIF (G, P, RGB, YUV, CMYK, ...), .PCX, .VSF, .MPG, ...
- **MPEG PLAYER™** : veritable digital VCR, letting you play MPEG-compressed sequences in normal mode or single-step forward or backward under WINDOWS 3.0 and 3.1.
- **MULTIMEDIA MANAGER™ from MULTIMEDIA TELECOM:** true generator of multimedia and hypermedia applications with the following main features:
  - intuitive icon-based interactive multimedia scenarios,
  - directly compatible with **VIDEO MAKER™**,
  - compatible with all the MPC audio cards (ex.: **SOUND BLASTER™**),
  - manages multimedia librairies with sound, image, ...
  - manages active regions in the images.

VIDEO MAKER
MANUFACTURER

U.S. & CANADA
Ph.: 404 921 61 67 - Fax.: 404 921 92 43
E.E.C. Ph.: 33.1.46.29.03.06
Fax.: 33.1.46.29.03.04

Circle 167 on Inquiry Card.

FREQUENCE H.M. 33 1 46 51 01 86

World Radio History

PALMTOP FEATURES

Table 2: *Palmtops are about the size of electronic calculators and run on alkaline batteries. The HP 95LX includes Lotus 1-2-3 in ROM. The Sharp Wizard OZ-9600 features a touchscreen and infrared communications.* (● = *yes;* ○ = *no.*)

	Hewlett-Packard	Psion	Sharp Electronics
Palmtop model	HP 95LX	Series 3 256K-s	Wizard OZ-9600
Price	$550 for 512-KB model, $799 for 1-MB model	$545	$649
Processor	NEC V20H (8088-compatible)	NEC V30H (80C86-compatible)	Proprietary
Standard RAM	512 KB or 1 MB	256 KB	256 KB
Dimensions (D×W×H; inches)	3.4 × 6.3 × 1.0	3.3 × 6.5 × 0.9	4.1 × 7.1 × 1.0
Weight	11 ounces	12 ounces	15 ounces
Display type	Supertwist LCD	Retardation film LCD	Touchscreen LCD
Display size (inches)	1.9 × 4.5	1.5 × 3.9	3.0 × 4.0
Ports	Serial	Serial	Serial, infrared
Card slots	One PCMCIA	Two (solid-state disks for RAM, EEPROM, or ROM)	One proprietary Wizard slot
Batteries	Two AA	Two AA	Four AAA
Options	Connectivity pack, serial interface, RAM cards, dictionary card	Serial and parallel interfaces, C development environment, language translator, software cards	Wireless printer and computer interfaces, PC and Mac link software, 30 software cards
Integrated software			
Editor	●	●	●
Spreadsheet	●	●	Optional
Calculator	●	●	●
Address book	●	●	●
Scheduler	●	●	●
To-do list	●	●	●
File transfer	●	●	●
Other	File utility	Database, programming language, world information, Spanish version	World clock, electronic ink pad, filer

for example, explain how to clear the calculator's "list of previous calculations," a pot into which all solved problems are thrown when a new problem is begun. Neither could I figure out how to do this on my own. To the day I sent the unit back, the list remained.

The Series 3 works very well as a simple organizer and scheduler. It does not offer some of the high-end features of the OZ-9600 or the HP 95LX, but it is very easy to learn and use. If you want an electronic replacement for your Day-Timer, the Series 3 is a solid choice.

Hewlett-Packard 95LX

The HP 95LX is quite plain, with a small keyboard featuring black keys on a black background, but don't let the aesthetics fool you. HP has packed a lot of power into a small package, as evidenced by the intimidating user's guide. The guide is nearly as thick as the Concise Oxford Dictionary that sits on the shelf above my PC. But there is a lot to cover here. The HP 95LX contains real Lotus 1-2-3, not a compatible, in ROM; and much of the manual is devoted to explaining the spreadsheet program alone. The HP 95LX also features a high-end HP scientific calculator and the usual array of applications: a to-do list, an appointment diary, a memo editor, a card file, and a telephone directory. It also has MS-DOS loaded into ROM.

For data communications, the HP 95LX is a powerhouse—especially considering the number of after-market wireless devices that will work with it to send and receive information over long distances. It also boasts the most on-board memory for data storage: The $799 model includes 1 MB; the $550 model holds 512 KB. Its reflective LCD is adequate.

If you have serious spreadsheet work in mind for your palmtop computer, the HP 95LX is an excellent choice. You'll also appreciate the connectivity pack for transferring files to your PC.

Carry-Along Alternatives

Subnotebook and palmtop computers serve very different needs. The larger machines, while they can be loaded with the same types of applications found in the palmtop models, are not nearly as portable and are usually more expensive. Moreover, battery life for the subnotebooks is measured in hours, not weeks or months as with the palmtops, and that often means you'll have to take along a cumbersome AC adapter. Add to that an external floppy drive and perhaps a spare battery, and you might be looking at a major nuisance.

You should consider these systems only if portability is your chief criterion. When testing the battery life of the subnotebooks (see the figure on page 166), the BYTE Lab discovered some problems with voltage levels on the serial port. The Gateway HandBook, in particular, provided unacceptable voltage levels to the serial port as battery power began to degrade. And, in general, the subnotebooks did not seem as sturdy as standard notebooks. These types of problems emphasize the nature of these units: They are not in the same class, in terms of power and functionality, as standard notebook computers.

World Radio History

The World At Your Fingertips.

"A wonder of small-scale engineering"
–*PC Week*
September 14, 1992

"The first mini PC with a keyboard large enough for serious typing"
–*PC World*
November 1992

"Blows the HP palmtop away"
–*Computer Shopper*
December 1992

INTRODUCING A 1.3 LB. PC! SEND & RECEIVE E-MAIL AND MORE.

Imagine a portable PC that lets you send and receive e-mail, modem a memo to the home office, write reports, create spreadsheets, manage your calendar, calculate your expenses...*work non-stop for ten hours*...and is so portable that it weighs about the same as a notepad.

A futuristic fantasy? Not unless the future is now. It's the ZEOS® Pocket PC, and only ZEOS has it. You're going to love how portable and affordable it is. In fact, we think you'll find it's the one PC you'll want to take with you everywhere!

COMPACT YET COMPLETE.

At only 9⅝" x 4½" and only 1.3 lbs., what's great about the ZEOS Pocket PC is that it has a keyboard you can really use. If you're accustomed to typing with both hands, switching to a palmtop can be awkward because the keyboard only lets you type with one hand or even one finger. Yet the ZEOS Pocket PC's keyboard lets you use both hands easily, so you won't sacrifice comfort and speed for portability.

And even though it's small, the ZEOS Pocket PC carries a *full suite of industry standard software* already loaded and ready to go! You get Microsoft DOS 5.0 system files with built-in file transfer and Microsoft Works 2.0 with word processing, spreadsheet, database and communications programs. Plus, you get a personal organizer which includes a calendar/planner, "to do" list, business card file, information retrieval (for country codes, converting measurements and currency) and more. It's everything you need to manage your life!

YOUR LINK TO THE WORLD.

Modem a memo to a client; send and retrieve your e-mail. With the Pocket PC's optional fax/modem, you can communicate worldwide. Plus, expanding the memory is another easy option—with an additional memory card that slips right into a slot on the system's underside. And that's not all.

IT JUST KEEPS GOING . . .

Ten hours of continuous use? Absolutely! All it takes is the two AA alkaline batteries included with your system. And your ZEOS Pocket PC has great power management, too—it automatically switches to the suspend mode when you take a break. Plus, when you turn off your system, then turn it on again, it goes right back to where you left off. What a time-saver!

FREE 24-HOUR TECH SUPPORT.

Questions about your purchase? ZEOS technical support is 24 hours a day, 365 days a year, and always toll-free. And we back every ZEOS purchase with our 30-Day Absolute Satisfaction Money-Back Guarantee, One Year Limited Warranty and more.

ORDER YOUR ZEOS POCKET PC TODAY. MAKES A GREAT GIFT!

Call us today at 800-554-5226. You're going to love the new ZEOS Pocket PC. *We guarantee it!*

SERVICE & RELIABILITY PC MAGAZINE READERS' CHOICE

BUY WITH CONFIDENCE.
ZEOS just won PC Magazine's *Readers' Choice for Service & Reliability (Feb. 9, 1993). We're the only PC vendor to earn the "Excellent" rating for both our laptop* and *desktop systems!*

- ***CPU:*** **Industry-standard NEC V30.**
- ***Memory:*** **1 MB of RAM and 1.5 MB of ROM.**
- ***Size:*** **Only 1.3 lbs., 9⅝" x 4½" x ⅞".**
- ***Power Supply:*** **Two AA alkaline batteries and 2032 Lithium back-up battery, all included. Ten hours battery life with continuous use, even more in suspend!**
- ***Preloaded Software:*** **MS-DOS 5.0 system files, Microsoft Works 2.0 (word processing, spreadsheet, database and communications programs) and a personal organizer, planner, to do list, card file, information retrieval and calculator.**
- ***I/O Ports:*** **One seriol, one parallel and two PCMCIA memory card connectors.**
- **Carrying case, cables and adapters included.**
- ***Power Management:*** **Automatic transition between active, doze and suspend modes.**
- ***Screen:*** **Easy-to-read 7" x 2¾", 640 x 200. 80 x 25 character display.**
- ***Keyboard:*** **81-key with 12 function keys, embedded numeric keypad and special-function hot keys.**
- ***Special Travel Kit only $24*** ***Comes with send/receive fax/modem and communications software.***

ORDER NOW TOLL FREE
800-554-5226

Fax Orders: 612-633-1325
Government: 800-245-2449
Outside U.S. and Canada: 612-633-6131
Hearing Impaired (TDD): 800-228-5389
MasterCard, VISA, Discover, American Express, Z-Card,℠ COD and Leasing Programs
Open 24 Hours a Day, 365 Days a Year!

All prices and specifications are subject to change without notice. Please call for current pricing and warranty details. ZEOS is a publicly traded company: NASDAQ symbol: ZEOS. © 1993 ZEOS International, Ltd., 1301 Industrial Blvd., Minneapolis, MN 55413 USA. All products and company names are trademarks or registered trademarks of their respective holders. PT1R-BYT-9304

ZEOS INTERNATIONAL LTD.

Circle 152 on Inquiry Card.

World Radio History

Of the units tested, I really appreciated the Dell 320SLi's larger keyboard and the form factor of the Zeos Pocket PC, but the Gateway HandBook offers a strong combination of features and, even with the optional floppy drive included, lists for almost $600 less than the 320SLi.

The palmtop units can be useless if your major work entails typing or using powerful PC software while mobile. They're intended as supplements, not substitutes, for a desktop or even a notebook PC. They can be very efficient organizational tools if used to their full advantage as replacements for the myriad scraps of paper that might be floating around in your pockets and on your desk right now. Because of its impressive mix of power and features, I recommend the HP 95LX. ■

Robert E. Calem is a freelance computer journalist based in New York. He can be reached on both BIX and MCI Mail as "rcalem."

COMPANY INFORMATION

Dell Computer Corp.
(320SLi)
9505 Arboretum Blvd.
Austin, TX 78759
(800) 289-3355
(512) 338-4400
fax: (512) 343-3653
Circle 1232 on Inquiry Card.

Gateway 2000, Inc.
(HandBook)
610 Gateway Dr.
North Sioux City, SD 57049
(800) 523-2000
(605) 232-2000
fax: (605) 232-2023
Circle 1233 on Inquiry Card.

Hewlett-Packard Co.
(HP 95LX)
Corvallis Division
1000 Northeast Circle Blvd.
Corvallis, OR 97330
(800) 443-1254
Circle 1234 on Inquiry Card.

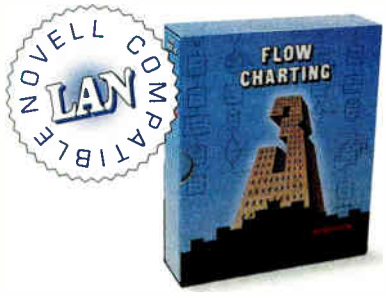
Olivetti
(Quaderno)
22425 East Appleway Ave.
Liberty Lake, WA 99019
(509) 927-5600
fax: (509) 927-5612
Circle 1235 on Inquiry Card.

Psion, Inc.
(Series 3 256K-s)
5 Concord Farms
555 Virginia Rd.
Concord, MA 01742
(508) 371-0310
fax: (508) 371-9611
Circle 1236 on Inquiry Card.

Sharp Electronics Corp.
(Wizard OZ-9600)
Wizard Division
Sharp Plaza
Mahwah, NJ 07430
(800) 321-8877
Circle 1237 on Inquiry Card.

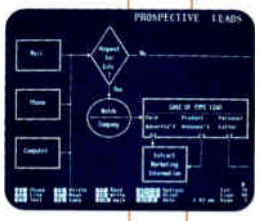
Zeos International, Ltd.
(Pocket PC)
1301 International Blvd.
Minneapolis, MN 55413
(800) 423-5891
fax: (612) 633-1325
Circle 1238 on Inquiry Card.

ARE YOU SPENDING TOO MUCH TIME DRAWING FLOWCHARTS?
YOU NEED FLOW CHARTING™ 3.



Every day, professionals worldwide save time and money using Flow Charting 3. It's fast, efficient, easy to use, and always produces presentation-perfect charts and diagrams.

With Flow Charting 3's built-in flexibility, you can create customized charts using a variety of shapes, lines, and text—placed where you want them.



Plus, Flow Charting 3 is now available in a LAN version. Making it easy to share files and set up work groups for specific projects.

And it's backed with free technical support and a 90-day no-risk guarantee. So if you're spending too much time drawing charts, call for a free demo and see for yourself what makes Flow Charting 3 the best-selling flowcharting software.

See your dealer today! Or for a free interactive demo disk,call 1-800-525-0082, ext. 112
International: 408-778-6557, ext. 112

Novell is a registered trademark of Novell, Inc.

PATTON & PATTON
Software Corporation

Excellence in charting the flow of ideas!

Patton & Patton Software Corp. 485 Cochrane Circle, Morgan Hill, CA 95037

Circle 115 on Inquiry Card.

World Radio History

YOUR DIRECT LINK CARD

For free product information, mail your completed card today. For quicker response, fax to 1-413-637-4343!

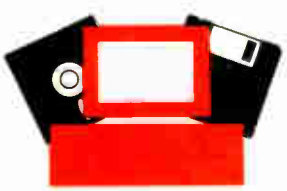
1. Circle the Numbers on Your Direct Link Card

Circle the numbers which are found on ads and articles in this issue or circle the product category number and receive information on all advertisers listed in that category.

2. Print Your Name and Address

Answer questions "A" through "E" and mail or fax card to 1-413-637-4343.

3. Product information will be rushed to you from the selected companies!



BYTE

Yes, I want FREE information on the following products!

Fill out this coupon carefully. ***Please Print.***

Name

Title

Company

Address

City State Zip

Phone Fax

A. What is your primary job function/principal area of responsibility? (Check one)

1 ❑ MIS/DIP
2 ❑ Programmer/Systems Analyst
3 ❑ Administration/Management
4 ❑ Sales/Marketing
5 ❑ Engineer/Scientist
6 ❑ Other

B. What is your level of management responsibility?

7 ❑ Senior-level 9 ❑ Professional
8 ❑ Middle-level

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?

10 ❑ Yes 11 ❑ No

D. What operating systems are you currently using? (Check all that apply)

12 ❑ PC/MS-DOS 15 ❑ Unix
13 ❑ DOS + Windows 16 ❑ MacOS
14 ❑ OS/2 17 ❑ VAX/VMS

E. For how many people do you influence the purchase of hardware or software?

18 ❑ 1-25 20 ❑ 51-99
19 ❑ 26-50 21 ❑ 100 or more

April 1993 86 96 98

Product Category Information

Circle the numbers below for information on the entire category of products you're interested in.

Hardware

Accessories/Supplies	1
Add-in Boards	2
Bar Coding	3
Communications/Networking	4
Computer Systems	5
Data Acquisition	6
Disks & Optical Drives	7
Diskettes/Duplicators	8
Fax Boards/Machines	9
Graphics Tablets/Mice/ Pen Input	10
Keyboards	11
LAN Hardware	12
Laptops & Notebooks	13
Mail Order	14
Memory/Chips/Upgrades	15
Miscellaneous Hardware	16
Modems/Multiplexors	17
Monitors & Terminals	18
Multimedia	19
Printers/Plotters	20
Programmable Hardware	21
Scanners/OCR/Digitizers	22
Tape Drives	23
UPS	24

Software

Business	25
CAD/CAM	26
Communications/Networking	27
Data Acquisition	28
Database	29
Educational	30
Engineering/Scientific	31
Entertainment	32
Graphics	33
Macintosh	34
Mail Order	35
Mathematical/Statistical	36
Miscellaneous Software	37
On-Line Services	38
Operating Systems	39
Programming Languages/ Tools	40
Security	41
Shareware	42
Software Duplication	43
Spreadsheets	44
Unix	45
Utilities	46
Windows	47
Word Processing	48

General

Books/Publications	49
Recruitment	50
Miscellaneous	51

Inquiry Numbers 52-233

52	78	104	130	156	182	208
53	79	105	131	157	183	209
54	80	106	132	158	184	210
55	81	107	133	159	185	211
56	82	108	134	160	186	212
57	83	109	135	161	187	213
58	84	110	136	162	188	214
59	85	111	137	163	189	215
60	86	112	138	164	190	216
61	87	113	139	165	191	217
62	88	114	140	166	192	218
63	89	115	141	167	193	219
64	90	116	142	168	194	220
65	91	117	143	169	195	221
66	92	118	144	170	196	222
67	93	119	145	171	197	223
68	94	120	146	172	198	224
69	95	121	147	173	199	225
70	96	122	148	174	200	226
71	97	123	149	175	201	227
72	98	124	150	176	202	228
73	99	125	151	177	203	229
74	100	126	152	178	204	230
75	101	127	153	179	205	231
76	102	128	154	180	206	232
77	103	129	155	181	207	233

Inquiry Numbers 234-408

234	259	284	309	334	359	384
235	260	285	310	335	360	385
236	261	286	311	336	361	386
237	262	287	312	337	362	387
238	263	288	313	338	363	388
239	264	289	314	339	364	389
240	265	290	315	340	365	390
241	266	291	316	341	366	391
242	267	292	317	342	367	392
243	268	293	318	343	368	393
244	269	294	319	344	369	394
245	270	295	320	345	370	395
246	271	296	321	346	371	396
247	272	297	322	347	372	397
248	273	298	323	348	373	398
249	274	299	324	349	374	399
250	275	300	325	350	375	400
251	276	301	326	351	376	401
252	277	302	327	352	377	402
253	278	303	328	353	378	403
254	279	304	329	354	379	404
255	280	305	330	355	380	405
256	281	306	331	356	381	406
257	282	307	332	357	382	407
258	283	308	333	358	383	408

Inquiry Numbers 409-590

409	435	461	487	513	539	565
410	436	462	488	514	540	566
411	437	463	489	515	541	567
412	438	464	490	516	542	568
413	439	465	491	517	543	569
414	440	466	492	518	544	570
415	441	467	493	519	545	571
416	442	468	494	520	546	572
417	443	469	495	521	547	573
418	444	470	496	522	548	574
419	445	471	497	523	549	575
420	446	472	498	524	550	576
421	447	473	499	525	551	577
422	448	474	500	526	552	578
423	449	475	501	527	553	579
424	450	476	502	528	554	580
425	451	477	503	529	555	581
426	452	478	504	530	556	582
427	453	479	505	531	557	583
428	454	480	506	532	558	584
429	455	481	507	533	559	585
430	456	482	508	534	560	586
431	457	483	509	535	561	587
432	458	484	510	536	562	588
433	459	485	511	537	563	589
434	460	486	512	538	564	590

Inquiry Numbers 591-765

591	616	641	666	691	716	741
592	617	642	667	692	717	742
593	618	643	668	693	718	743
594	619	644	669	694	719	744
595	620	645	670	695	720	745
596	621	646	671	696	721	746
597	622	647	672	697	722	747
598	623	648	673	698	723	748
599	624	649	674	699	724	749
600	625	650	675	700	725	750
601	626	651	676	701	726	751
602	627	652	677	702	727	752
603	628	653	678	703	728	753
604	629	654	679	704	729	754
605	630	655	680	705	730	755
606	631	656	681	706	731	756
607	632	657	682	707	732	757
608	633	658	683	708	733	758
609	634	659	684	709	734	759
610	635	660	685	710	735	760
611	636	661	686	711	736	761
612	637	662	687	712	737	762
613	638	663	688	713	738	763
614	639	664	689	714	739	764
615	640	665	690	715	740	765

Inquiry Numbers 766-947

766	792	818	844	870	896	922
767	793	819	845	871	897	923
768	794	820	846	872	898	924
769	795	821	847	873	899	925
770	796	822	848	874	900	926
771	797	823	849	875	901	927
772	798	824	850	876	902	928
773	799	825	851	877	903	929
774	800	826	852	878	904	930
775	801	827	853	879	905	931
776	802	828	854	880	906	932
777	803	829	855	881	907	933
778	804	830	856	882	908	934
779	805	831	857	883	909	935
780	806	832	858	884	910	936
781	807	833	859	885	911	937
782	808	834	860	886	912	938
783	809	835	861	887	913	939
784	810	836	862	888	914	940
785	811	837	863	889	915	941
786	812	838	864	890	916	942
787	813	839	865	891	917	943
788	814	840	866	892	918	944
789	815	841	867	893	919	945
790	816	842	868	894	920	946
791	817	843	869	895	921	947

Inquiry Numbers 948-1122

948	973	998	1023	1048	1073	1098
949	974	999	1024	1049	1074	1099
950	975	1000	1025	1050	1075	1100
951	976	1001	1026	1051	1076	1101
952	977	1002	1027	1052	1077	1102
953	978	1003	1028	1053	1078	1103
954	979	1004	1029	1054	1079	1104
955	980	1005	1030	1055	1080	1105
956	981	1006	1031	1056	1081	1106
957	982	1007	1032	1057	1082	1107
958	983	1008	1033	1058	1083	1108
959	984	1009	1034	1059	1084	1109
960	985	1010	1035	1060	1085	1110
961	986	1011	1036	1061	1086	1111
962	987	1012	1037	1062	1087	1112
963	988	1013	1038	1063	1088	1113
964	989	1014	1039	1064	1089	1114
965	990	1015	1040	1065	1090	1115
966	991	1016	1041	1066	1091	1116
967	992	1017	1042	1067	1092	1117
968	993	1018	1043	1068	1093	1118
969	994	1019	1044	1069	1094	1119
970	995	1020	1045	1070	1095	1120
971	996	1021	1046	1071	1096	1121
972	997	1022	1047	1072	1097	1122

Inquiry Numbers 1123-1304

1123	1149	1175	1201	1227	1253	1279
1124	1150	1176	1202	1228	1254	1280
1125	1151	1177	1203	1229	1255	1281
1126	1152	1178	1204	1230	1256	1282
1127	1153	1179	1205	1231	1257	1283
1128	1154	1180	1206	1232	1258	1284
1129	1155	1181	1207	1233	1259	1285
1130	1156	1182	1208	1234	1260	1286
1131	1157	1183	1209	1235	1261	1287
1132	1158	1184	1210	1236	1262	1288
1133	1159	1185	1211	1237	1263	1289
1134	1160	1186	1212	1238	1264	1290
1135	1161	1187	1213	1239	1265	1291
1136	1162	1188	1214	1240	1266	1292
1137	1163	1189	1215	1241	1267	1293
1138	1164	1190	1216	1242	1268	1294
1139	1165	1191	1217	1243	1269	1295
1140	1166	1192	1218	1244	1270	1296
1141	1167	1193	1219	1245	1271	1297
1142	1168	1194	1220	1246	1272	1298
1143	1169	1195	1221	1247	1273	1299
1144	1170	1196	1222	1248	1274	1300
1145	1171	1197	1223	1249	1275	1301
1146	1172	1198	1224	1250	1276	1302
1147	1173	1199	1225	1251	1277	1303
1148	1174	1200	1226	1252	1278	1304

Inquiry Numbers 1305-1479

1305	1330	1355	1380	1405	1430	1455
1306	1331	1356	1381	1406	1431	1456
1307	1332	1357	1382	1407	1432	1457
1308	1333	1358	1383	1408	1433	1458
1309	1334	1359	1384	1409	1434	1459
1310	1335	1360	1385	1410	1435	1460
1311	1336	1361	1386	1411	1436	1461
1312	1337	1362	1387	1412	1437	1462
1313	1338	1363	1388	1413	1438	1463
1314	1339	1364	1389	1414	1439	1464
1315	1340	1365	1390	1415	1440	1465
1316	1341	1366	1391	1416	1441	1466
1317	1342	1367	1392	1417	1442	1467
1318	1343	1368	1393	1418	1443	1468
1319	1344	1369	1394	1419	1444	1469
1320	1345	1370	1395	1420	1445	1470
1321	1346	1371	1396	1421	1446	1471
1322	1347	1372	1397	1422	1447	1472
1323	1348	1373	1398	1423	1448	1473
1324	1349	1374	1399	1424	1449	1474
1325	1350	1375	1400	1425	1450	1475
1326	1351	1376	1401	1426	1451	1476
1327	1352	1377	1402	1427	1452	1477
1328	1353	1378	1403	1428	1453	1478
1329	1354	1379	1404	1429	1454	1479

World Radio History

YOUR DIRECT LINK CARD

For free product information, mail your completed card today. For quicker response, fax to 1-413-637-4343!

See reverse side for card.

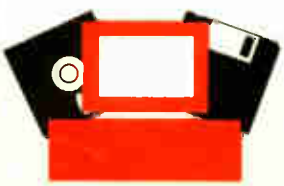
1. Circle the Numbers on Your Direct Link Card

Circle the numbers which are found on ads and articles in this issue or circle the product category number and receive information on all advertisers listed in that category.

2. Print Your Name and Address

Answer questions "A" through "E" and mail or fax card to 1-413-637-4343.

3. Product information will be rushed to you from the selected companies!



BYTE

BUSINESS REPLY MAIL

FIRST CLASS MAIL PERMIT NO. 176 PITTSFIELD, MA

POSTAGE WILL BE PAID BY ADDRESSEE

BYTE

READER SERVICE

P.O. BOX 5110

Pittsfield, MA 01203-9926

USA

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

World Radio History

HARDWARE

PowerBook Peripherals

TOM THOMPSON

In October 1991, Apple introduced the PowerBooks, the company's new line of notebook computers. A year later, Apple delivered more powerful PowerBooks and introduced new, lightweight PowerBook Duos designed for docking stations. As small and light as the original PowerBook and the PowerBook Duo are, their designs actually offer significant room for expansion. Both models have two slots: a memory slot for adding extra RAM and a modem slot for installing an optional modem.

Unfortunately, Apple offers only a few options for these systems: a pricey 4-MB RAM expansion board for each machine; a 14,400-bps data and 9600-bps fax modem, called the Express Modem, for each machine; and a 2400-bps fax/data modem for the PowerBook. Naturally, third-party vendors leapt at the opportunity to get a piece of the PowerBook action, and they quickly offered their own expansion hardware at competitive prices.

To see how this third-party expansion market is developing, I gathered together a variety of peripherals, ranging from network connectors to modems to a Duo docking unit, for evaluation. For hardware, I used a PowerBook 180 and a PowerBook Duo 230. This review is by no means intended to be a comprehensive guide to every PowerBook peripheral on the market, but it does offer an overview of some of the more significant products that are now available.

While I found plenty of products for the standard PowerBooks, there were virtually none for the Duo. Two factors account for this paucity of Duo peripherals. First, the Duo is a new design, on the market for scarcely six months. Second, the dimensions and power requirements for Duo expansion boards are radically different from those of the PowerBook, which means that even seasoned third-party vendors practically had to start over on the peripheral designs.

At the time of this review, most Duo products were still preliminary or in very short supply. Even Apple was experiencing difficulties: The Duo 230 that it sent me came without an Express Modem or MiniDock. By the time you read this, however, more Duo peripherals will be available.

Photo 1: *Two ways for PowerBooks to tap into Ethernet: Asanté's EN/SC PB (left) and Dayna Communications' DaynaPort SCSI/Link-3 PB (right).*

Outside In

Gaining access to the PowerBooks' innards is a simple matter of loosening some screws. You'll need a Torx #10 and a Torx #8 driver for the PowerBook 140, 145, and 170, while just a Torx #8 suffices for the PowerBook 160 and 180 and the Duo 210 and 230.

First, shut down the PowerBook and take out the battery. Remove the four screws from the bottom and then the one at the back. Next, *gently* pry open the PowerBook at the front seam, starting at the battery compartment. Then unplug the SCSI cable from the internal hard drive and separate the top and bottom sections of the notebook to get at the slots.

To open up the PowerBook Duo, you loosen the three rearmost screws on the bottom of the computer. (Do not loosen the deeply recessed screw near the front!) Then turn the Duo over, and gently pry up the keyboard with your fingernail. Don't yank it, because the keyboard is attached to the main unit by two slender ribbon cables. Beneath the keyboard, on the main logic board's right side, are the two slots for memory and a modem board.

For a good description of how to open a PowerBook safely, get a copy of *The PowerBook Companion* by Richard Wolfson (Addison-Wesley, 1992). This book is chock full of tips and hints on the care and feeding of PowerBooks, and it's well worth the money.

Exercise care when opening these computers, as you can easily damage them. Neither I nor BYTE is responsible if you damage your PowerBook while following these instructions. If you're not handy with tools or if the PowerBook is still under warranty, take the computer and peripheral to a dealer for installation.

Network Connections

The high-end PowerBooks (the 160, 170, and 180) have enough processing power and hard disk capacity (80 to 120 MB) to make them suitable as substitute desktop systems. But how do you connect them to the office network? Of course, there's the LocalTalk port, but if the notebook is going to play desktop computer, you will also want it to manipulate large chunks of data. That job requires being hooked into Ethernet.

Some hardware solutions are available. Two are Dayna Communications' DaynaPort SCSI/Link-3 PB and Asanté's EN/SC PB (see photo 1). These are Ethernet interface units that attach to the PowerBook's SCSI port. Clever Ethernet driver software routes network traffic through the SCSI port, to the interface unit, and out over the network. Both units have two DB-25 SCSI ports and a SCSI ID selector switch so that they can be daisy chained with other SCSI devices; they provide thick, thin, and 10Base-T Ethernet connectors. Be sure that you specify the PB version to obtain the special HDI-30 SCSI–to–DB-25 SCSI adapter cable required to connect these

World Radio History

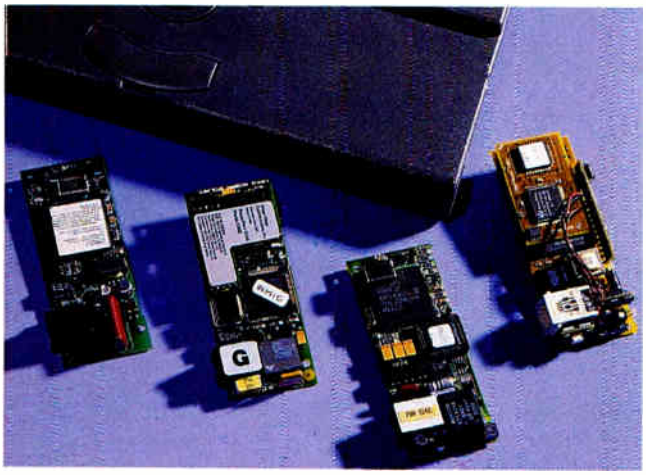


Photo 2: *Internal modems for the PowerBook (from left to right): PSI Integration's PowerModem IV, Global Village's PowerPort/Gold, Supra's SupraFaxModem 144PB, and Applied Engineering's DataLink PB.*

peripherals to the PowerBook.

Both the SCSI/Link-3 PB and the EN/SC PB provide an Installer disk, along with the appropriate driver software. Be careful when you do the installation: The Dayna installation script wants to install a serial version of the driver (it has no way of knowing there's a SCSI device present if the SCSI/Link-3 isn't powered on, so it guesses), and the Asanté installation script wants to add AppleTalk 57. Version 57 supplies some important features that the driver requires, but it is superseded by AppleTalk 58, which is found in the PowerBook 160 and 180. For both peripherals, you should click on the Custom Installation button when you run the Installer and make the choices yourself. If you sidestep these pitfalls, the SCSI/Link-3 PB and the EN/SC PB both work well, providing high-speed Ethernet communications—including printing and file sharing—with a minimum of trouble.

If you are unable to get an Ethernet connection because you have a PowerBook Duo (which doesn't have a built-in SCSI port), check out Farallon's PowerPath solution. PowerPath consists of two PhoneNet nodes and a cable, plus a disk of software. You plug one node into the Duo's LocalTalk port and the other into the printer port of a desktop Mac connected to Ethernet. Then you copy the PowerPath Control Panel to the desktop Mac and reboot.

The PowerPath software acts as a forwarding agent, routing network traffic appearing at the printer port onto the Ethernet network. From a Duo 230 connected to my office Mac IIci running PowerPath, I was able to access BYTE's file servers and printers located on the Ethernet. Furthermore, when the Duo ran File Sharing, other Macs on the network could see the Duo and access its hard drive. Network traffic operates at LocalTalk speeds, and the host Mac's performance plummets when the Duo accesses the network; still, at $149, the PowerPath offers a quick but elegant network connection for Duo owners.

Going Serial

For keeping in touch with the office, either by E-mail or by ARA (AppleTalk Remote Access), you have a wide choice of PowerBook-compatible modems (see photo 2). I looked at four V.42bis/V.32bis modems: Global Village Communication's PowerPort/Gold, PSI Integration's PowerModem IV, Applied Engineering's DataLink PB, and Supra's SupraFaxModem 144PB. These modems have 14,400-bps data and send/receive fax capabilities, except for the PowerPort/Gold (14,400-bps data, 9600-bps send/receive fax). Each is compliant with MNP levels 2–5; the DataLink PB also complies with MNP level 10.

The DataLink PB also comes with built-in digitizer hardware and memory that allow it to act as a telephone, a speakerphone, and an answering machine. I didn't check out this feature because it required soldering wires to the PowerBook 180's main logic board.

Each modem has disks containing fax software, a CCL (Connection Control Language) file for ARA, and perhaps a modem control panel. All come bundled with terminal-emulation software—typically MicroPhone 1.7, except for the DataLink PB, for which a freeware terminal application is provided. I had no problem installing any of the boards.

For modem tests, I called the National Bureau of Standards atomic clock to reset the PowerBook's date and time (which get lost when you remove the battery during modem installation), faxed a three-page document with a mix of typefaces to our fax machine, and dialed into BYTE's AppleTalk network as an ARA client. I used Shiva's LanRover/L and an external SupraFaxModem to manage the ARA server connection.

Global Village's Control Panel 2.04 did not recognize the PowerBook 180. However, the PowerPort/Gold still functioned, so I called AppleLink and downloaded the company's 2.06 software revision. Once I updated the software, the PowerPort/Gold was the only modem to run through the tests without problems. The PowerPort/Gold's data dial-up test ran cleanly; the faxed output was crisp at the high-quality settings; and I got good 14,400-bps ARA connections to the network every time.

With the other three modems I experienced some problems, all having to do with software. The difficulties involved either the CCL file, which ARA relies on to configure the modem properly and to establish a connection, or the fax software. PSI Integration, Applied Engineering, and Supra all rely on STF Technologies for their fax software. For the DataLink PB and the SupraFaxModem, the STF Installer didn't have the name of the modem in its selection list. I had to guess, using a related modem name, or install the software by driver type. Once the software was installed properly, I got fine faxes out of these modems.

The PowerModem IV faxed without incident, but I had all sorts of problems trying to establish an ARA session with it. With the PowerModem IV CCL, ARA did not recognize the modem at all. A

BYTE ACTION SUMMARY

- **WHAT POWERBOOK PERIPHERALS ARE**
  Third-party hardware that delivers expanded functionality—communications, network connections, or other services—to Apple PowerBooks.
- **LIKES**
  These peripherals connect your PowerBook to the world.
- **DISLIKES**
  There's a dearth of peripherals for the Duo Dock; some of the modems have software problems.
- **RECOMMENDATIONS**
  Wait for the PowerBook Duo peripherals market to mature somewhat before making any large-scale purchases.

World Radio History

"I couldn't find a powerful CASE tool that was affordable. So I designed one."

JAN POPKIN, CHIEF SCIENTIST
POPKIN SOFTWARE & SYSTEMS, INC.

"I'm an engineer. And I know what it's like to need a high-performance and easy-to-use CASE tool. One that I could afford to place on every project team member's desk, not just a select few. That's why I developed System Architect.™

As Chief Scientist at Popkin Software, my role is to bring the experiences of our developers to bear on the design of the best CASE tool possible. System Architect is the result."

Low Price. High Performance.

Since its introduction in 1988, System Architect (SA) has proven that many of the features offered by more expensive CASE tools are available for a fraction of the cost. There are now more than 12,000 SA copies in use at 3,000 installations worldwide.

MICROSOFT WINDOWS.

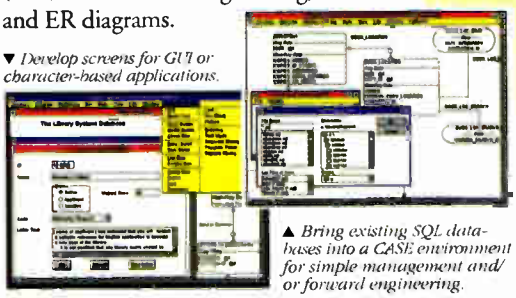
Quick And Easy.

System Architect works on IBM® and IBM-compatible PCs running *MS Windows*® or *OS/2 PM*®. It comes with an integrated data dictionary that users can customize to meet their needs. Project personnel can easily share information both on and off a network. It's so user-friendly that even from the first day you can sit down, get to work, and produce results.

Multiple Choice.

SA works with multiple methodologies: Yourdon/DeMarco, Gane & Sarson, Ward & Mellor (real-time), Shlaer/Mellor (OO), Information Engineering, SSADM, and ER diagrams.

▼ *Develop screens for GUI or character-based applications.*



▲ *Bring existing SQL databases into a CASE environment for simple management and/or forward engineering.*

The Power To Grow.

To respond to advances in technology such as Client/Server Architecture, SA continues to grow in functionality and productivity. A few optional modules now offered are:

SA Reverse Data Engineer: Provides reverse engineering of SQL databases, including DB2, Informix, Oracle, and SQL Server. Allows existing SQL databases to be brought into a CASE environment for management, enhancement, and/or forward engineering. Provides generation of graphic screens and menus from .DGL and .MNU files. And ensures new SQL database applications are built with the proper design integrity.

SA Screen Painter: Automatically creates screens for GUI or character-based applications from your SA Data Dictionary; captures existing screens; provides an easy-to-use tool for designing screens from scratch—or mix-and-match all 3 methods; generates MS Windows dialogs and Microsoft Microfocus COBOL Screen Sections.

SA Schema Generator: Translates entity models from the encyclopedia into schema for DB2, Oracle, Ingres, SQL Server, Rdb, PROGRESS, Paradox, SQL Base, AS400 (SQL & DDS), Interbase, OS/2 DBMS, dBASE III, XDB, SYBASE, and Informix. Generates Windows DLGs, and C type data definitions or COBOL data structures.

SA Object Oriented Analysis & Design (OOA/OOD): Supports Booch '91 and Coad/Yourdon.

SA Network Version: Diagram and data dictionary record locking allows multiple project members to work concurrently on the same project.

All The Tools You Need.

SA also has other features: automated documentation; extensible dictionary; normalization, rules and balancing; requirements traceability; import/export; custom reporting; and CRUD Matrices.

Call us toll-free today at 800-REAL-CASE, x109.

To find out how to qualify for your free 30-day evaluation copy, simply call us today or fax us at 212-571-3436.

SYSTEM ARCHITECT

Popkin Software & Systems, Inc.,
11 Park Place, New York, NY 10007
England 44-926-881186; Benelux 31-3406-65530;
Germany 49-6151-82077; Italy 39-49-8700366;
Switzerland 41-61-6922666; Denmark 45-45-823200;
Australia 61-02-346499; Sweden 46-8-626-8100.

©1993 Popkin Software & Systems Incorporated. The System Architect logo is a trademark of Popkin Software & Systems, Inc. All other brand names and products are trademarks or registered trademarks of their respective holders. Specifications subject to change at the sole discretion of the company.

Circle 123 on Inquiry Card.

World Radio History

call to PSI's technical support confirmed that this CCL file was bad. The company sent me a new version of the file via AppleLink, and, at last, I was able to get ARA sessions at 14,400 bps.

The SupraFaxModem had the same problem, but I found a CCL (the Practical Peripherals 14400-SXFA) that allowed me to establish 14,400-bps ARA sessions reliably. The DataLink PB was the only modem besides the PowerPort/Gold whose CCL file worked perfectly the first time, providing me with 14,400-bps sessions.

These are all good modems, but their effectiveness can be seriously hampered by the software. Global Village writes its own fax software to avoid problems. PSI has just bought STF's fax source code so it can manage its own updates and add new features, such as a one-stop fax menu and OCR (optical character recognition) software.

Currently, only a few fax machines can accept faxes at 14,400 bps, but that will change over time. Those funky CCL files are a more serious problem. Most people shell out extra for these modems so that they can connect to the office network through ARA at high speeds. An ineffective CCL file can turn that high-performance, high-priced modem into useless junk.

Getting Docked

Earlier, I mentioned a shortage of PowerBook Duo peripherals. In fact, there was exactly one ready at review time: E-Machines' PowerLink Presentor.

Photo 3: *E-Machines' PowerLink Presentor plugs into the Duo's back expansion connector and provides a floppy drive connector, a port for the ADB, a sound jack, and external video ports.*

This docking module plugs into the Duo's back expansion connector and brings out a variety of useful signals. There is an HDI-20 floppy drive connector, a port for the ADB (Apple Desktop Bus), a sound jack, a DB-15 RGB video port, and a composite video port. The PowerLink Presentor's driver and frame buffer support monitors in sizes ranging from 13 inches (displaying 256 colors) to 21 inches (displaying 16 colors). The PowerLink Presentor also supports a "virtual desktop" 1656 by 1296 pixels when it's in black-and-white mode.

I plugged the PowerLink Presentor into the back of the Duo 230 (see photo 3) and checked it out. It worked fine driving both 13- and 16-inch Apple monitors. Better still, I didn't have to plug in the power charger to use them—unlike with the PowerBook 180, which insists on running off its power charger when an external monitor is connected.

The video mirroring mode worked fine (video mirroring allows you to see an identical image on both the PowerBook screen and the external monitor), as did a mouse plugged into the ADB port. I plugged a stereo amplifier input cable into the sound jack and got bowled over when a beep sound came blasting out of the speakers.

I routed the composite video to a small color monitor and got a good image: E-Machines has some sophisticated deconvolution hardware inside the PowerLink Presentor that minimizes the shimmering that occurs when 1-pixel-wide lines are shown on an interlaced display. A Duo, monitor, PowerLink Presentor, and mouse would make a dandy on-the-road demonstration machine.

The diversity in the current crop of peripherals indicates that the PowerBook market is growing rapidly. The presence of different vendors, especially for modems, will only produce better products while driving prices down. I expect to see even more interesting things happen when the PowerBook Duos arrive in force. Stay tuned. ■

Tom Thompson is a BYTE senior technical editor at large with a B.S.E.E. from Memphis State University. He is also an Associate Apple Developer. You can contact him on BIX as "tom_thompson," or on the Internet at tomt@byteph.byte.com.

ITEMS DISCUSSED

DataLink PB $525
Applied Engineering, Inc.
3210 Beltline Rd.
Dallas, TX 75234
(800) 554-6227
(214) 241-6060
fax: (214) 484-1365
Circle 1075 on Inquiry Card.

DaynaPort SCSI/Link-3 PB.....$499
Dayna Communications, Inc.
50 South Main St., Fifth Floor
Salt Lake City, UT 84144
(801) 531-0600
Circle 1076 on Inquiry Card.

EN/SC PB (for thick, thin, and 10Base-T cable).....$499
EN/SC 10-T PB (for 10Base-T only).....$419
Asanté Technologies, Inc.
821 Fox Lane
San Jose, CA 95131
(408) 435-8388
fax: (408) 432-7511
Circle 1077 on Inquiry Card.

PowerLink Presentor....$499
E-Machines, Inc.
9305 Southwest Gemini Dr.
Beaverton, OR 97005
(800) 344-7274
(503) 646-6699
fax: (503) 641-0946
Circle 1078 on Inquiry Card.

PowerModem IV $495
PSI Integration, Inc.
851 East Hamilton Ave.,
Suite 200
Campbell, CA 95008
(800) 622-1722
(408) 559-8544
fax: (408) 559-8548
Circle 1079 on Inquiry Card.

PowerPath.....$149
Farallon Computing
2470 Mariner Square Loop
Alameda, CA 94501
(510) 814-5000
fax: (510) 814-5023
Circle 1080 on Inquiry Card.

PowerPort/Gold.....$499
Global Village Communication
685 East Middle Field Rd.,
Building B
Mountain View, CA 94043
(800) 736-4821
(415) 390-8200
fax: (415) 390-8361
Circle 1081 on Inquiry Card.

SupraFaxModem 144PB.....$349.95
Supra Corp.
7101 Supra Dr. SW
Albany, OR 97321
(503) 967-2400
fax: (503) 967-2401
Circle 1082 on Inquiry Card.

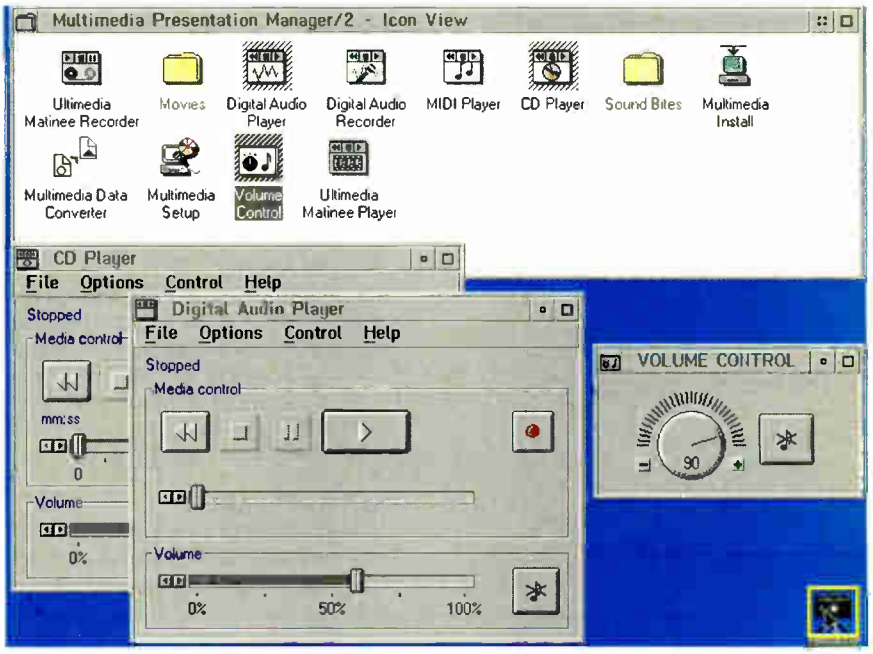
World Radio History

SOFTWARE

OS/2's Multimedia Extensions

TOM YAGER

With the release of Multimedia Presentation Manager/2, IBM bridges the gap between OS/2 and the world of multimedia. MMPM/2 builds a systems-level foundation for multimedia applications into OS/2, inviting developers and multimedia producers to create their programs and materials on IBM's powerful PC operating environment.



MMPM/2's standard applications are functional, but the real power of OS/2 multimedia is best seen from a programmer's point of view.

The Flyby

IBM didn't spend a lot of time making MMPM/2 glamorous. The packaging and documentation are minimal. That treatment fits, though, because MMPM/2 isn't an application; it's an OS/2 extension. You can get the basic version of MMPM/2 on floppy disks or preinstalled on a PS/2 system, or grab the development kit on CD-ROM (MMPM Toolkit/2).

The basic version of MMPM/2 came to me loaded onto a PS/2 Ultimedia Model 77. This system, and its less-expensive brother, the M57 SLC (see "IBM's New System Speaks for Itself," September 1992 BYTE), are the target hardware environment for MMPM/2. I had both the shipping version and a prerelease of the next version of MMPM/2 for this review, and while I can't go into detail about those things that aren't real yet, I can say that IBM is planning some support for non-PS/2 systems.

I installed the CD-ROM developer's toolkit version onto my system. The installer lets you choose from among the available drivers and modules, which include complete on-line manuals, sample source code, and the header files and libraries you need to write C or assembly language programs. Standard multimedia device support in MMPM/2 1.0 includes digital audio and MIDI (through the M/Audio board), CD audio, and videodisc control. The prerelease included CD-ROM XA (Extended Architecture) support, and that will be standard in MMPM/2 in the future as well.

You don't get a lot of cute sample programs in MMPM/2. You get only a media player, volume control, and data converter. The media player records digital audio as well (see the screen), but it provides no control over sampling rate, record level, and other settings. The volume control is as close as MMPM/2 gets to the central mixer applet bundled with most Windows sound boards. Just one knob controls the volume for the entire system's audio output. The data converter is most useful for converting audio and graphics originally created in AVC (Audio Visual Connection—IBM's most popular multimedia development system) to MMPM/2 formats.

The media player itself is merely functional. When you play CD audio, for example, you see only the total playing time of the disc on the seek slider; there are no track markers or next/previous track buttons. It works, but as your primary introduction and interface to MMPM/2, the media player belies the power of the structure beneath it. The media player launches automatically when you double-click on a multimedia file from within the Workplace Shell. Unlike Windows, which is hobbled by the DOS file system, OS/2 can identify multimedia files either by extension or by data in the file's extended attributes.

Digging In

To appreciate MMPM/2 today, you must look at it from a developer's point of view. IBM wisely chose to create a structure and an API for its multimedia extensions that are very similar to Microsoft's. The benefit is obvious: It's easier for IBM to coax developers into an environment that's familiar to them.

There are a number of low-level calls, but you'll likely use MMPM/2's high-level API. IBM's MCI (media control interface) is a superset of Microsoft's, so if you're Windows MCI–savvy, you'll feel right at home. The MCI string interface reduces most multimedia programming to simple commands like `play iquit.wav` that you can easily build into your applications regardless of the language.

MMPM/2 is no clone: It has several intriguing and useful traits that distance it from Windows' multimedia extensions. Among the notable enhancements offered by IBM are playlists, cuepoints, closed captioning, and connectors. A playlist is a microprogram that lets you exert precise control over the data stream associated with an open MCI device. The machine language–like playlist instructions include branches, loops, and subroutines, and playlist programs offer many benefits of driver-level operations without forcing you to dabble in low-level or device-dependent code.

MMPM/2's cuepoint interface allows

World Radio History

BYTE ACTION SUMMARY

- **WHAT MULTIMEDIA PRESENTATION MANAGER/2 IS**
  An OS/2 extension providing extensible support for multimedia devices and programs.
- **LIKES**
  Powerful API; closed captioning.
- **DISLIKES**
  Poor set of standard applications.
- **RECOMMENDATIONS**
  The most powerful PC multimedia environment available. A good choice for multimedia applications developers.
- **FOR MORE INFORMATION**
  IBM
  1000 Northwest 51st St.
  Boca Raton, FL 33429
  (800) 426-2468
  Circle 1222 on Inquiry Card.

you to drop markers at precise, arbitrary positions in a media stream, from within your application. Each time a marker is hit during recording or playback, a message is dispatched to your application. Cue-points can be embedded in MMPM/2 data files in addition to being set at run time.

Closed captioning offers multimedia producers an easy system for providing running caption text with audio. This is an extremely thoughtful aid for persons with hearing impairment.

Finally, MMPM/2's connector interface puts your program in charge of those hardware signal paths under the system's control. You can, for example, connect the CD audio output to the system's headphone jack, or switch the audio card's recording input from the microphone to the line input jack. Connectors elegantly solve the problem of managing signal flows, but they can also be applied to data streams; this patchcord metaphor works just as well for audio as for data.

Borrowed but Blue

That MMPM/2 looks so much like Windows' multimedia extensions doesn't bother me a bit; I consider it an asset. But once you peel away the look-alike layers, you learn that IBM's multimedia foundation is much more powerful than Windows'.

As a developer, I became instantly enamored with the greater control offered by IBM's MCI. OS/2 is not constrained by the limitations of a DOS environment (e.g., dealing with DOS device drivers, working within a segmented memory model, or making things run on a 286 system), so it's no surprise that MMPM/2 attains a higher standard than the multimedia extensions built into Windows 3.1. Developers who take the time to dig deeper than the Windows-compatible layers will find a well-designed support structure for demanding multimedia applications. Certainly, anyone who thinks Windows is the only game in town for multimedia development needs to take a look at OS/2 and MMPM/2. ■

Tom Yager is a multimedia consultant, analyst, and developer, and author of The Multimedia Production Handbook for the PC, Macintosh and Amiga *(Academic Press, forthcoming). He can be reached on BIX as "tyager" and on the Internet at tyager@bytepb.byte.com.*

The Perfect Back-up For An Imperfect World.

Accidents don't happen in perfect worlds. In *this* world, the best solution is VALITEK.

VALITEK builds every tape back-up drive as though your business depends on it. There's no safer, simpler, smarter tape back-up drive anywhere. No installation. No controller cards. No pre-formatting tapes. Back-up from 60 MB to 1.2 GB with speed and reliability no bargain basement tape drive can begin to match.

Complete portability. Rock-solid construction. Uncompromising quality.

When you can't afford to lose a single bit of data, can you afford anything less than VALITEK?

VALITEK

100 University Drive, Amherst, MA 01002
CALL: 1-800-VALITEK or 413-549-2700
FAX: 413-549-2900 BBS: 413-549-7560

The worldwide leader in parallel/serial technology

Circle 147 on Inquiry Card.

World Radio History

HARDWARE

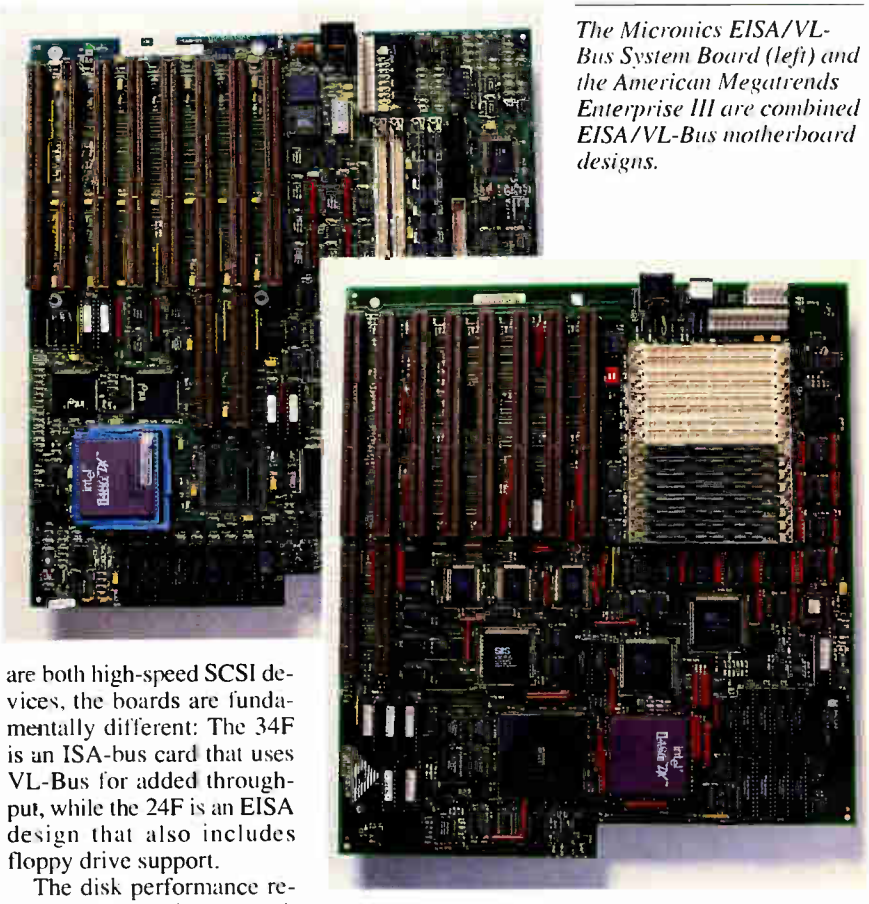
Two Ways to Say VL-Bus

RAYMOND GA CÔTÉ

Systems that use VL-Bus (VESA Local Bus, from Video Electronics Standards Association) technology promise faster throughput for peripherals from video cards to network adapters. These PCs can now be purchased from a host of system manufacturers. Further proof that VL-Bus has hit the big time lies in the ready availability of VL-Bus motherboards from high-end board manufacturers. These boards will not only form the basis of many VL-Bus clones but will be popular items in the end-user replacement market. I tested the performance of two 486 VL-Bus motherboards: American Megatrends' Enterprise III and Micronics' EISA/VL-Bus System Board (see the photo).

The boards were similarly configured, with 8 MB of base memory, 256 KB of processor cache, and a 33-MHz 486DX processor. Micronics places its 486DX processor in a ZIF (zero insertion force) socket for easy removal. Both boards are in standard AT format with eight EISA slots, two of which have accompanying VL-Bus sockets. Micronics' EISA/VL-Bus System Board provides on-board IDE and floppy drive controllers, while the Enterprise III sports a PS/2-style mouse port. Both motherboards provide an industry-standard BIOS: Micronics opts for the Phoenix BIOS, and American Megatrends, not surprisingly, includes its own AMI BIOS.

In my test configuration, the Enterprise III lists at $1150, and the EISA/VL-Bus System Board lists at $1275. In OEM quantities, both should be comparable at about $1000. But as is frequently true with new technology, it's performance, not price, that drives the decision.



The Micronics EISA/VL-Bus System Board (left) and the American Megatrends Enterprise III are combined EISA/VL-Bus motherboard designs.

Test Flight

To get a feel for performance, I ran a series of low-level benchmark tests on both motherboards, both through the VL-Bus and through the EISA channel. Naturally, the tests required fast peripherals that were available for both buses.

First, I ran BYTE's File I/O benchmarks on a 540-MB Maxtor SCSI drive (see figure 1). I hooked the SCSI drive to the motherboards through both the VL-Bus (using an Ultra 34F host adapter, $325) and the EISA bus (with an Ultra 24F, $595). Although the two UltraStor adapters are both high-speed SCSI devices, the boards are fundamentally different: The 34F is an ISA-bus card that uses VL-Bus for added throughput, while the 24F is an EISA design that also includes floppy drive support.

The disk performance results were surprising. On both motherboards, the EISA host adapter ran significantly faster than the VL-Bus version. On the Micronics board, the Ultra 24F showed a 10 percent advantage in read rates. According to UltraStor, VL-Bus interface boards that need to move large

BYTE ACTION SUMMARY

- **WHAT VL-BUS MOTHERBOARDS ARE**
  High-end 33-MHz 486 motherboards with EISA and VESA Local Bus support.
- **LIKES**
  High performance for both systems. A variety of platforms (EISA, VL-Bus, and ISA) from which to choose the fastest peripherals.
- **DISLIKES**
  Disk performance shows an advantage for EISA over VL-Bus.
- **RECOMMENDATIONS**
  Price/performance is about equal between the two boards. The Micronics EISA/VL-Bus System Board has superior EISA-bus performance, but it is also somewhat more expensive.
- **PRICE**
  Enterprise III (486DX/33, 8 MB of RAM), $1150
  EISA/VL-Bus System Board (486DX/33, 8 MB of RAM), $1275

World Radio History

No Doubt

YOU're the Expert!

BYTE READERS are considered **experts** in today's complex computer environment. When you need to make decisions, BYTE editorial is there to give information on current products and emerging technologies.

And when you order products, **BYTE advertisers** are ready to answer your every need. Use the convenient toll-free numbers in this issue, and remember to say:

You Saw it in BYTE

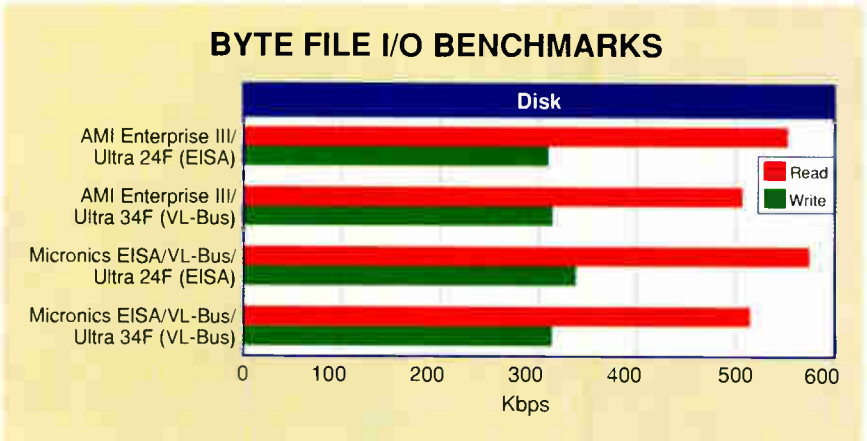


Figure 1: *Disk tests show similar performance for both system boards using VL-Bus peripherals. However, the Micronics EISA/VL-Bus System Board is somewhat faster as the basis for an EISA design.*

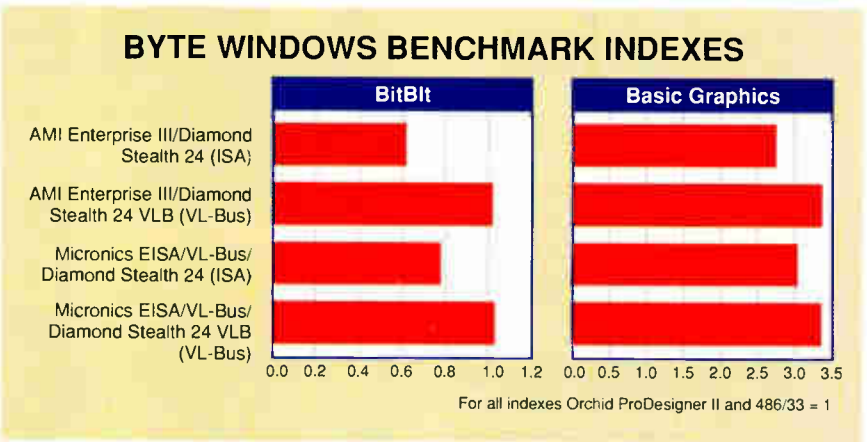


Figure 2: *Video benchmarks for both motherboards, running over ISA and over VL-Bus. The BitBlt test, especially, shows a substantial performance increase when run through a VL-Bus video card.*

blocks of data are very sensitive to system architecture (e.g., factors like memory interleave).

When purchasing a motherboard to use with a VL-Bus peripheral such as a SCSI interface, you should test the particular board to ensure that it meets your needs. Keep in mind that although the EISA interface looks faster on both motherboards in this configuration, EISA peripherals are often more expensive than VL-Bus devices.

My video tests (see figure 2) ran on two Diamond Stealth video boards: the Stealth 24 (an ISA-bus board) and Stealth 24 VLB. Except for the additional VL-Bus support, these two boards are identical. Both contain 1 MB of display memory, support up to 1280 by 1024 pixels at 16 colors, have a 24-bit Super VGA Windows accelerator, and sell for $249. Both motherboards showed substantially better video performance through VL-Bus than through EISA.

VESA Vis

Comparing the performance of these motherboards yields some interesting conclusions. On the video tests, Micronics' board was faster with the ISA-based Diamond Stealth, but the two motherboards showed equivalent performance using VL-Bus accelerated video. Disk test results show that VL-Bus performance was nearly equal, while the Micronics board outperformed the Enterprise III over the EISA bus.

So, which motherboard is best for you? When considering them strictly as EISA-bus systems, the Micronics board is clearly the quicker of the two motherboards. It showed a significant increase in video throughput and maintained a slight edge

World Radio History

LESS NOISE LESS HASSLE LESS MONEY!

OLI Optical Line Interface

DataPort™ 14.4/Fax Modem with optical technology

MORE SPEED: Only AT&T's *exclusive* Optical Line Interface (OLI), pat. pending, eliminates the noise that other high-speed fax modems add to the data stream. Less noise means the highest speeds possible on good or bad phone lines!

MORE COMPATIBILITY: OLI delivers hassle-free compatibility for more consistent connectivity than other high-speed fax modems.

The DataPort 14.4/Fax Modem costs less, gives you much more!

- Optical Line Interface (OLI) pat. pend.
- V.32bis (14,400 bps data, 9,600 bps fax)
- V.42bis/MNP 5 (data compression, error correction)
- Effective throughput up to 57,600 bps
- Lifetime warranty
- Lifetime toll-free technical support

$289 PC/AT internal card

$299 PC/AT/XT or Macintosh external model

Comes complete with: QuickLink II comm/fax software for DOS and Windows or the Macintosh; CompuServe bonus ($22.95 value), user's manual and fax modem phone cord. Macintosh version also includes Mac cable.

MORE VALUE: You get everything you want in a high-speed fax modem, backed by AT&T's lifetime warranty and helpful, toll-free support. Special low prices, so hurry!

Solidly-built, solidly-backed by AT&T.

Visit the participating dealer near you. Or for the name of other dealers near you, or to order the DataPort 14.4/Fax Modem directly, call now: 1 800 554-4996 ext 9604.

COMPUTER CITY — Fry's ELECTRONICS — ELEK-TEK since 1979 The Computer Wonderland

Offer ends April 30, 1993. Visit the dealer nearest you, today!

Prices under $300 vary by dealer.

© 1993 AT&T Paradyne DataPort is a trademark of AT&T All other products or services mentioned here are the trademarks, service marks, registered trademarks, or registered service marks of their respective owners *Lifetime warranty is limited and applies to original purchaser only.*

Circle 170 on Inquiry Card (RESELLERS: 171).

AT&T

World Radio History

on SCSI performance. For either system, I would recommend an EISA SCSI card over a VL-Bus host adapter if maximum performance is required.

Price/performance is about equal between the two boards; the Micronics board compensates for its somewhat higher price with slightly better performance. You'll have to consider your need for VL-Bus throughput against the availability of EISA peripherals, which may offer a performance advantage. ■

Raymond GA Côté is a BYTE consulting editor, freelance writer, and publisher of the Robot Explorer *newsletter. You can reach him on BIX as "rgacote" and on the Internet at rgacote@byteph.byte.com.*

COMPANY INFORMATION

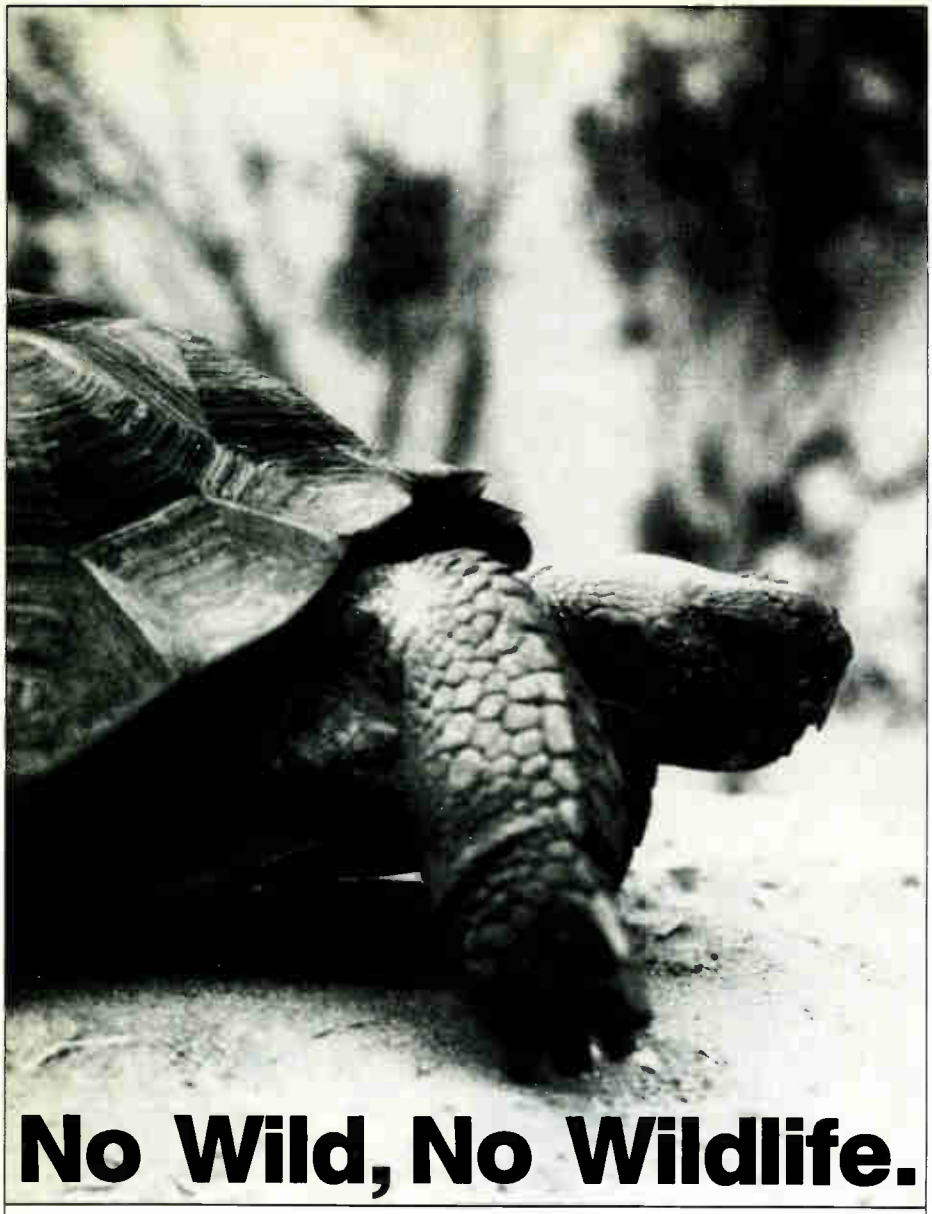
American Megatrends, Inc.
(Enterprise III)
6145-F Northbelt Pkwy.
Norcross, GA 30071
(800) 828-9264
(404) 263-8181
fax: (404) 263-9381
Circle 1225 on Inquiry Card.

Diamond Computer Systems, Inc.
(Diamond Stealth 24, Diamond Stealth 24 VLB)
1130 East Arques Ave.
Sunnyvale, CA 94086
(408) 736-2000
fax: (408) 730-5750
Circle 1226 on Inquiry Card.

Maxtor
(MXT-540S)
211 River Oaks Pkwy.
San Jose, CA 95134
(800) 262-9867
(408) 432-1700
fax: (408) 432-4698
Circle 1227 on Inquiry Card.

Micronics Computers, Inc.
(EISA/VL-Bus System Board)
232 East Warren Ave.
Fremont, CA 94539
(510) 651-2300
fax: (510) 651-5612
Circle 1228 on Inquiry Card.

UltraStor
(Ultra 14F, Ultra 24F, Ultra 34F)
15 Hammond, Suite 310
Irvine, CA 92718
(714) 581-4100
fax: (714) 581-0826
Circle 1229 on Inquiry Card.



The California desert tortoise is losing ground. Its young are being crushed by motorcycles and off-road vehicles. Sheep and cattle grazing are diminishing an already scant supply of food while mining and road building are destroying the tortoise's natural habitat.

The fact is that the tortoise population has declined as much as 90% over the last fifty years. This drop is a true biological indicator of how severely the desert ecosystem is at risk.

The Sierra Club works to save wildlife by saving the wilderness. We have a history of victories. And, we believe with your help, the three-million-year-old desert tortoise can win back its native turf.

For information on how you can help:

SIERRA CLUB CENTENNIAL 1892-1992

Sierra Club
Dept. DT
730 Polk Street
San Francisco, CA 94109
(415) 776-2211

World Radio History

SOFTWARE

Teaching Macs to Fetch

STANFORD DIEHL

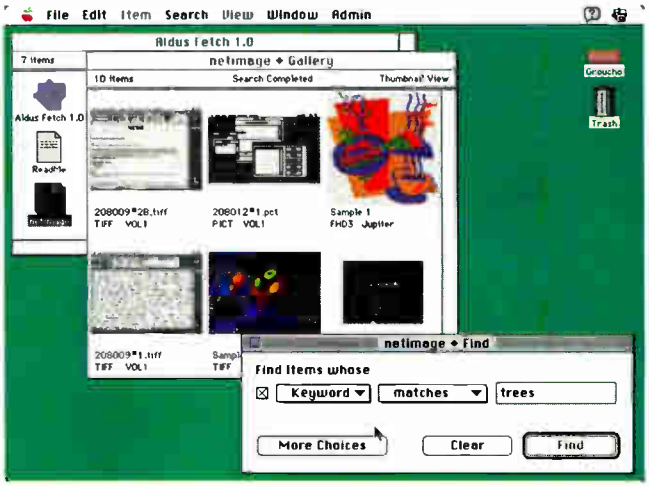
Graphics professionals working in a production environment must maintain thousands of images. These images, created in-house or purchased, come in a variety of formats and spill across network servers, removable-cartridge drives, CD-ROM discs, and shared volumes. Aldus Fetch 1.0—a $295 multiuser, mixed-media database for cataloging images, QuickTime movies, animations, and sound files—is designed to meet the challenges of a workgroup production environment.

Fetch is a snap to use. To catalog a CD-ROM full of images, I simply dragged the CD-ROM icon onto the Fetch application icon. Indexing 500-plus images on a CD-ROM took a little over 45 minutes. Once created, a catalog contains a visual thumbnail (a tiny replica) of all the items within it. You can browse through the thumbnails or search for a specific item by filename, description, or user-supplied keywords (see the screen). Double-clicking on an item loads it into the proper viewer. There is no need to open the application that created the file.

Fetch supports a wide variety of formats (e.g., EPS, JPEG, PICT, TIFF, SND, Illustrator, Photoshop, Kodak Photo CD, and SoundEdit), but noticeably missing is a GIF viewer. Aldus does plan to ship one with the next version.

Fetch keeps track of where an image resides. When you call up a cataloged image on CD-ROM, Fetch prompts you for the correct disc. If you're working off a network server, the volume is automatically mounted and the file retrieved. Even if an image is moved from one place to another, Fetch will find it and update the catalog. Fetch is not quite as smooth when dealing with shared drives. When a catalog is created on a local drive and then accessed remotely, Fetch thinks the files in that catalog have moved and asks if you want to update every file you access. Only if you use file sharing to access local CD-ROM drives or removable-cartridge drives should this limitation be of concern.

By designating a subset of a catalog as a "project," you can streamline the flow of files. For example, an art director could create a project of images to be used in a specific layout and send the images over the network (or through E-mail) to the production department.



Fetch creates a catalog of thumbnail images. You can browse through the images or search for a specific item by filename, description, or keyword.

The advantages are numerous. For instance, the art department can maintain a central catalog of images; designers can quickly browse through images (or search for items of interest) and visually select graphical elements for the layout; the production department can work with small images and view the full image without source applications; and one set of images can be stored on a network drive while only the thumbnails are shipped around. And if a file changes along the way, you needn't worry about obsolete files floating around, since everyone is working with pointers to a single file. Fetch doesn't have the high-end version-control features of some document management packages, but it's a very useful utility that doesn't require a large commitment of resources to learn and implement.

Fetch lets you search for files by description or keywords rather than just filenames, but generating this information can be quite a chore. Descriptions and keywords can be attached to any file using the pnot resource, and pnot information isn't destroyed by a desktop rebuild, making it more persistent than simple Finder comments. Major applications (including the new versions of Adobe Premiere and Aldus FreeHand) are starting to include menu options for adding descriptions to a file. With some procedural discipline, all your files could have keywords and descriptions built into them, allowing Fetch to use all of its ample searching capabilities.

I hope to see some enhancements to Fetch soon—a GIF viewer and better version tracking would be nice—but anyone who deals with lots of images, QuickTime movies, sounds, or animations will surely appreciate Fetch. ■

Stanford Diehl is a BYTE Lab technical editor covering graphics software, peripherals, and add-ins. You can reach him on BIX as "sdiehl."

BYTE ACTION SUMMARY

- **WHAT ALDUS FETCH 1.0 IS**
  A multiuser, mixed-media database for cataloging images, animations, QuickTime movies, and sound files on the Mac.
- **LIKES**
  Easy to learn and use; broad support of file formats.
- **DISLIKES**
  No GIF viewer; lacks version-control features.
- **RECOMMENDATIONS**
  An excellent utility for workgroups working with images.
- **PRICE**
  $295
- **FOR MORE INFORMATION**
  Aldus Corp.
  411 First Ave. S
  Seattle, WA 98104
  (206) 622-5500
  Circle 1224 on Inquiry Card.

World Radio History

Up to Date. Down to Earth.

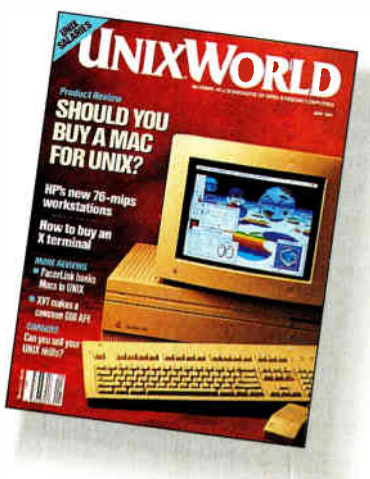
UNIX is changing the world of computers, the world of business – quite simply, changing the world. It's revolutionizing office automation. It's required for U.S. government computer contracts. It's the backbone of information strategies worldwide.

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 recieve 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

McGraw-Hill's Magazine of **OPEN SYSTEMS COMPUTING**.

**UnixWorld's no-risk guarantee: If not satisfied, cancel and receive a full refund for the balance of your subscription.*

UNIX is a registered trademark of UNIX System Laboratories, Inc.

DH1AUW9

World Radio History

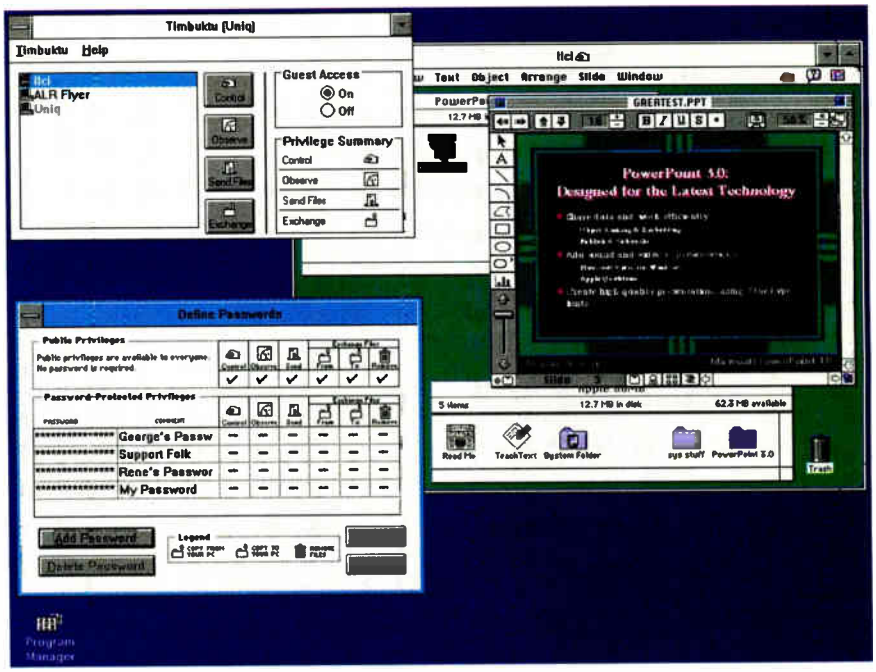
SOFTWARE

Macs and Windows PCs Share Control

TOM YAGER

With the success of Windows and the Macintosh, most offices include systems of both types. There are plenty of ways to share files between PCs and Macs, but the most useful link would permit you to share applications as well.

Farallon Computing's Timbuktu is a popular Macintosh program that allows you to reach across a network link to operate someone else's Mac by remote control. Now the vendor has introduced Timbuktu for Windows, making it possible to create remote-control links not only from Windows PC to Windows PC but between Macs and Windows systems as well.



Timbuktu for Windows' connection dialog box (upper left) and access-control dialog box (lower left), and a remote Mac screen. This PowerPoint image was relatively unchanged, but others had severely distorted colors.

The Road to Timbuktu

I tested Timbuktu for Windows using a trio of machines: an Advanced Logic Research Flyer 32LCT (66-MHz 486DX2), a Uniq 50-MHz 486 EISA file server, and a Mac IIci. Both PC systems were running DOS 5.0 and Windows 3.1, and all three systems had 8 MB of memory. I hooked the systems together on a dedicated thin-wire Ethernet network.

I installed Timbuktu on all three systems. On the PC, it sits atop Farallon's AppleTalk software, called PhoneNet PC. This foundation network is installed under DOS and runs as an army of TSR programs—160 KB of them, in my case. That's the last thing my already-overburdened PCs needed. Farallon's documentation lays out some useful tips for moving the PhoneNet drivers into high memory, and you can selectively leave out some services—like printer sharing—to conserve memory.

The PhoneNet TSRs bring partial AppleTalk network participation to your PC. You can mount a remote Mac's hard drive as a DOS drive or redirect your printer output to an AppleTalk printer, but PhoneNet PC provides no reciprocal incoming services.

Starting a Timbuktu session is easy. The New Session dialog box (see the top-left window in the screen) maintains a list of systems listening for incoming connections. All you have to do is select the system you want and then click on the icon for the level of service you're requesting: You can control, observe, send files, or exchange files.

You can request any of these services, but what you're actually granted is determined by the remote system. Timbuktu's access-control scheme is inventive: Instead of assigning a password to each service, the interface (the bottom-left window in the screen) gives you up to four passwords, each of which unlocks a group of services. I found Timbuktu's access controls excellent as far as they go, but I'd have liked a little more control, perhaps in limiting access from certain machines or certain named users.

Services Rendered

The services offered by Timbuktu fall into the four classes shown in the connection dialog box's icons. The least capable is a Send Files connection. With this, all you can do is copy files from your system to a designated drop folder or subdirectory on the destination machine. You can't see the other system's directories or access its files. Timbuktu doesn't make any conversions between Mac- and DOS-format files, except to mangle Mac filenames to fit the DOS 8.3 convention.

The next level up is bidirectional file transfer. When you send, receive, and delete files through this interface, you can specify independent permissions through the access-control dialog box. The file transfer interface looks just like the familiar Apple File Exchange: You see your system's files listed side by side with the other system's files. All you have to do is select the files you want moved or deleted and click on the appropriate button.

The heart of this program is its remote-session capability. Timbuktu allows both observing and controlling connections. As an observer, you can monitor a remote system's display. With a controlling connection, your keyboard and mouse input is relayed to the remote machine, and that system's display is duplicated on your screen.

By default, Timbuktu presents the remote system's display in a window (the middle window in the screen). With a controlling connection, Timbuktu sends your input over the wire whenever that window is selected and the mouse pointer is inside it. If the window is smaller than the remote system's screen, Timbuktu will scroll in all directions; as you move the mouse close to the edges of the window, the screen scrolls underneath it. It's a little disconcerting, because the scrolling makes

World Radio History

the mouse pointer sit still even though you're busily rolling away. It's like moving your mouse pad around to position your cursor. It works, though, and since all my systems have accelerated graphics controllers, scrolling was very snappy.

When the screens are precisely the same size (as they were when I connected the two Windows systems), maximizing the Timbuktu session window makes the borders and scroll bars disappear. The remote system's display fills yours, and only a floating title bar remains to remind you that you're running someone else's machine. Clicking on an icon on the title bar will put the screen back into a resizable window.

You can have only one screen-sharing session going at once, but you can pop up the send or exchange interfaces during a screen-sharing session. I'd have liked the ability to run more than one observation session, a feature that would be particularly useful for network administrators, instructors, and others who benefit from keeping a watchful eye over a small flock of users.

If you're worried about Big Brother, you'll be relieved that Timbuktu doesn't allow silent connections. Whenever someone is hooked into your system, a tiny icon appears in the corner of the screen that reflects the type of connection.

Protocol Matters

According to Farallon, Timbuktu for Windows expands on a scheme the company devised for its Macintosh Timbuktu product. When two Macs converse, Timbuktu passes data using a packaged version of the Mac's QuickDraw graphics system. When mixing Macs and Windows PCs, Timbuktu uses the guest's native graphics system: That is, a Windows system controlling a Mac uses GDI (Graphical Device Interface) for its protocol, and a Mac controlling a Windows system uses QuickDraw.

With Timbuktu for Windows, Farallon has also introduced a set of optimizations that are specific to graphics type. The result is that elements drawn by Windows (e.g., text, icons, windows, and other specific object types) are specially packaged for efficient transport and display on the guest system.

Farallon admits that there are weaknesses in its current scheme, especially when controlling a Mac from a Windows system. Text-display scrolling is particularly painful. Also, complex graphics can bog Timbuktu down, particularly if the application's interface is sloppy. The Mac version of PowerPoint, for example, repaints its entire window *a lot*. That's not something you notice sitting in front of the system, but when those changes are packed up, sent through a little wire, and unpacked on the other end, you notice.

The good side of Timbuktu's performance can be seen in the rapid drawing of filled rectangles (like windows) and icons. Menus and dialog boxes generally popped up in good time on both sides of my test connection.

The two Windows machines, with their 66-MHz and 50-MHz 486 processors, got along famously. I ran FrameMaker over a remote connection, even on a file loaded with bit-mapped graphics. I would liken the performance to that of an unaccelerated display card. It felt smooth and fast enough that I sometimes lost track of whether I was running remotely or not. Similarly, I was able to connect to Windows from a fast Mac with lesser but still acceptable performance. Although the display lagged noticeably behind my typing, Timbuktu never dropped a character.

Timbuktu proceeds only as quickly as the remote connection will allow; the local system always stays in sync with the remote. This can be troublesome, as Timbuktu's response often lags well behind input. Scroll buttons and other interface elements that require a click-and-hold are handled badly. If you hold down a scroll button until the image in the window looks like it's in the right position, you'll generate a long queue of scroll requests that will continue to march along well after you release the button.

As I mentioned earlier, running a Mac remotely from a Windows system brought out the worst in Timbuktu. Windows and icons came up quickly enough, but text and complex graphics drew and scrolled so slowly as to be really frustrating. Moreover, while both Windows systems happily displayed each other's 256-color screens with no loss of quality, 256-color Mac screens under Windows lost their color palette. I chose one of the less-affected images for the screen shot; PowerPoint slides that used graduated shading got hopelessly stepped on by Timbuktu for Windows.

Timbuktu supports up to 24-bit color between systems, but Farallon wisely recommends that you put the Mac in monochrome-display mode for acceptable performance when you're controlling it from Timbuktu for Windows.

How Slow Can You Go?

Among fast machines, Timbuktu is good enough to use anytime it's not convenient to walk over to a free Mac or Windows system, or when you need to guide someone through a tough problem without looking over his or her shoulder. However, when you control a Mac from a Windows system, performance is poor enough that you need to seriously consider what Timbuktu offers before running it.

If you use it to gain access from off-site through a WAN (wide-area network), then the convenience of access to your files and applications may well be worth the sluggish response. And for remote administration and support, as well as occasional short bursts of cross-platform applications use, I'd say Timbuktu is good enough in every case to give you most of the benefits of sitting in front of a remote machine. ■

Tom Yager is a multimedia consultant, analyst, and developer, and author of The Multimedia Production Handbook for the PC, Macintosh and Amiga *(Academic Press, forthcoming). He can be reached on BIX as "tyager" and on the Internet at tyager@bytepb.byte.com.*

BYTE ACTION SUMMARY

- **WHAT TIMBUKTU FOR WINDOWS IS**
  A remote-control package that allows file transfer and remote-session connections to PCs and Macs.
- **LIKES**
  Well-designed interface, particularly access controls and full-screen remote sessions; notification and control over incoming remote connections.
- **DISLIKES**
  Size (160 KB) of TSRs; poor color-palette mapping from Mac to Windows; serious performance problems on slower systems.
- **RECOMMENDATIONS**
  An elegant solution for network administrators, support people, and others who value accessibility over performance.
- **PRICE**
  $199
- **FOR MORE INFORMATION**
  Farallon Computing, Inc.
  2470 Mariner Square Loop
  Alameda, CA 94501
  (510) 814-5100
  fax: (510) 814-5020
  Circle 1230 on Inquiry Card.

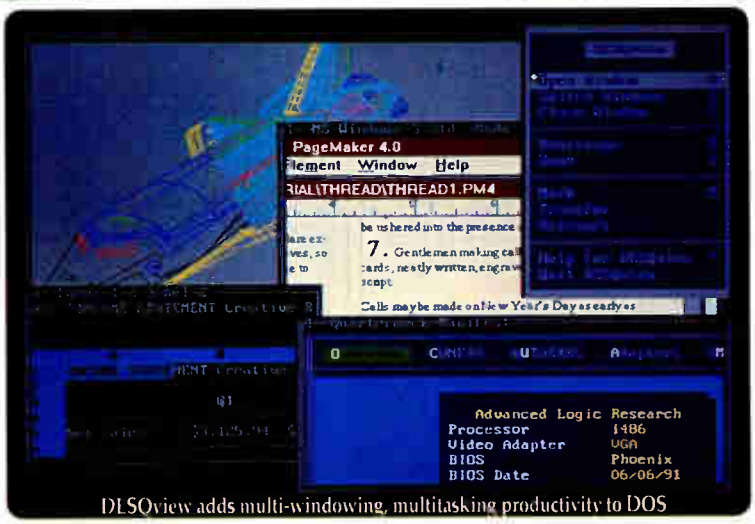
World Radio History

The death of DOS Has been greatly exaggerated

DOS is still the preferred operating system on over 80% of the PCs in Fortune 1,000 companies, according to recent studies.

Bring Windowing Advantages to DOS.

Many Fortune 1,000 companies are using DESQview™ as the best solution for keeping the dependability and familiarity of DOS programs and adding multitasking, windowing productivity. DESQview users give up nothing—since it actually runs MS Windows better should users wish to run Windows programs.



DESQview adds multi-windowing, multitasking productivity to DOS

As you may know, DESQview 386 has been around for years, evolving into a highly efficient multitasking, windowing environment that extends the power of DOS, giving you increased productivity while conserving precious memory and disk space. In fact, the vast majority of 386 and 486 PCs need no additional memory or disk space to run DESQview.

DESQview 386 gives you pre-emptive multitasking like OS/2, but with ½th of the disk space and ⅛th of the memory requirements. It gives you windowing like MS Windows, but with greater speed and efficiency and fewer 'crashes.' And DESQview lets you use a mouse or stick to the keyboard.

You Create the Standards; We Follow.

We've never been confused about our role. We believe software companies exist to make your job easier and your working day more productive. When publishers step out of that mold and begin to tell you what hardware you need and that you should throw out somebody else's perfectly good software—well, they simply are not operating in your best interest.

Software publishers don't create standards. You do. And whatever standard you choose, we support it.

If you like a program that only runs in MS Windows, like Wordperfect for Windows, DESQview 386 supports your choice. If you prefer a spreadsheet that runs in DOS, Lotus 1-2-3 Release 3, for example, we support that too. In fact, DESQview 386 lets you run your favorite DOS and Windows programs side-by-side.

Have Your Cake and Eat It, Too.

DESQview 386 comes with QEMM-386, the number one memory management utility, and Quarterdeck Manifest, the award-winning memory analysis and monitoring program. Between them, they assure you every last 'K' of memory is put to use.* In many cases, QEMM can mean the difference between running the TSRs you want and not having enough memory.

And DESQview is an open doorway to the future, too. Our next step up, DESQview/X, opens your PC to a network full of possibilities, including graphic workstation standards—X Window System software—all while retaining the compatibility of DESQview.

If you're as committed to DOS as we are, and feeling left out by the so-called industry leaders, take heart. There's no reason to leave DOS. If more productivity is what you need, we can provide it.

Quarterdeck helps you get the most out of the hardware and software you own today.

Quarterdeck

See us at CeBit
Halle 3 Stand E50

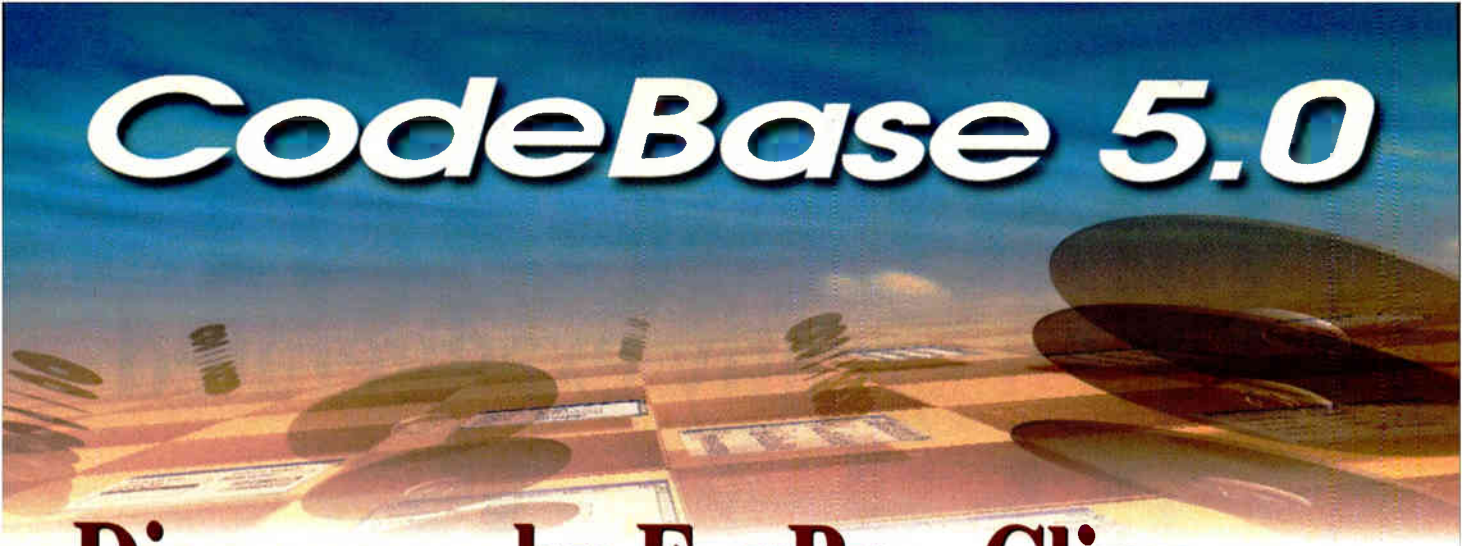
Quarterdeck Office Systems, 150 Pico Boulevard, Santa Monica, CA 90405 (310) 392-9851 Fax (310) 314-4219
Quarterdeck International Ltd., B.I.M. House, Crofton Terrace, Dun Laoghaire Co. Dublin, Ireland Tel.(353) (1) 284-1444 Fax: (353) (1) 284-4380

* DESQview makes multitasking and windowing available to users of 286-class machines with similar memory efficiencies through QEMM-50/60 for IBM™ PS/@ 50 and 60 users and QRAM for other 286 users.

©1992 Quarterdeck Office Systems. Trademarks are property of their respective owners.

Circle 124 on Inquiry Card.

World Radio History



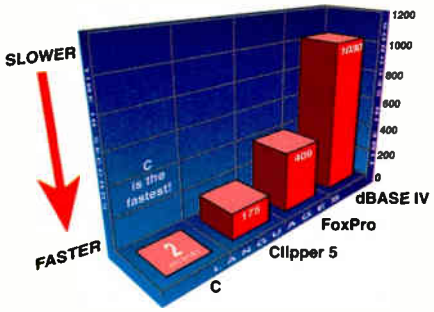
Discover why FoxPro, Clipper, and dBASE were all written in C.

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. Consider the following statistics, from the publisher of Clipper:



"Sieve of Erastothenes"
Benchmark for Prime Number Generation
Shows C to be incredibly faster !

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.

dBASE Compatible data, index and memo files...

You want the industry standard. You need compatibility. Sure, dBASE is the standard, but every dBASE compatible DBMS product uses its own unique index and memo file formats. Only CodeBase has them all: FoxPro (.cdx), Clipper (.ntx), dBASE IV (.mdx) and dBASE III (.ndx). Now it's your choice, we're compatible with you.

Announcing CodeBase 5.0

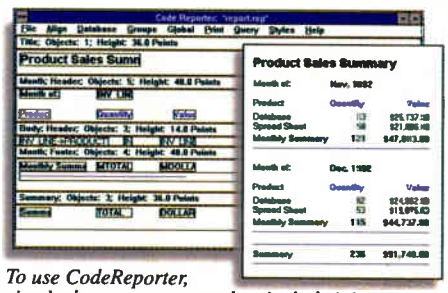
The power of a complete DBMS, the benefits of C

NEW - Multi-user sharing with FoxPro, Clipper and dBASE...

Now your multi-user C/C++ programs can share data, index and memo files at the same time as concurrently running FoxPro, Clipper and dBASE programs. No incompatibilities. No waiting.

NEW - Queries & Relations 1000 times faster...

CodeBase 5.0 now lets you query related 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:



To use CodeReporter, simply draw your report, then include it in any program you write. Call 403/437-2410 now for your FREE working model of CodeReporter.

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 April 30, 1993 and receive CodeReporter for free! This offer includes our no-risk, 90-day money back guarantee, so order today!

CodeBase 5.0
The C/C++ Library for DataBase Management

Call Now
403-437-2410

SEQUITER SOFTWARE INC.
FAX 403•436•2999
Europe 33.20.24.20.14
#209,9644-54 AVE., EDMONTON, AB, CANADA T6E-5V1

©1992 Sequiter Software Inc. All rights reserved. CodeBase is a trademark of Sequiter Software Inc. All other trade names referenced herein are property of their respective companies. MAdvertising by MicroArts

Circle 129 on Inquiry Card.

World Radio History

APPLICATION

Sun's C Solution for Solaris

BENJAMIN FRIED AND OTHAR HANSSON

Sun Microsystems startled many of its customers when it announced that, starting with SunOS 5.0 (a.k.a. Solaris 2.0), SunOS will no longer include a C compiler. Sun has explained that a C compiler is no longer necessary to reconfigure the operating system and has pointed to the bulk of Solaris customers who never use one.

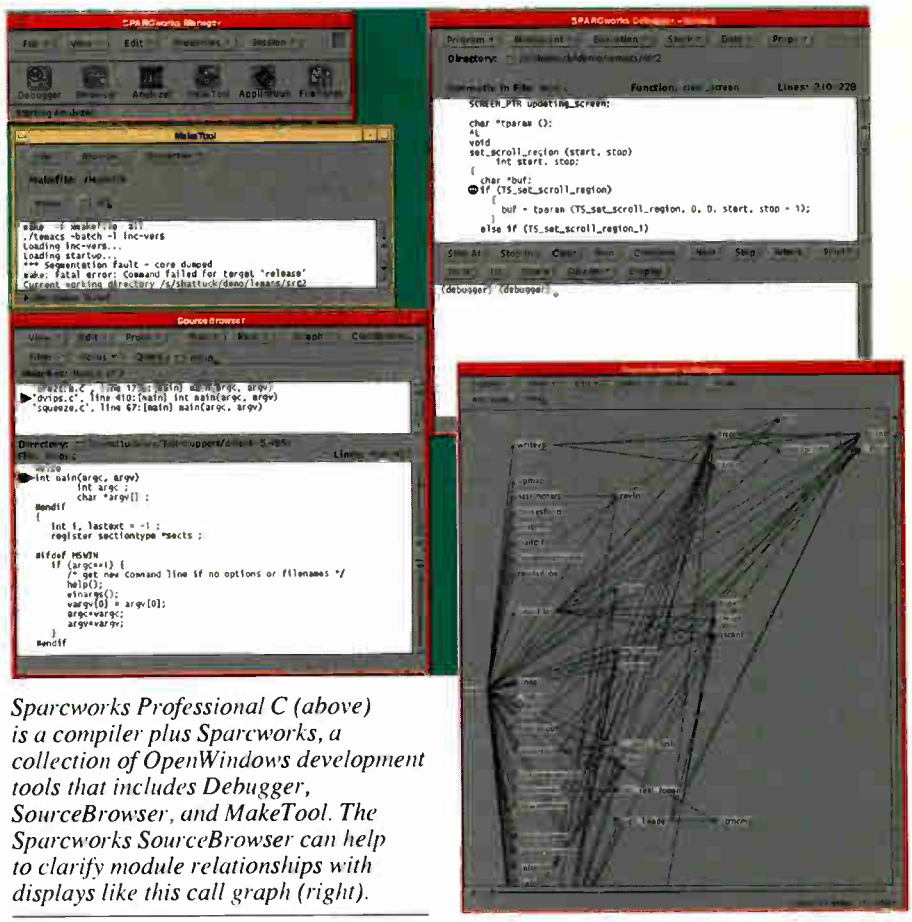
For those of us who do use one, including Solaris 2.0 developers and SunOS 4.1 users who want a professional compiler and development environment, SunPro offers Sparcworks Professional C. Sparcworks Professional C is the bundling of two development products: Sparcompiler C, which is Sun's C compiler, and Sparcworks, a collection of language-independent tools, including a browser and a debugger (see the screens).

What's New

Sun hasn't just uncoupled its old compiler and remarketed it at a premium; Sparcompiler C is a significant improvement, providing ANSI C compatibility, better optimization, and many new command-line options. The compiler also offers substantial support for developers moving their programs from Kernighan and Ritchie C to ANSI C, plus a wealth of useful documentation.

Sparcworks is a set of language-independent development tools with OpenWindows user interfaces, controlled by a graphical utility called Sparcworks Manager. The Sparcworks applications are

- *FileMerge*, which aids in comparing and merging differing versions of source files.
- *SourceBrowser*, for examining and searching source code, viewing call graphs, and performing simple editing tasks. SourceBrowser can also graphically display C++ classes and class hierarchies with the Sun C++ compiler.
- *Analyzer*, a profiler and performance tuner (for Solaris 2.0 only).
- *MakeTool*, which browses make files, displays expansions for make-file rules and macros, and runs `make` on selected targets.
- *dbx* and *Debugger*, a multilanguage command-line debugger and its OpenWindows front end.



Sparcworks Professional C (above) is a compiler plus Sparcworks, a collection of OpenWindows development tools that includes Debugger, SourceBrowser, and MakeTool. The Sparcworks SourceBrowser can help to clarify module relationships with displays like this call graph (right).

SunPro also bundles AnswerBook—Sun's handy hypertext browser and navigator—with on-line copies of all the paper manuals.

SunPro distributes all this on a single CD-ROM. Installation is simple. Sun's CDmanager program shows icons for each package on the CD-ROM; all you have to do is select the products for which you hold licenses.

Sparcworks Does Windows

The window-oriented tools that make up Sparcworks were not equally useful. FileMerge has an impressive GUI, but it was not as good as a combination of `diff` and `patch`, a free command-line utility. Similarly, MakeTool has a pretty interface and some nice features, including a menu with entries for each target and being able to run user-specified commands when `make` operations start, complete, or fail. Overall, though, MakeTool was more cumbersome than just running `make` directly from a shell window.

In contrast, the other two tools are clearly better for the addition of the GUI. The debugger shows the most improvement. Being able to use the mouse to set breakpoints, display the value of variables, and step through code represents a big step up from the traditional `dbx`.

SourceBrowser's graphical display of function-calling relationships (see the screen) can clarify the structure of a program. SourceBrowser includes an editor, good for making simple changes to source code, and it hooks into the debugger to keep the debugger and browser displays in sync.

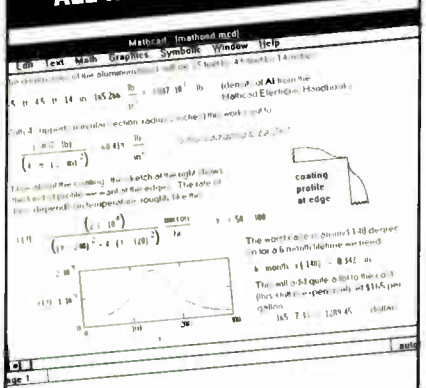
continued

World Radio History

Circle 100 on Inquiry Card.

Technical calculations made easy!

ALL NEW VERSION 3.1!



Now it's easier than ever to perform faster, more reliable engineering and scientific calculations.

- **Windows graphics features make Mathcad 3.1 the simple solution to complex analytic needs.** Dialogs, pull-down menus, and mouse point-and-click capabilities make it easy to combine equations, text, and graphics right on your screen and print it all in a presentation-quality document.
- **New Electronic Handbook Help facility serves as an on-line reference library.** Paste standard formulas, constants, and diagrams from searchable, hypertext Electronic Handbooks for instant use in your Mathcad worksheet.
- **Symbolic calculations with a simple menu pick.** Use expressions resulting from symbolic derivations in your numeric calculations or for further symbolic manipulation.
- **Mathcad works on PC DOS, PC Windows, Macintosh, or UNIX.** More than 600,000 engineers, scientists, and educators already use Mathcad for a variety of technical applications. Applications Packs are also available to customize Mathcad for particular disciplines, including electrical, mechanical, and civil engineering and advanced math.

Call 800-MATHCAD or use this coupon to request a free 3.1 demo disk!

In Massachusetts, call 617-577-1017.
Please specify diskette size: ☐ 3 1/2" ☐ 5 1/4"
For a free Mathcad 3.1 Introductory Kit, clip this coupon and mail it back to us, or fax it to 617-577-8829. Or circle your reader service card.

☐ **Yes! Tell me more about Mathcad 3.1!**

Name
Title
Company or Institution
Address
City State Zip
Phone ( )

MathSoft

Mail this coupon to:
MathSoft, Inc.
201 Broadway
Cambridge, MA 02139
USA

B99 BYT

Lots of Options

Of course, the backbone of the development environment is the compiler, and Sparcompiler C supports its environment well. Sparcompiler C has four levels of ANSI conformance, ranging from loose—essentially K&R C—to strict. Sparcompiler C also has five levels of optimization, which lets you choose the trade-off between size and speed. You can compile with both optimization and debugging switches set and run the debugger on optimized executables.

When we compiled for size, object files were about as large as those produced by Sun's old compiler. When we targeted speed, results were impressive with both integer- and floating-point-intensive code.

BYTE ACTION SUMMARY

- **WHAT SPARCWORKS PROFESSIONAL C IS**
  It comprises Sparcompiler C, a highly optimizing ANSI C compiler, and Sparcworks, an integrated set of OpenWindows development tools.
- **LIKES**
  Sophisticated optimization, good support for moving from K&R C to ANSI C, and a nice user interface to the debugger.
- **DISLIKES**
  Some Sparcworks tools are of limited utility; the price will seem high for users used to getting a compiler and debugger free with the operating system.
- **RECOMMENDATIONS**
  Superior optimization and excellent ANSI C compatibility make the compiler well worth considering.
- **PRICE**
  (single-user, with printed manuals)
  Sparcworks Professional C, $1795
  Sparcompiler C, $795
- **FOR MORE INFORMATION**
  SunPro
  2550 Garcia Ave.
  Mountain View, CA 94043
  (800) 926-6620
  (415) 336-6848
  fax: (415) 964-0946
  Circle 1223 on Inquiry Card.

Although Sparcompiler C generated reasonably sized object files, SunOS 4.1 executables of very small programs (e.g., "hello, world") were about 100 KB larger than those compiled with Sun's bundled compiler or with the GNU C compiler. A call to Sun technical support revealed the reason: The SunOS 4.1 shared C library has a bug in the base conversion routines. Rather than distribute an updated shared library, Sun elected to include the fixes with Sparcompiler C. The compiler statically links in the fixed routines if they're needed, and it was these routines that inflated the files.

Compiler Comparisons

Sun's is a fine compiler, but it's not the only horse in the race. GNU's GCC supports SunOS 4.1 and Solaris 2.0, is ANSI-compatible (with several strictness levels), has a long list of optimizations that can be switched individually, and comes with extensive documentation. Its price is hard to beat, too: It's free. Since GCC comes with source code, fixes are widely available, and several companies provide commercial support at rates that compare favorably to Sun's right-to-use licenses and support contracts.

Sparcompiler C, for its part, optimizes better than GCC, provides good support for moving between K&R C and ANSI C, and with Sparcworks is part of a promising development environment. AnswerBook provides most of the help you'll need, and SunPro's sizable support infrastructure offers added assistance. If you want a well-supported compiler that produces good code, and if buying the compiler from the hardware vendor is important to you, you'll feel comfortable with Sparcompiler C.

Of the Sparcworks tools, we found that Debugger stood well above the rest as a genuine improvement over the command-line utility it replaces. SourceBrowser has some useful features, providing elements of many different utilities under a single window. The other tools were not very useful, and we abandoned them for their (free) command-line equivalents. You'll want to carefully consider whether two good tools justify the cost ($1795) of the entire package. If you're working with more than one Sun language, Sparcworks becomes considerably more attractive than in a single-language environment. ■

Benjamin Fried and Othar Hansson are both members of the technical staff at Heuristicrats Research, Inc., a software R&D firm in Berkeley, California. You can contact them on the Internet at ben @heuristicrat.com and othar@heuristicrat.com, respectively.

World Radio History

SOFTWARE

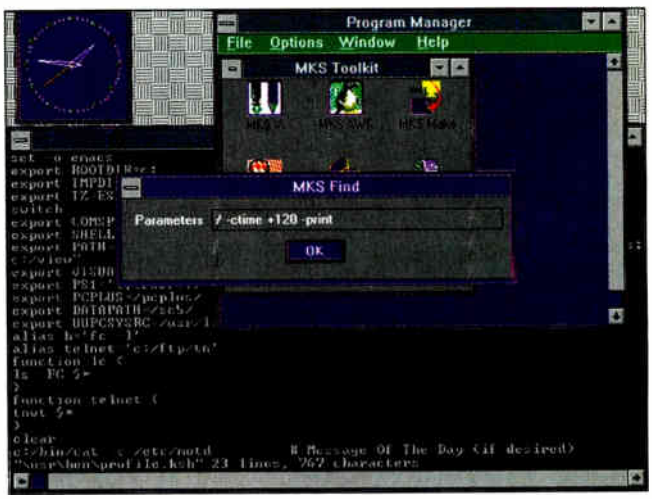
A Beefier MKS Toolkit

BEN SMITH

Ask a developer what's best about Unix, and you'll hear about its rich set of command-line utilities and the great flexibility with which these can be strung together. Ask a developer what's best about MS-DOS, and you'll hear first about a massive potential market.

But why sacrifice a great working environment just because DOS and Windows are where all the action is? The MKS Toolkit has been bringing DOS and Unix together for eight years by providing DOS (and more recently, OS/2) developers with a full set of Unix utilities and a Korn shell command interpreter. Version 4.1 of the MKS Toolkit represents a significant improvement, introducing background UUCP file transfer and Unix mail and bundling two utilities (make and awkc) that were previously sold separately.

The Toolkit bucks a trend with its primarily command-driven, nongraphical user interface. Version 4.1 does include some character-based GUI utilities and some PIFs for Windows (see the screen). However, its extensive set of Unix utilities easily offers far more power and flexibility than a flashy palette of icons.



MKS Toolkit 4.1 makes a few concessions to graphical orientation, including Windows PIFs for some (appropriate) command-line utilities.

Significant Enhancements

The two most significant enhancements in version 4.1 are UUCP support and the addition of Unix E-mail. There are standalone UUCP systems that run under DOS, but Mortice Kern Systems puts most of its UUCP system in a TSR program that takes up less than 3 KB. As a result, the entire process of calling (or answering) another UUCP system, setting up the connection, and handling spooled UUCP requests takes place in the background. MKS's UUCP utilities include file transfer (uucico) and remote command execution (uux and uuxqt) as well as utilities for configuring and administrating UUCP.

Version 4.1 includes the Berkeley E-mail interface (mailx) and a mail router (rmail) so you can carry on Unix E-mail communications just as if you were on a Unix system. The mail and UUCP support are solid enough that you can even create a UUCP network of DOS or OS/2 sites running MKS utilities. You'll need one real Unix site designated as a "smart site" to resolve unknown addresses; MKS UUCP does not include sendmail, required to resolve addresses for sites not directly connected to your system.

MKS's UUCP configuration program uses a character-based GUI. Configuration files are binary rather than plain text (the Unix way) for security, since text files have no protection on a DOS system.

Variable Immersion

You can install the Toolkit in several different configurations, depending on how deeply you want to immerse yourself in a Unix-like working environment. You can choose anything from installing a simple collection of utility programs (more than 170) to replacing COMMAND.COM and AUTOEXEC.BAT with a Unix-style shell complete with log-in security. MKS Toolkit includes on-line documentation in the form of the man command and quick syntax reference with help.

MKS's utilities are very well written; the quality and level of Posix compliance of these tools exceed that of many commercial Unix versions. In fact, the Toolkit is often used by vendors of non-Unix operating systems, such as in DEC's VMS, to claim Posix compliance.

I run the MKS Toolkit on every DOS machine that I use, from laptops to high-end desktops. With version 4.1, I also enjoy background access to Unix mail and UUCP while running a DOS application. ■

Ben Smith is a testing editor for the BYTE Lab and the author of Unix Step-by-Step *(H. W. Sams, 1990). You can reach him on BIX as "bensmith" or on the Internet at ben@bytepb.byte.com.*

BYTE ACTION SUMMARY

- **WHAT MKS TOOLKIT 4.1 IS**
  Unix utilities and a Korn shell command interpreter for DOS and OS/2.
- **LIKES**
  Inclusion of UUCP and background mail access; quality and completeness of utilities.
- **DISLIKES**
  If you prefer working with a GUI, you won't get much out of it.
- **RECOMMENDATIONS**
  Well worth the price for developers and users familiar with Unix. Current MKS Toolkit users who make frequent use of Unix mail should make the upgrade.
- **PRICE**
  $299
- **FOR MORE INFORMATION**
  Mortice Kern Systems, Inc.
  35 King St. N
  Waterloo, Ontario,
  Canada N2J 2W9
  (519) 884-2251
  fax: (519) 884-8861
  Circle 1221 on Inquiry Card.

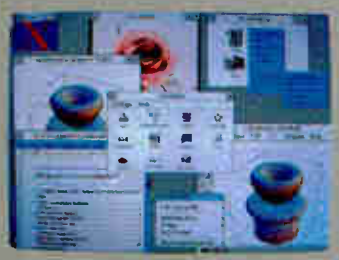
World Radio History

eXCEED THE LIMITS OF X TERMINAL EMULATION.

Turn your PC into an X station.

With HCL-eXceed/W PC X server software, Hummingbird allows you to live in two worlds: DOS/MS-Windows and X Windows/UNIX.

Imagine being able to move both text and images between UNIX hosts and your DOS PC. It's as simple as copying and pasting from one window of your PC screen to another.



Discover other innovative capabilities of HCL-eXceed/W.

- Launch Pad menuing facility
- Telnet and FTP applications
- X11 R5: support for scalable fonts, font servers, XDMCP security
- Xstart — X client program starter
- Xtrace — protocol tracing facility
- single window and multiple window mode
- supports 15 different TCP/IP transports and DECnet

- supports up to 16 million colors
- plane mask support

X Development Tools

HCL-eXceed/W now includes the Xlib, Xt intrinsics, Xaw and Xmu libraries. This introduces a whole new dimension to PC X servers. Now you can use your PC as a low-cost workstation to develop and run X applications. You can also give other PCs and workstations access to these applications over the network.

HCL-eXceed/W from Hummingbird. It's far more than X terminal emulation for PCs. And it's one of the family:

HCL-eXceed Plus — A DOS-based X server with a local window manager that supports EGA, VGA and Super VGA.

HCL-eXceed HiRes — The same as "Plus" but it also supports 8514A, XGA and TIGA 2 high resolution graphic standards.

HCL-eXtend — UNIX host-based X clients for accessing DOS services.

HUMMINGBIRD COMMUNICATIONS LTD.

For the name of your closest reseller, please contact:

2900 John Street, Unit 4, Markham, Ontario, Canada L3R 5G3
Telephone: (416) 470-1203, Fax: (416) 470-1207

In Europe: 37-39 rue de Vermont, 1202 Geneva, Switzerland
Telephone: 41 (22) 733 18 58, Fax: 41 (22) 734 14 79

Circle 214 on Inquiry Card.

World Radio History

HARDWARE

Pioneer's Super CD-ROM Drive

HOWARD EGLOWSTEIN

If you think your CD-ROM drive is fast enough and you like loading those ornery CD caddies, then don't try out Pioneer's DRM-604X high-speed minichanger. This drive features Pioneer's Quadraspin technology to achieve a continuous 600-KBps transfer rate, and it automatically switches between six CD-ROM discs at one time.

The DRM-604X is an external unit with two 50-pin SCSI connectors, switchable internal termination, and push-button SCSI ID selection. You load your CD-ROMs into a six-disc magazine that slips easily into a slot on the front panel. Loading the discs is simple enough, but the magazine itself feels breakable. The leaves that separate the discs are thin, and it wouldn't take much to snap one off. A front-panel button ejects the magazine; a rear-panel DIP-switch setting allows you to disable the eject button if you wish.

The Pioneer DRM-604X racks six CD-ROM discs at one time.

I tested the Pioneer drive on a Mac IIfx and a 33-MHz 486 EISA machine with an Adaptec 1742 EISA SCSI controller and an internal Sony CDU-541 CD-ROM drive. Pioneer's drivers loaded perfectly on the Mac. In spite of the IIfx's goofy SCSI port, I had no trouble using the Pioneer's internal terminators. If a SCSI drive works on the IIfx, it'll work just about anywhere. I loaded up the magazine with a selection of Mac HFS, ISO 9660, and Kodak Photo CD ROMs. The IIfx had file sharing enabled, and I had no trouble accessing a number of different CD-ROMs simultaneously from different machines on the network. The Pioneer drive handles the disc requests on a first-come, first-served basis, transparent to the Mac OS. The discs get swapped in and out of the magazine as needed; as far as the Mac can tell, the drive is simply six different CD-ROM drives.

Using the drive on the 486 machine should have been as easy, but the Pioneer DOS drivers simply wouldn't talk to the Adaptec board. The drivers will handle standard ASPI (advanced SCSI programming interface) drivers or selected Future Domain boards. I had been using Adaptec's ASPI to run the internal Sony drive, so connecting the Pioneer should have been a simple cabling problem. I ended up using CorelSCSI to drive both the Sony and Pioneer drives at the same time.

A test program confirmed Pioneer's speed claims: The DRM-604X transferred 60 MB in about 10 seconds (actually 598.6 KBps). The Sony CDU-541 single-speed drive ran the same test at 149.8 KBps. Some of the machines in the BYTE Lab have hard drives slower than the Pioneer CD-ROM drive. Scary.

I also installed Microsoft's Video for Windows and ran a number of video clips (.AVI files) from a Microsoft sampler CD-ROM. AVI files get choppy if your CD-ROM drive can't read fast enough; the DRM-604X's busy light barely flickered.

At $1795, the DRM-604X isn't for everyone. To date, I haven't seen six CD-ROMs that I'd ever use on a regular basis; for me, switching CD-ROMs isn't a big problem. If all you need is a drive for occasional software installation, you don't really need quadruple-speed performance.

However, in some applications, Pioneer's drive would be a bargain at twice the price. Research libraries often have a number of large CD-ROM databases, and the minichanger would save wear and tear on both the users' patience and the CD-ROMs. Educational applications are notorious for accessing a lot of animations and graphics, and the DRM-604X's speed really makes these applications fly. You may also find yourself switching between several software programming reference CD-ROMs on a regular basis. If you regularly use more than one CD-ROM and spend a lot of time watching your drive's busy light, check out the DRM-604X; you'll wonder how you ever worked without one. ■

Howard Eglowstein is a BYTE Lab testing editor who holds an S.B. from MIT. You can reach him on BIX as "heglowstein."

BYTE ACTION SUMMARY

- **WHAT THE PIONEER DRM-604X IS**
  A CD-ROM drive that accepts six discs at a time and runs at four times the speed of standard CD-ROM drives.
- **LIKES**
  Fast and convenient.
- **DISLIKES**
  The magazine is somewhat flimsy.
- **RECOMMENDATIONS**
  If you need to access large databases on CD-ROM or regularly use multiple discs, the DRM-604X is an excellent choice.
- **PRICE**
  $1795
- **FOR MORE INFORMATION**
  Pioneer Communications of America, Inc.
  3255-1 Scott Blvd., Suite 103
  Santa Clara, CA 95054
  (408) 988-1702
  fax: (408) 988-1848
  Circle 1231 on Inquiry Card.

World Radio History

BOOK AND CD-ROM REVIEWS

MARKETS AS VIRTUAL REALITY

The Death of Money
Joel Kurtzman
Simon & Schuster, $21,
ISBN 671-68799-9

Windows 3.1 Insider
Keith Weiskamp and Ron Pronk
John Wiley & Sons, $26.95,
ISBN 0471-57984-X

HUGH KENNER

Such was the barbarity of its opening prose, I nearly tossed *The Death of Money* aside. "The network is juxtaposed by computers that chart investment risk"—that kind of thing. And (my favorite), "Supply and demand—the two bedrock tenants of economics." What Joel Kurtzman must mean is *tenets*, but I cannot guess what he intends by *bedrock*.

Don't expect computer expertise, either. Of TFLOPS CPU speeds he exclaims, "A machine this big could read, digest, and process the entire contents of the Library of Congress" in just seconds. But the reading bottleneck isn't the CPU, it's the medium read from. And "digest, and process"? What can be going on? *Burp* suggests itself. Or *barf*.

But Kurtzman's book does come to cohere, sort of. He has arresting news. Time was, you bought a bond and held it to maturity. Now, the average ownership period is 20 days. That comes of eyes kept on tiny fluctuations—quick, it's up, sell it—that need cashing in on at speeds once unimaginable. Computers enable that. So does Money-as-Information: not gold nor paper, just strings of bytes moving via New York–Tokyo–Zurich, zap.

The book's title says the money you carry in your pocket is no longer what matters. That's the money you imagine as "real" because it's imprinted on real paper and used to buy real commodities: autos, houses, software, kittens. There, it's a measure of comparative values. But the economy in which I hand you $20 and you hand me the kitten of my choice is no longer, Kurtzman says, where the action is. That economy—of kittens, scissors, cars, screwdrivers—is where most of us live most of the time. But it's now exceeded by the non-kitten economy of just, oh, futures contracts, to which nothing tangible, nothing save spreadsheet numbers, can be attached.

Exceeded, moreover, by—hang on—a multiplier of 30 to 50. That's the extent to which phantom trading exceeds trades in anything as real as a meowing kitten. So forget kittens. Consider how we all exist amid "a network of financial networks." Unless we're speculators, they don't touch you and me in our daily transactions at all. But they touch us, year by year, as they devalue our dollar. Each January it buys less than in former Januaries. That's because (Kurtzman says) the "dollar" has lost all contact with tangible commodities. It's bounced about by speculative fervor, which can be obsessed with mere seconds. (Humans haven't so short an attention span, let alone reaction time. But trading programs, yes, have.)

The new electronic economy, juggling those phantom dollars, is "not only exceptionally complex and responsive, but it is also prone to volatility...temperamentally high-strung." Though I closed the book persuaded of that much, some things never did get clear. How was it that our pre-1971 money supply, tied to gold, grew at just about the right rate to deal with "the orderly expansion of growth and trade"? What magic in gold? And when the crash of '87 wiped out "trillions of dollars," just how were zapped megabucks re-created within two years?

Still, an arresting book while we wait for a better one.

Short Subject

Wiley's *Insider* series aspires to "put an expert by your side." The introductory volume, on Windows 3.1, may be the best Windows book yet. It avoids rewriting the manual when the manual is adequate. It's knowingly explicit where the manual is confusing or silent. It abounds in hot tips. And it's organized to help you find what you need. ■

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."*

RAY TRACING AS ART

Practical Ray Tracing in C, *Craig Lindley,* John Wiley & Sons, $49.95, ISBN 0-471-57301-9

Practical Ray Tracing in C is the perfect introduction to ray tracing as art and science. Ray tracing is a technique for generating photo-realistic 3-D images using the principles of geometric optics. It models the interaction of light and objects within a scene so you can display shadows, reflections, perspective, and surface texturing.

This is a dense book that's not for casual browsing. I had to work hard to gain a firm understanding of the mathematical basis for using this powerful technique.

Lindley emphasizes the practical. He tells you exactly what you need to know and moves on. No fluff. No unnecessary details. You'll learn to view ray tracing from two perspectives—the technology required to make a picture and the techniques required to make it pretty.

An accompanying set of source code and executable files lets you start experimenting with designing and drawing images without writing thousands of lines of code. The package includes full source code for DKBTrace, a high-quality public domain ray-tracing program. Although it's written for PC compatibles, you can port the source code to the Amiga, Mac, VAX, and Unix environments.

Practical Ray Tracing in C will have you whiling away many hours of your free time. Rather than sitting idle overnight or during weekends, your computer will be generating your new masterpieces for the world to see.

—Raymond GA Côté

ILLUSTRATION: TIM GRAJEK © 1993

World Radio History

HEALTH ON DISC

The Mayo Clinic Family Health Book on CD-ROM (Windows or Mac), $99.95, Sony Electronic Publishing, 9 West 57th St., New York, NY 10019, (212) 410-9409

The CD-ROM version of *The Mayo Clinic Family Health Book* augments the full text of the 1378-page book with 500 narrated illustrations and 45 animations and video clips. You locate a subject by way of the table of contents, an illustration list, or a full-text search. But the main attraction is a morph-like animation of the human anatomy that gradually exposes the muscles, organs, and skeleton as you move a slider bar. From there, you can click on an anatomical label to bring up more detailed illustrations.

Like most family health books, the Mayo Clinic CD-ROM presents an overview of many subjects but lacks depth. Many illustrations don't add much detail, and they often include single-sentence narrations that state the obvious (e.g., "Arterial pressure points are shown in this sequence"). The product also would benefit from more hypertext links between subjects.

I searched for "chronic lymphocytic leukemia" and turned up a one-screen synopsis of the disease and a link to a sidebar on "understanding your blood." But there were no links to cancer, chemotherapy, prednisone treatments, or other mentioned subjects. Prescription-drug information is limited to a simple listing. And a section on childhood immunizations includes just a few sentences about each inoculation and when your child should receive it. I'd like to see hypertext links to all the diseases mentioned, as well as information on each immunization's potential side effects.

The Mayo Clinic Family Health Book on CD-ROM is an entertaining introduction to family health, but I don't see a clear advantage over the book version. Anatomical illustrations aside, the multimedia contents aren't compelling, and the textual content lacks the depth to make hypertext links truly beneficial. For more serious health questions, you'll find a copy of the *Physicians' Desk Reference* or the *Merck Manual* more informative.

—Rob Mitchell

FUZZY-LOGIC FOUNDATIONS

Fuzzy Logic, *Daniel McNeill and Paul Freiberger,* Simon & Schuster, $22, ISBN 0-671-73843-7

A washing machine evaluates a load of clothes and automatically chooses the correct cycle. A hand-held camcorder compensates for wobble and records rock-steady scenes. Two common threads weave through these examples: The products represent applications of fuzzy logic, and they are made in Japan.

Fuzzy logic deals with vague knowledge and shades of meaning. Unlike classical set theory, which requires binary inclusion or exclusion, fuzzy logic defines continuously varying degrees of set membership: The load of laundry is *mostly* white, *moderately* heavy, and *extremely* dirty. Because fuzzy logic uses the numerical equivalent of such language (e.g., 0.8 heavy, 0.9 dirty), it greatly simplifies the development of control systems that mimic human judgment. Although such systems have proved effective, there's been a strong Western bias against a technique whose name connotes imprecision.

The authors of *Fuzzy Logic* plausibly suggest that fuzzy logic may require a Kuhnian paradigm shift to break free of the 2000-year tradition of crisp Aristotelian logic. Attributing Japan's rapid embrace of fuzzy logic to an inherently "vague" religious and cultural disposition, however, they skate on dangerously thin ice. It's true that fuzzy logicians Lotfi Zadeh and Bart Kosko are far better known in Japan than in their own U.S., but so is the management scientist W. Edwards Deming. In fairness, McNeill and Freiberger do eventually admit that pragmatism, more than Buddhism, may account for these preferences.

While *Fuzzy Logic* whetted my appetite, I went away hungry. The authors assert the superiority of fuzzy logic as a basis for control systems and say it will work synergistically with expert systems and neural networks, but they don't describe their gee-whiz examples in enough detail to help you evaluate these claims. I would prefer less pop sociology and more substance.

—Jon Udell

PHOTO JOURNEY

From Alice to Ocean, *Rick Smolan and Robyn Davidson,* Addison-Wesley, $49.95, ISBN 0-201-63216-0

From Alice to Ocean is a coffee-table picture book with a twist. The subject is Robyn Davidson's solo journey by camel across the Australian outback, and the book contains photojournalist Rick Smolan's dazzling pictures, with text from Davidson's book *Tracks*. The bonus are the two CD-ROMs: a Kodak Photo CD of high-quality images from the book and an interactive CD developed by Apple. The interactive CD presents a map of the trip that lets you point and click to jump to different portions of the route, and to see and hear Davidson's travel experiences in an arbitrary hypertext fashion.

The audio tracks—snatches of native music, *Tracks* narratives read by Beverly Dunn, and Smolan's commentary on the making of the book—pepper the work with intriguing facts and draw you into Davidson's travails as she makes the trip.

The discs are well done. The images are carefully dithered to 8-bit color and reproduce gorgeously on a 14-inch Mac monitor. This is the best example of interactive CD technology that I've seen. It's too bad Davidson herself didn't read the excerpts: That would have made the account more compelling.

—Tom Thompson

World Radio History

The best sound is not in the cards.

PORT·ABLE *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 PORT·ABLE Sound Plus from Digispeech. You know, those real smart people who make simple sound solutions.

PORT·ABLE Sound Plus is the first portable external sound peripheral to deliver 16 Bit CD quality music with audio stereo 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 PORT·ABLE Sound Plus to any other external sound peripherals, you will see why anything else is just noise. PORT·ABLE 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. PORT·ABLE Sound Plus comes complete with everything you need including a high fidelity speaker and built-in microphone. There is and "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 PORT·ABLE 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 your whether you use rechargeable or non-rechargeable AA batteries. PORT·ABLE 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. Digispeech'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, PORT·ABLE Sound Plus from Digispeech, Inc. is your ace in the hole. Suggested retail is only $198.95.

To order or obtain more information about PORT·ABLE Sound Plus, write or call Digispeech, or, contact your local dealer.

Sales Office: 550 Main Street, Suite J, Placerville, California 95667. Telephone: (916) 621-1787 Fax (916) 621-2093.

Digispeech™ THE SOUND SOLUTION inc.

MICROSOFT® WINDOWS™ COMPATIBLE

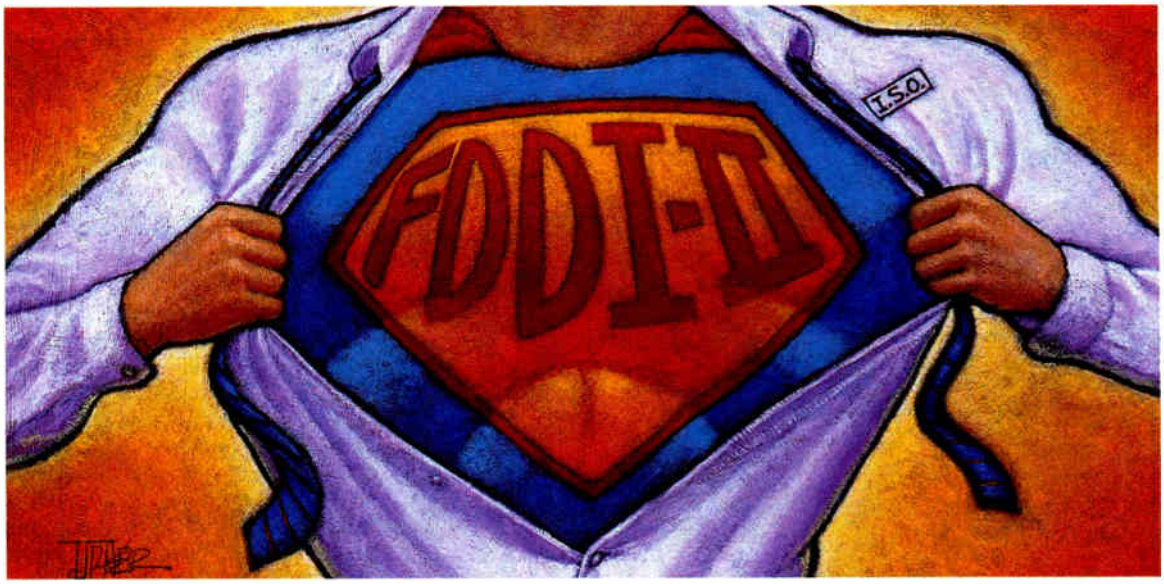
PORT·ABLE Sound Plus is a trademark of Digispeech, Inc. All other product names are trademarks or registered trademarks of their respective owners.

Circle 173 on Inquiry Card.

World Radio History

WILLIAM STALLINGS

FDDI SPEAKS



A new optical-fiber LAN standard adds circuit-switched voice and video traffic to the mix

After a long standardization period and a slow start, FDDI (Fiber Distributed Data Interface) has gained acceptance. Now a new FDDI standard is set to take the technology to the next level.

The original FDDI, known as FDDI I, calls for a 100-Mbps optical-fiber network that can function as both a LAN and a MAN (metropolitan-area network). With the increasing use of high-speed workstations, the growing reliance on graphics and image processing, and the need to interconnect departmental LANs with a high-speed backbone, FDDI has found plenty of niches.

However, FDDI is poorly suited to voice and other applications that have traditionally been handled by circuit-switching networks. To remedy this weakness, the ISO has defined FDDI II. As of this writing, the FDDI I documents are approved ANSI standards; the FDDI II documents are still in committee, but they appear to be technically stable.

The Optical Advantage

One of the biggest strengths of FDDI I and II is that both use optical fiber. Fiber-optic cable already enjoys considerable use in long-distance telecommunications and in the military. But optical fiber is used less than twisted-pair and coaxial cable for office LANs because of its relatively high cost and the complexity of its installation and maintenance.

Nonetheless, optical fiber enjoys several advantages over copper media that make it attractive for a number of LAN applications. The most obvious advantage is capacity. Optical fiber's potential bandwidth is immense: Data rates in the gigabit-per-second range have been achieved. In addition, optical-fiber cable is considerably thinner and lighter than coaxial cable or bundled twisted-pair cable, and it's at least an order of magnitude thinner in terms of comparable information-transmission capacity. For cramped conduits in buildings or underground along public rights-of-way, the advantage of small size is considerable. The corresponding reduction in weight reduces structural support requirements.

Another advantage of optical fiber is its electromagnetic isolation properties. Fiber-optic LANs are not affected by external electromagnetic fields that create interference, impulse noise, and cross talk. And optical fibers do not radiate energy that might cause interference with other equipment and provide an easily detectable signal for eavesdropping.

Because of these advantages, fiber-optic LAN technology has enjoyed substantial R&D, and related products have proliferated in recent years.

FDDI Foundations

The original FDDI I standard is a high-speed, fiber-based alternative to existing LAN standards. Like the twisted-

ILLUSTRATION: DAVID TURNER © 1993

World Radio History

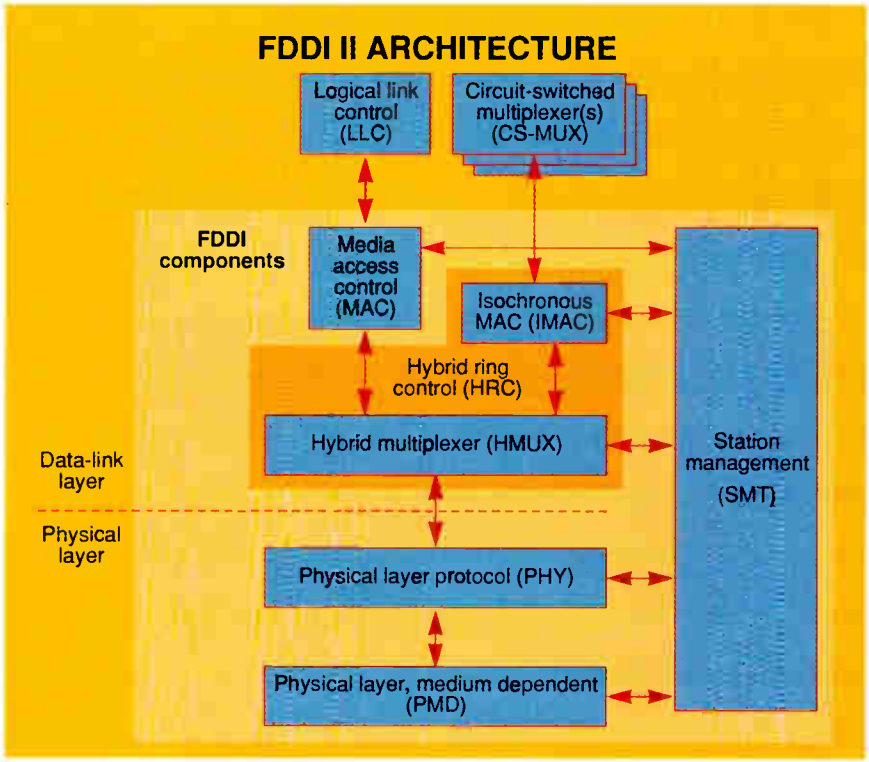


Figure 1: *The internal structure of the FDDI II data-link layer enables support for the usual packet-based applications provided by other LANs, as well as circuit-switching applications.*

pair token-ring standard, FDDI uses token passing to control access to the ring.

The FDDI MAC (media access control) algorithm is based on the use of a small token packet that circulates around the ring when all stations are idle. A station with data packets to transmit must wait until it detects a passing token. The station then captures the token by aborting the token transmission (i.e., by not repeating bits of the token) as soon as it recognizes the token. After it has completely received the captured token, the station begins transmitting one or more packets.

At this point, other stations with data to transmit must wait until the transmitting workstation releases the token. The transmitting station does this by inserting a new token on the ring when it has completed transmitting.

FDDI enhances this basic scheme with a capacity-allocation capability that regulates the amount of access time available to each station. Each station must release the token after its allocated time is up; stations with a higher priority are allowed to hold the token longer than other stations.

FDDI Extended

FDDI LANs transmit all data in frames of variable length. Each frame includes delimiters to mark its beginning and end, and address information indicating source and destination stations. But FDDI I is not suitable for maintaining a continuous constant-data-rate connection between two stations. Even the so-called *synchronous* traffic class of FDDI guarantees only a minimum sustained data rate; it does not provide a uniform data stream. Such a continuous, constant data stream is required for circuit-switched applications such as digitized voice or video.

With FDDI II, you can maintain a constant-data-rate connection.

FDDI II is an upward-compatible extension to FDDI that provides a circuit-switched service while still maintaining FDDI's token-controlled packet-switched service. With FDDI II, you can set up and maintain a constant-data-rate connection between two stations. Instead of using embedded addresses in frames, a connection is established on the basis of a prior agreement, which may have been negotiated using packet messages or established by some other suitable convention known to the stations involved.

The technique FDDI II uses to provide circuit-switched services imposes a 125-microsecond frame structure on the ring. A circuit-switched connection consists of regularly repeating time slots in the frame. This mode of transmission is sometimes called *isochronous* transmission.

The FDDI II Architecture

Figure 1 shows a block diagram of an FDDI II station. The PMD (physical-layer, medium-dependent) portion of the specification defines the physical medium and specifies reliability features. The FDDI standard specifies an optical-fiber ring with a data rate of 100 Mbps. Based on the detailed characteristics of the medium and the electrical signaling specification, the maximum distance between adjacent repeaters is 2 kilometers. The total ring can have a maximum of 1000 repeaters and a total fiber path length around the ring of up to 200 km. Thus, FDDI can easily cover large office buildings and building complexes and can support a large number of computers and slow-speed LANs.

The medium-independent portion of the physical layer specification, the PHY(physical layer protocol), addresses the electrical specification of the signal that transmits bits on the ring. The encoding scheme developed provides for efficient signaling at FDDI's high data rate. This scheme, known as 4B5B, includes the definition of several nondata symbols that are used to communicate control information.

At the MAC level, two new components are added to the token-passing MAC module: the HMUX (hybrid multiplexer) and IMAC (isochronous MAC). The IMAC module provides the interface between FDDI and the isochronous service, represented by the CS-MUX (circuit-switched multiplexer). The HMUX multiplexes the packet data from the MAC and the isochronous data from the IMAC.

SMT (station management) monitors activity and exercises overall control of physical- and data-link-layer activity at each workstation. These functions include control and management within a workstation for such purposes as initialization, activation, maintenance, performance monitoring, and error control. SMT also com-

World Radio History

municates with other SMT entities on the LAN for the purpose of controlling network operation. Examples of SMT functions include the administration of addressing, allocation of network capacity, and network control and configuration.

A Hybrid LAN

An FDDI II network can operate in either basic or hybrid mode. In basic mode, only the packet-switched service is available, and the network operates in the same fashion as an FDDI I network. In hybrid mode, both packet and circuit services are available. An FDDI II network typically starts out in basic mode to set up the timers and parameters necessary for the token protocol (e.g., each station's token-holding time) and then switches to hybrid mode.

When operating in hybrid mode, FDDI II uses a continuously repeating 16-bit pattern referred to as a *cycle*. A cycle is a framing structure similar in principle to that used in synchronous transmission systems such as T1. The contents of the cycle are visible to all stations as it circulates around the ring. A station called the *cycle master* generates a new cycle 8000 times per second, or once every 125 µs. At 100 Mbps, this works out to a cycle size of 12,500 bits (see the table). The cycle master strips each cycle as it completes its circuit around the ring.

Figure 2 shows the cycle format, which has four components. The *preamble* is a five-symbol (20-bit) nondata stream. Its actual size varies from four to six symbols to maintain synchronization in the face of jitter. The 12-octet (8-bit) *cycle header* defines how the rest of the cycle is used. A *DPG* (dedicated packet group) consists of 12 octets that are always available for token-controlled packet transfer. Finally, the *WBCs* (wideband channels) each consist of 96 octets per cycle.

Each WBC provides a capacity of 6.144 Mbps (96 octets per cycle × 8 bits/octet × 8000 cycles/second). Each channel can be set aside for circuit switching or packet switching. If a channel is used for packet switching, then it is merged with the DPG octets and any WBCs set aside for packet switching to form one large, dedicated packet-switching channel. This channel, referred to as the *packet-data channel*, is controlled by a circulating token. The minimum capacity of the packet-data channel is 768 Kbps, and it can grow in increments of 6.144 Mbps to a maximum of 99.072 Mbps. The table shows the capacity allocation of FDDI II.

The IMAC sublayer located within the hybrid ring control (see figure 1) determines which WBCs are used for circuit-switched traffic. Each 6.144-Mbps wideband channel can support a single isochronous channel. Alternatively, the IMAC can subdivide one WBC into several subchannels that permit simultaneous, independent, isochronous dialogues between different pairs of FDDI II stations.

The Cycle Header

The FDDI II cycle header consists of the fields shown in figure 3. The start delimiter (SD) indicates the beginning of a cycle and contains a unique pair of nondata symbols. The synchronization-control field (C1) establishes the ring's synchronization state. The nondata symbol R indicates that synchronization has not yet been established and that the cycle can be legally interrupted by another cycle. The C1 field is set to R during hybrid-mode initialization or by any station that detects a loss of cycle synchronization by not receiving a cycle within 125 µs of the previous cycle. The nondata symbol S indicates that synchronization has been established; only the cycle master can set this value.

The sequence-control field (C2) indicates the status of cycle sequencing. A value of R indicates that either the cycle sequence (CS) has not yet been established or that a CS error has been detected; a value of S indicates that a valid CS has been established and stations can latch each CS value to compare it to the CS value in the next cycle.

continued

FDDI CAPACITY ALLOCATION

The minimum capacity of a data channel in an FDDI II system is 768 Kbps; the maximum capacity is 99.072 Mbps.

	Bits per cycle	Data rate (Mbps)
Overhead (cycle header + preamble)	116	0.928
***n* channels of circuit-switched data**	*n*×768	*n*×6.144
Packet-data channel	96+(16–*n*)×768	0.768+(16–*n*)×6.144
Total	12,500	100

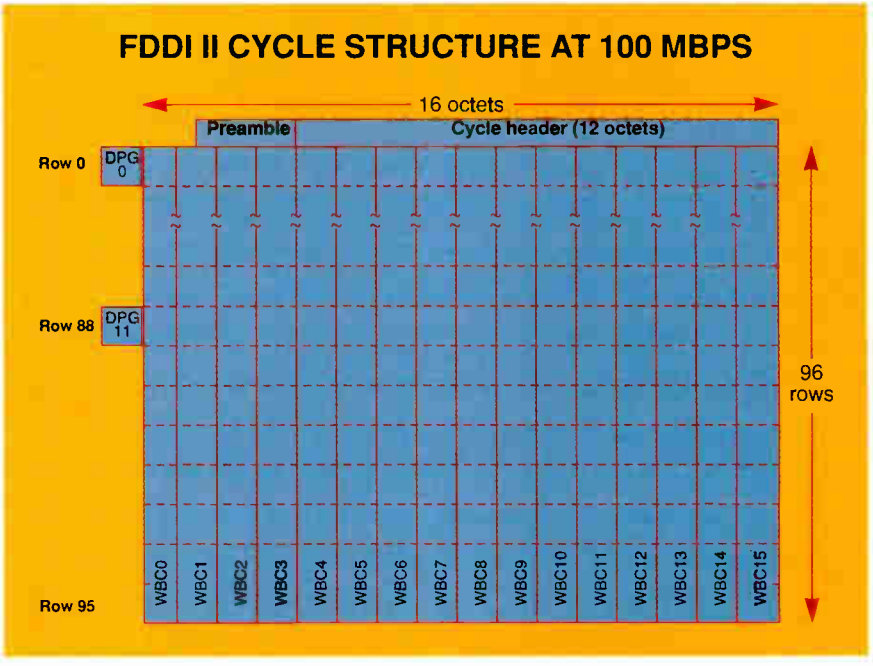


Figure 2: *FDDI II imposes a framing structure on 100-Mbps traffic. The specification divides this structure into several channels to provide both packet-switching and circuit-switching facilities.*

World Radio History

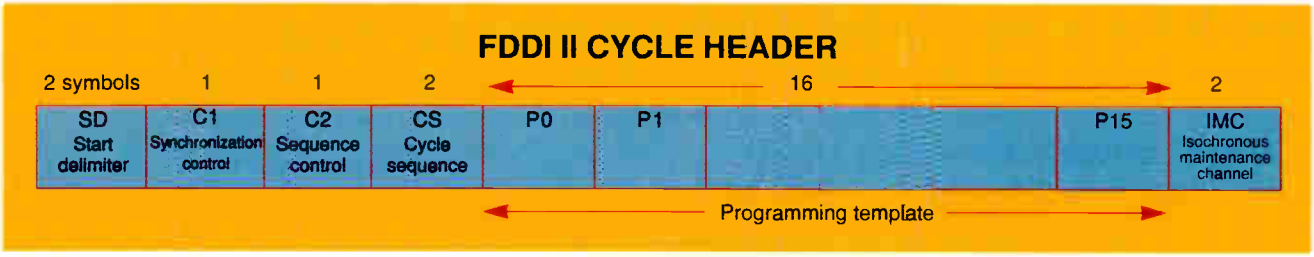


Figure 3: *The cycle header appears at the start of each cycle. It provides synchronization and housekeeping information and defines the channel allocation used.*

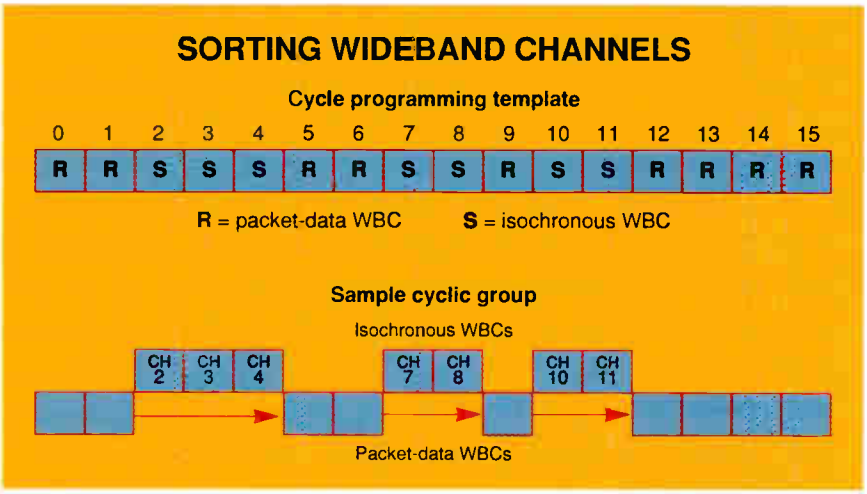


Figure 4: *This sample programming template indicates which channels to merge to provide one token-passing channel for packet-based traffic and which channels to reserve for circuit-mode traffic.*

The CS field takes the form *nn*, where *n* is a data symbol. If the C1 and C2 fields both contain R, then the CS field is interpreted as containing a monitor rank. The monitor rank, used during the monitor contention process, can take on a value from 0 to 63. During this process, monitor stations transmit their rank in the CS field. The station with the highest rank becomes the new cycle master. During normal operation, both C1 and C2 contain S, and CS contains a value between 64 and 255. The cycle master increments this number by one for each new cycle. When the value reaches 255, it wraps around and starts incrementing at 64.

The programming template field (P0–P15) consists of 16 symbols, one for each WBC. An R value indicates that the corresponding WBC is part of the packet-data channel, while an S indicates that the corresponding WBC is dedicated to isochronous traffic (see figure 4). All stations read the programming template, but only the cycle master can modify it.

The IMC (isochronous maintenance channel) field carries isochronous traffic for maintenance purposes. Its use is outside the scope of FDDI II.

Operation

During normal operation, the activity on an FDDI II network consists of a sequence of cycles generated by the cycle master. Two stations can communicate using circuit switching by sharing the use of a dedicated isochronous channel, or they can communicate using packet switching over the packet-data channel, observing the rules imposed by the token-ring protocol.

The ring initializes in basic mode. Once basic mode is established and operating, one or more stations can attempt to move the network to hybrid mode by issuing a cycle. One monitor station might be preassigned this task, or all monitor stations might compete. During the monitor-contention process, each contending monitor station continually issues cycles with an R value in the C1 and C2 fields and issues its monitor value in the CS field. If it sees an incoming frame with a higher monitor value, it ceases to transmit its own cycles and simply repeats incoming cycles. Eventually, the monitor with the highest rank sees its own rank. It then issues cycles with an S value in the C1 and C2 fields and a cycle-sequence number in the CS field.

The cycle master maintains the programming template. The allocation of capacity between packet and circuit transmission can be modified dynamically by means of SMT requests to the cycle master. When a request for modification comes in, the cycle master waits until it receives the token on the packet-data channel to ensure that no other station's packet data is circulating on the ring. It then generates a new cycle with the new programming template and issues a new token on the packet data channel. Other FDDI II stations adjust to the new allocation as soon as they receive the new programming template.

The End of the Line

FDDI II expands the power of FDDI I by supporting circuit switching for users who need LAN support for voice, video, or other constant-data-rate applications. With its standardized data rates, FDDI II lends itself to ready integration with ISDN, T1, and other long-haul data-transmission services.

FDDI II most likely represents the end of the line for refinements of this sort of shared-access technology. Vendors are already beginning to explore the use of ATM (asynchronous transfer mode), or cell relay, technology. With the use of ATM switches, it is possible to build a LAN or MAN in which each attached station has a dedicated high-speed link to the network, rather than a shared link, as is the case with FDDI II. For the near term, however, FDDI II should rejuvenate the FDDI market. ■

William Stallings is president of Comp-Comm Consulting (Brewster, MA) and is a lecturer and author. This article is based on his two most recent books: Local and Metropolitan Area Networks, *4th Edition (Macmillan, 1993), and* Networking Standards: A Guide to OSI, ISDN, LAN, and MAN Standards *(Addison-Wesley, 1993). You can reach him on BIX c/o "editors" or on CompuServe at 72500,3562.*

World Radio History

RAYMOND GA CÔTÉ

PROCESSING MAGIC ON THE MAC

Here's a look at how the System 7 Process Manager works—and how you can use it

Imagine working in an environment of total isolation. You have no neighbors, no one to call, and nobody to help you with your work. Until Apple's System 7 operating system arrived, most Macintosh programs worked this way. Programs executed in the midst of a bustling, industrious work environment without any means of communicating outside their own boundaries. While programmers could find an occasional peephole through which a trickle of information might pass between applications, doing so required arcane knowledge and questionable tricks.

Today, System 7 enhancements such as the Process Manager and Apple Events permit programs to communicate freely with other applications, request help, and exchange data. While System 7 has been around since 1991, many programmers are still unaware of how their applications can take advantage of these enhancements. I'll focus here on the capabilities of the Mac Process Manager.

History Lesson

The original Mac OS could run just one application at a time. You could also run DAs (desk accessories)—small utility programs roughly equivalent to TSR utilities under DOS—but these specialized utilities had several severe constraints, including very limited size.

Apple's Switcher was the first attempt to allow users to keep multiple applications active on the Mac. Switcher moved applications in and out of memory while fooling the operating system into seeing only one application. This solution let users quickly change from one application to another, but tricking the operating system was not an optimal solution.

Then came MultiFinder, which let users have multiple applications active simultaneously and allowed operations to continue in applications that were not currently on-screen. MultiFinder still required a bit of magic to work. The Finder still saw only one program; MultiFinder tricked the Finder into running more than one. To add to the complexity, MultiFinder was an option, and you couldn't easily tell when it was installed. Nevertheless, MultiFinder appeared to be a complete solution for users, who could now have multiple programs running at the same time and could switch smoothly and quickly between them.

Programmers saw things differently. They wanted to use the inherent features of MultiFinder in their products, but doing so wasn't easy. Apple proclaimed that MultiFinder should be transparent: A program shouldn't have to know whether it was running under MultiFinder or the Finder. But some subtle—and not so subtle—differences between the two environments made complying difficult.

The most important difference was how one application could start another application and then regain

ILLUSTRATION: MANUEL KING © 1993

World Radio History

PROCESS MANAGER CALLS

Use these Macintosh Process Manager calls to read process information.

```
OSErr GetCurrentProcess ( ProcessSerialNumber *psn );
OSErr GetFrontProcess ( ProcessSerialNumber *psn );
OSErr GetNextProcess ( ProcessSerialNumber *psn );
OSErr GetProcessInformation ( ProcessSerialNumber *psn, ProcessInfoRec *pInfo );
OSErr SameProcess ( ProcessSerialNumber *psn, ProcessSerialNumber *ps2 );
OSErr SetFrontProcess ( ProcessSerialNumber *psn );
OSErr WakeUpProcess ( ProcessSerialNumber *psn );
```

control. An application running under the Finder could perform this task, but it would not regain control until the other application had finished. Launching from within MultiFinder allowed both of the applications to be active simultaneously. Furthermore, developers found that the process of launching one application from within another was fraught with loopholes and dangers: This operation was not officially supported by Apple, required a relatively arcane invocation of the code, and usually broke between operating-system releases.

It was also impractical, if not downright impossible, to detect other currently active applications. This, again, required delving into the hidden system resources and was fraught with peril, since Apple never guaranteed that such officially unsanctioned features would exist in the next system release.

Salvation

System 7's arrival changed the rules. MultiFinder and the Finder are fully integrated and documented, and one of the results of this integration is the Process Manager. It schedules all processes, including both applications and DAs. The number of available processes is limited only by available memory.

Apple also provides an official interface to the Process Manager's internal data structures and functions. Although much of this information is interesting only to programmers who design operating-system utilities, other pieces are vital if you want to use interprocess communications in your applications.

When a user launches an application or a DA, the Process Manager assigns it a PSN (process serial number) that's unique to the system but not necessarily unique to the application. The Process Manager stores the PSN, a 64-bit value, as two 32-bit unsigned long integers in a structure of type `ProcessSerialNumber`. This ID is the key to all the system-maintained information stored about that process.

The sample program I built for this article prints out the PSN for informational purposes, but Apple instructs programmers not to try to interpret it. Apple doesn't want you to even try to compare two PSNs, except by way of the built-in `SameProcess` function. The company reserves the

FIRMLOC
Hardware and Software Computer Security System
Version 2.0

FIRMLOC™ uses a combination of hardware and software to provide total system security to owners/users of IBM PCs or compatible computers **for only $249.95.** Get the same security now in use by major corporations and U. S. government agencies. Features include:

- Installs easily • No password/hotkey req'd
- Hardware auto-verify • No I/O slot needed
- Hardware card disables floppy boot-up
- File/Directory selective • Electronic key
- Network compatible–up to 100 users/system
- Electronic bookmark • User audit trail
- Windows™ compatible • Total security

AFFORDABLE, EFFECTIVE, EASY-TO-USE!

Dealer inquiries welcomed. Direct all inquiries to:

INTELLIGENT SECURITY SYSTEMS, INC.
P. O. Box 1133 • Addison, Texas 75001-1133
Phone: (214) 315-1254 or FAX: (214) 315-1597
Toll Free: 1-800-237-4774
CALL NOW! Limited Offer! 10% off Version 2.0!

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 174 on Inquiry Card (RESELLERS: 175).

World Radio History

right to maintain status data or other dynamic information in the PSN, so don't make any assumptions about the format of the PSNs, their order, or their magnitude.

The table lists the system calls used to acquire process-dependent information. The three functions that return PSNs are `GetCurrentProcess`, `GetFrontProcess`, and `GetNextProcess`. Each of these calls accepts a pointer to a `ProcessSerialNumber` structure. The `GetCurrentProcess` call returns the PSN for the currently active process, which is your own identity. `GetFrontProcess` returns the PSN of the process that owns the active window, which the user sees. Since applications can operate in the background, these two numbers are frequently different. One way your application can determine whether it is the foreground process is to compare the PSNs returned from calls to `GetFrontProcess` and `GetCurrentProcess`.

You use `GetNextProcess` to walk through the system's internal process list and find all active processes. Listing 1 shows the simple process. Before the first call to `GetNextProcess`, the Process Manager sets the PSN to the special system constant `kNoProcess`. The first call to `GetNextProcess` returns the first active process—typically, the Finder. On subsequent calls, the program passes the record that was returned from the previous call.

`GetNextProcess` currently returns only three defined values: `noErr`, `paramErr`, and `procNotFound`. The `paramErr` value indicates that the PSN passed in the record structure is invalid. If you receive `procNotFound`, then there are no other processes on the process list following the specified one. This is not an error—it simply means that you've iterated through all available processes.

Current versions of System 7 assign PSN 8192 to the Finder and then increment the PSN by 1 for each additional launched application. Be aware that this is not a behavior on which your code should depend. Apple doesn't even guarantee that the values will appear in sequential order.

Having a PSN is not very interesting unless you can do something useful with it. One use is to bring an application to the foreground. For example, an application can call `GetCurrentProcess` to determine its own ID and then call `SetFrontProcess` to activate itself. Or you can use it when an application needs to launch several other applications simultaneously. Instead of having each of the new applications flash on the screen, your application can launch them with instructions to stay in the background. The launching application can then determine which application to move to the foreground.

Since the Mac is still a cooperative multitasking environment, calling `SetFrontProcess` doesn't automatically make the specified application move to the foreground. The specified process becomes the foreground process only after the current foreground process makes a call to `WaitNextEvent` or `EventAvail`. The one exception to this is when the current foreground process is displaying a modal dialog box. In this case, the specified process remains in the background until the user dismisses the dialog box.

Process Details

The Process Manager maintains a data set on each process. The information it contains ranges from the application name to its memory location. Programs access this data by calling `GetProcessInformation` with a pointer to a PSN structure

PUT AN END TO SOFTWARE PIRACY!

Meet the growing family of security keys from Software Security.

Each one a specialist at enforcing your license agreement in virtually any user environment you can think of. Whether it's DOS, UNIX, Macintosh or OS/2. Whether it's a single user installation or a LAN.

Simply connect the appropriate key to a single user computer, or a non-dedicated file server in a network, and you control all access to your protected application.

Users, however, won't even know it's there. The keys are transparent and won't impact software functionality or the ability to make back-up copies. Normal node and LAN operations are unaffected.

The Ultimate Protection For Software Publishers

Simple. Unassuming. Ever vigilant. Easy to incorporate into your application package. And quite possibly the most profitable hardware investment a software developer can make.

To find out more, call:
1-800-841-1316
IN CONNECTICUT CALL: 203-329-8870
FAX 203-329-7428
EUROPE AND UK: + 44 784 43 00 60

SOFTWARE SECURITY INC
1011 High Ridge Road
Stamford, CT 06905
Proudly Made in the USA

All product names are trademarks or registered trademarks of their respective holders. Made in U.S.A.

North American Readers circle 131; Other Readers Worldwide circle 132.

World Radio History

Listing 1: *Listing all processes on a Macintosh.*

```
psn.highLongOfPSN = kNoProcess;
psn.lowLongOfPSN  = kNoProcess;

while( noErr == (result = GetNextProcess( &psn ) ) )
{
    /* process the information */
}
if( procNotFound != result )
{
    /* generate an error message */
}
```

Listing 2: `GetProcessInformation` *returns this process information record.*

```
struct ProcessInfoRec {
  unsigned long        processInfoLength;
  StringPtr            processName;
  ProcessSerialNumber  processNumber;
  unsigned long        processType;
  OSType               processSignature;
  unsigned long        processMode;
  Ptr                  processLocation;
  unsigned long        processSize;
  unsigned long        processFreeMem;
  ProcessSerialNumber  processLauncher;
  unsigned long        processLaunchDate;
  unsigned long        processActiveTime;
  FSSpecPtr            processAppSpec;
};
```

Listing 3: *Grabbing the process information.*

```
/*
 *  Initialize the size of the passed structure
 *  and a pointer to the buffer into which the
 *  name is returned.
 */
pInfo.processInfoLength =
     sizeof( ProcessInfoRec );
pInfo.processName =
     (StringPtr)(&theNameString);
pInfo.processAppSpec = &pFSpec;

result = GetProcessInformation( &psn, &pInfo );

if( noErr != result )
{
  /* Generate an error message */
}
```

Listing 4: *Typical output.*

```
Process.π
  Process ID:            8252
  Application file type: PROJ
  Application signature: KAHL
  Process mode
    Need suspend and resume events
    Can background
    Activate on foreground switch
    32-bit compatible
    Aware of high-level events
    Aware of local and remote high-level events
    Stationery aware
  Partition starts at:        00CADC38
  Partition size:               64000
  Free heap memory:             49634
  Launched by process ID:        8251
  Running since time tick:      4300cf
  Accumulated CPU time ticks:       9a
```

Listing 5: *Launching another application.*

```
void doLaunch( void )
{
 StandardFileReply     mySFR;
 SFTypeList            myTypeList;
 OSErr                 result;
 int                   fsRefNum;
 LaunchParamBlockRec   lParms;
 ProcessSerialNumber   launchedProcessSN;

 myTypeList[0] = 'APPL';
 StandardGetFile( NULL, 1, myTypeList, &mySFR );
 if( true == mySFR.sfGood )
 {
  lParms.launchBlockID      = extendedBlock;
  lParms.launchEPBLength    = extendedBlockLen;
  lParms.launchFileFlags    = 0;
  lParms.launchControlFlags =
                        launchContinue +
                        launchNoFileFlags +
                        launchInhibitDaemon;
  lParms.launchAppSpec      = &mySFR.sfFile;
  lParms.launchAppParameters = NULL;

  result = LaunchApplication( &lParms );

/*
 *  Process error codes
 *  MemFullErr, MemFragErr,
 *  appModeErr, appMemFullErr, and appIsDaemon
 */

 }
}     // doLaunch
```

obtained from one of the `Getnnn` calls and a pointer to a `ProcessInfoRec` structure (see listing 2).

Your application must initialize several fields in `ProcessInfoRec` before it can call `GetProcessInformation`. Since the size of this structure may increase in future versions of the operating system, the first 32-bit structure member is set to the size of the current record definition. (Note that all the structure members are 32-bit values. This helps speed up structure access in Macs using 32-bit processors.)

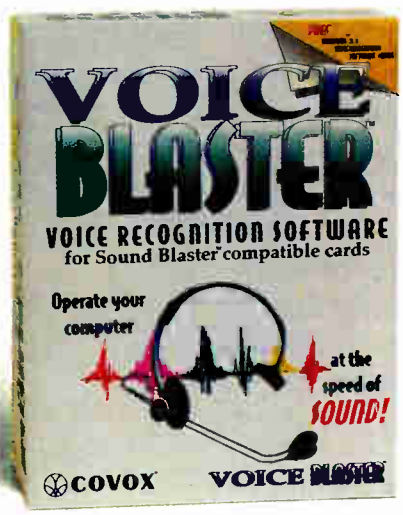
The structure also contains pointers to a name string and to a System 7 file specification record. If your application doesn't require this information, you can set the pointers to `NULL`. Listing 3 shows the setup code and call to `GetProcessInformation`. The only possible return values are `noErr` and `paramErr`.

Look at the information returned in the `ProcessInfoRec`. The `processName` returns the name of the application as a Pascal string—with one complication: DA names contain a `\0` in the first character location, and this makes them difficult to

World Radio History

If you *LISTEN* to your computer with one of these...

now you can *TALK* to your computer with THIS!



From the developers of the U.S. Air Force's "Bionic Ear" comes VOICE BLASTER, the world's first voice recognition software for popular sound cards.

The DOS and Windows 3.1 voice recognition programs included allow you to add voice commands to popular education, business and entertainment programs such as WordPerfect, F117A, Lotus 123, Secret Weapons of the Luftwaffe , DAC Easy, and hundreds more.

Easy to install and use, you will be up and running *at the speed of sound* in no time!

Also included are DOS and Windows 3.1 recording, editing and playback programs which represent leading edge PC sound technology.

Voice annotation software included brings your Windows 3.1 word processor to life by adding your own recorded messages to your documents.

The COVOX E/Q module and headset provided with VOICE BLASTER will improve your sound card's recording capability while giving you the best voice recognition possible. VOICE BLASTER *will change the way you use your computer!*

VOICE BLASTER is available at CompUSA, Software Etc. and other fine computer retail outlets.
Call COVOX, INC. (800)733-0420 Dealer inquiries call (818) 446-9932

Copyright 1993 COVOX® INC. All products and corporate names are trademarks and registered trademarks of their respective owners. All rights reserved. COVOX, INC. 675 Conger St. Eugene, OR 97402 (503) 342-1271

Circle 176 on Inquiry Card (RESELLERS: 177).

World Radio History

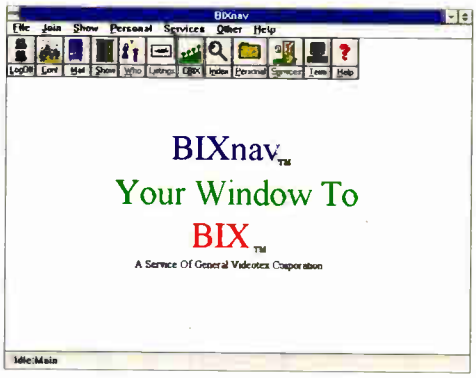
BIX and the Internet ....A Smart Combination

Access BIX Via TELNET

Only $1.00 per hour!

- From the Internet, telnet x25.bix.com for only $1.00 per hour
- Send and receive Internet mail
- Up to 10 million bytes of mail per month at no extra charge
- Windows™ Internet Mail front-end package available
- Subscribe to internet mail servers
- Access at 9600 bps at no additional charge
- Other Internet features coming soon

Other on-line services restrict Internet mail with small message sizes and per message surcharges for sending and receiving mail. Not on BIX. Move up to 10,000,000 characters per month with no additional charge. And with BIXnav, you get an Internet mail reader for Windows. Now you can send and receive internet mail from Windows.



*Optional Windows™ access program — just $9.95!

Subscribe to BIX for only $13 per month! There is no additional charge for internet mail. You can access BIX via SprintNet or Tymnet from over 600 locations in the continental US. Connect for only $3 per hour in the evening and on weekends. Daytime rates are $9 per hour. Telnet access is $1 per hour all hours.

International users: access from many international locations at 9600 bps for $24 per hour using SprintNet.

Money-Back Guarantee: If for any reason you aren't happy with BIX, simply cancel your account and request a refund of your first monthly fee.

Join BIX Now!

Using any communications program:

- Dial by modem: 1-800-695-4882
- At "login" enter ***bix***
- At "Name?" enter ***bix.byte34***

Further details and rate information will be provided during the toll-free

Questions? Call 1-800-695-4775 (voice) fax: 617-491-6642; or send Internet mail to: bix@genvid.com

Circle 450 on Inquiry Card.

Windows is a trademark of Microsoft Corporation. BIX is a service of General Videotex Corporation; 1030 Massachusetts Avenue, Cambridge, MA 02138. 617-491-3342

World Radio History

LET THEM KNOW

As a **BYTE reader,** you have a reputation for being an **informed decision maker.** You're one of the experts, directing the buying decisions of the most current products and emerging technologies.

You're the **Early Product Adopter,** with a window to today's complex computer environment.

By using the toll-free numbers in this issue, you're just a phone call away from reaching the leading suppliers and manufacturers of the products you're looking for.

Let Them Know Who They're Dealing With

Tell them you saw it in

BYTE

print from within C routines. I ignored the problem and obtained the program name from the file specification record, which contains the name of the file that launched the application. There is a subtle difference between the process name and the file specification record: One is the name of the application in memory, and the other holds the name of the application on disk. These two names are currently identical, but in future operating-system releases, in-memory applications might be allowed to have different names.

Although I defined the `processType` and `processSignature` values as unsigned long integers, they're actually 4-byte character arrays. The `processType` for applications is always `APPL`, unless the application launches at setup and runs only in the background. In that case, the type is `appe`. Apple's documentation says that all DAs are of type `drvr`, but all the DAs I tested had the file type `dfil`.

The 4-byte `processSignature` is unique for commercial applications, since Apple requires that developers register the signatures. This is the value applications store as the creator type in the files they create. The creator type determines which application System 7 launches when you double-click on a data file on the desktop.

The `processSignature` has other uses as well. If you're writing an application that communicates with other applications by way of Apple Events, then you must ensure that the application with which your application is communicating is active. You can do this by simply searching through all active processes until you find the one with the correct signature. You then know the PSN of the program with which you must communicate. For example, if you need to send Apple Events to Microsoft Word, you can search until you find a process with the signature `MSWD`.

The next structure member, `processMode`, contains a set of single-bit flags that indicate if the process is an application or a DA. It also contains information from the application's `size` resource. Among other things, these bits indicate whether the application is 32-bit compatible, if it can use high-level Apple Events, and whether it operates in the background.

The `ProcessInfoRec` also contains information detailing the application's memory use. The `processLocation` field contains the application's starting address. The amount of memory used is in `processSize`, and `processFreeMem` indicates the current number of bytes available in the application's heap. Use this information to build system memory maps and to monitor how closely applications are reaching their memory limits.

You could use the information the Process Manager returns to build a tree showing which applications launched other applications. The `processLauncher` value is a `ProcessSerialNumber` containing the process ID of the initializing application. Be aware, though, that the launching application may no longer be running.

You might also want to know when a process started an application (`processLaunchDate`) and how much of its activity has been devoted to computation (`processActiveTime`). My applications typically use 30 percent of their available time; the rest of the time they wait for user input. When developing new programs, I find it useful to check how much time an application is using while it is in the background. When the values become too large, I rethink my process architecture.

The Process Manager can determine when a process started an application and its activity level.

Finally, `ProcessInfoRec` contains the name of the file from which an application launched, and its location on the disk. You'll find this information by way of `launchAppSpec`, which points to the appropriate `FSSpec` record. This record type (available only in System 7) contains a volume reference number that identifies the file, the reference number of the directory in which it is located, and the actual name. This information is particularly useful if you have multiple copies of the same application on your system. Displaying the information available in the `FSSpec` record shows me that I am running the wrong application, and it shows precisely where it is so that I can remove it easily. Listing 4 shows the type of information that you can extract from the system for a single application.

Prepare to Launch

Having one application launch another just is a 5-minute exercise with System 7 (see

World Radio History

✣ *Coming in May* ✣

An All New BYTE Lab Product Report on Printers!

The BYTE Lab and National Software Testing Lab (NSTL— the world's largest independent testing facility) team up to bring readers the most complete product buying reports in the industry.

✣

Each and every month, BYTE Lab Product Reports give readers a full evaluation of products. Here's a line-up of future reports:

- ✣ Printers
- ✣ Systems
- ✣ Modems/Fax Boards
- ✣ Network Interface Cards
- ✣ Storage Devices
- ✣ Mobile Computers

✣

These comprehensive BYTE Lab Product Reports give readers all the buying information they need!

Don't miss the exciting BYTE Lab Printer Report this May — Over 125 will be Reviewed!

listing 5). Before you launch an application, first you have to fill out an `FSSpec` record with the appropriate information. The simplest method is to ask the user and the operating system to do it. `StandardGetFile` presents the user with the typical Open File dialog box and returns the required `FSRec` (professional programs will want to use a custom dialog box that says "Launch" rather than "Open").

The program fragment in Listing 5 sets up `StandardGetFile` to display only launchable applications. The user then selects the application to launch from the standard dialog box. When `StandardGetFile` returns, the `StandardFileReply` record is set to the description of the selected file. The `sfFile` member contains an `FSSpec` record that you must pass on to the `LaunchApplication` function.

Several other parameters must be initialized before launching the application. The values stored in `launchBlockID` and `launchEPBLength` are predefined constants provided for historical reasons. Always set these fields as shown.

The `launchFileFlags` variable allows you to set the Finder flags (typically found in the `size` resources) for the application. The easiest approach is to place a 0 in this location and set the `launchNoFileFlags` bit in the `launchControlFlags`. This instructs the Process Manager to extract the flags from the application file.

Launch options in `launchControlFlags` indicate how the application is loaded and whether or not the launching application will continue operating. The `launchContinue` option indicates that you want your application to continue running after the launch occurs. If you do not set this flag, your application will terminate, even if the launch attempt fails. When you set this flag, the launched application does not actually start executing until your application's next call to `WaitNextEvent` or `EventAvailable`.

Use `SetlaunchUseMinimum` when you want the application to load using the minimum amount of recommended memory. Without this flag, the application is launched using the preferred memory size. If you set the `launchDontSwitch` flag, the launched application will not automatically move to the foreground, but will remain in the background until the user selects it (or your program issues a `SetFrontProcess` call).

Setting the last option, `launchInhibitDaemon`, ensures that you do not launch a background-only application. Background-only applications have the `onlyBackground` flag set in the Finder flags; however, since my example shows the preferred method of letting the launch function set the flags for you, I never actually see them. This flag ensures that the user does not accidentally launch an application that has no user interface.

The last parameter to be set, `launchAppParameters`, is a pointer to the first high-level event to be sent to the newly launched application. If this field is set to `NULL`, the `Open Application` event is sent.

After you've set up the preliminaries, all that's left is to call `LaunchApplication` and check the result value. If the returned value is `memFullErr` or `memFragErr`, you can try relaunching the application in the minimum recommended space. You will receive an `appModeErr` if you attempt to launch an application that is not 32-bit clean while you are in 32-bit address mode. A result of `appMemFullErr` indicates that the application requires more memory to load than is indicated in the `size` resource; this is a programmer's problem that you cannot solve. If you have set the `launchInhibitDaemon` flag, you may receive the `appIsDaemon` result, indicating that the application was a background-only task and was not launched.

The `LaunchParams` record holds several other useful bits of information. The Process Manager returns the launched application's PSN in `launchProcessSN`. If you have difficulty launching because of limited memory, you can check the `launchPreferredSize` and `launchMinimumSize` parameters to see how much space the application would like to consume. The variable `launchAvailableSize` contains the size of the maximum contiguous chunk of memory currently available.

System 7 has elevated process management from the depths of murky obscurity to mainstream functionality. Programs are no longer officially isolated entities, but can be more fully aware of the environment in which they're operating. This capability will gain greater importance as more and more applications seek to communicate with each other through Apple Events. ■

Editor's note: *The complete listings for this article are available in electronic format. See page 5 for details.*

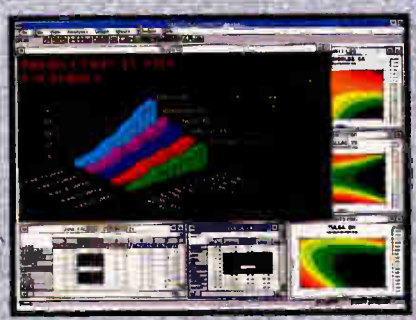
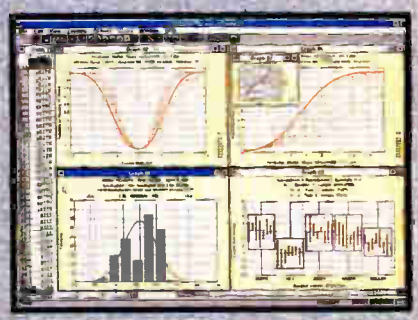
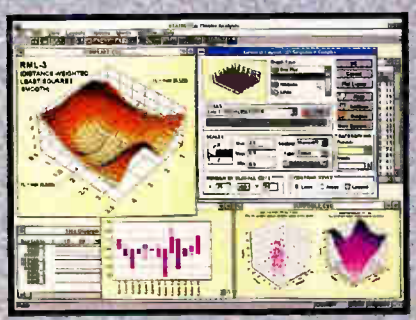
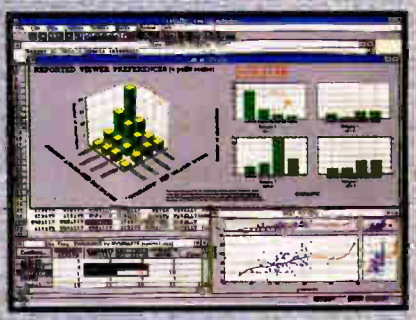
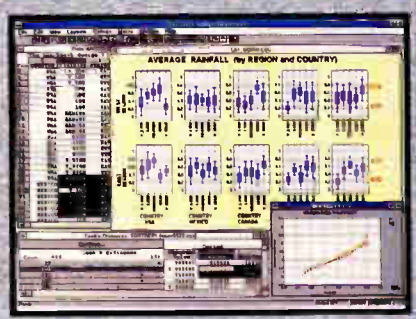
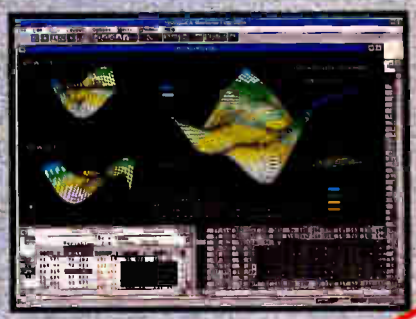
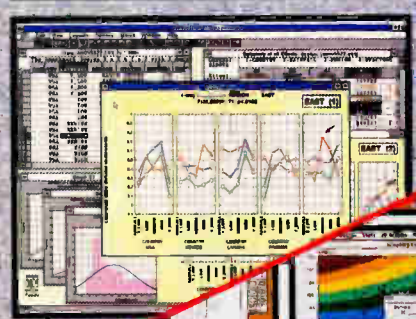
Raymond GA Côté is a software development engineer for Appropriate Solutions, Inc. (Peterborough, NH), specializing in cross-platform application development. He also edits the Robot Explorer *newsletter. You can contact him on BIX as "rgacote" or on the Internet at rgacote@byteph.byte.com.*

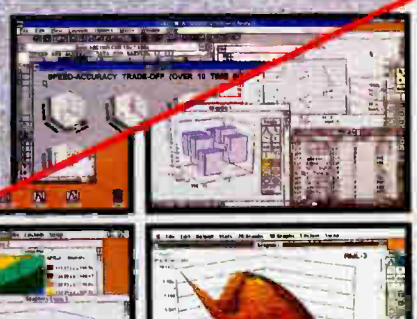
World Radio History

STATISTICA/w

Windows, DOS, Macintosh

See us at CeBit, Hannover: Hall 4, 1st Floor, Booth C 60 (33)



STATISTICA/w™ (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; multiway tables with banners (presentation-quality reports); nonparametrics; distribution fitting; multiple regression; general nonlinear estimation; stepwise logit/probit; general ANCOVA/MANCOVA; stepwise discriminant analysis; log-linear analysis; factor analysis; cluster analysis; multidimensional scaling; canonical correlation; item analysis/reliability; survival analysis; time series modeling; forecasting; lags analysis; quality control; process analysis; experimental design (with Taguchi); and much more ■ Manuals with comprehensive introductions to each procedure and examples ■ Hypertext-based Stats Advisor expert system ■ Extensive data management facilities (spreadsheet with long formulas, block operations, advanced Clipboard support, DDE hot links, relational merge, data verification, powerful programming language) ■ Batch command language and macros also supported, "turn-key system" options ■ All output displayed in Scrollsheets™ (dynamic, 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) ■ Megafile 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, multi-graphics 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/w™ (for Windows) A comprehensive 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 STATISTICA/DOS statistics and graphics ■ Price **$295**.

Domestic sh/h $10 per product; 14-day money back guarantee.

Circle 133 on Inquiry Card.

StatSoft™

2325 E. 13th St. • Tulsa, OK 74104 • (918) 583-4149
Fax: (918) 583-4376

STATISTICA/Mac™ (for Macintosh) A STATISTICA/w-compatible, comprehensive data analysis and graphics system designed for the Macintosh ■ Large selection of statistical methods fully integrated with presentation-quality graphics (incl. EDA, multiplots, a wide selection of interactively rotatable 3D graphs; MacDraw-style tools) ■ Unlimited size of files ■ Full support for System 7, incl. "Publish and Subscribe" ■ Price **$595**.

Quick STATISTICA/Mac™ (for Macintosh) A subset of STATISTICA/Mac: a comprehensive selection of basic statistics and the full graphics capabilities of STATISTICA/Mac ■ Price **$295**.

Overseas Offices: Statsoft of Europe (Hamburg, FRG), ph: 040/4200347, fax: 040/4911310; **StatSoft UK** (London, UK), ph: 0462/482822, fax: 0462/482855; **StatSoft Pacific** (Melbourne, Australia), ph: (03) 663 6580, fax: (03) 663 6117; **StatSoft Canada-CCO** (Ontario), ph: 416-849-0737, fax: 416-849-0918. Available From: CORPORATE SOFTWARE and other Authorized Representatives Worldwide: Holland: MAB Julsing, 071-230410; France: Version US (1) 40590913; Sweden: AkademiData 018-240035; Hungary: Dagent Kft 186-5782; Belgium: TEXMA 10 61 16 28; South Africa: Osiris 12 663-4500; Japan (Macintosh): Three's Company, Inc., 03-3770-7600; Japan (DOS and Windows): Design Technologies, Inc., 03-3667-1110.

StatSoft, STATISTICA/W, Quick STATISTICA/W, STATISTICA/Mac, Quick STATISTICA/Mac, STATISTICA/DOS, Quick STATISTICA/DOS, and Scrollsheet are trademarks of StatSoft, Inc.

World Radio History

SOFTWARE CORNER

BARRY NANCE

LAN REMOTE CONTROL

A pair of PC remote-control programs for NetWare LANs

Operating another PC across the LAN saves time walking around the office to troubleshoot problems. It's also useful for a variety of tasks. You might use remote control as a training tool, to demonstrate the proper use of an application. Or you can use remote control to manage an unattended PC, such as a backup server, without leaving your desk. This month's Software Corner offers a pair of programs, Control and SlaveIPX, that implement remote control of DOS sessions over IPX. These programs, which include assembly language source code, should run over any Novell NetWare 2.x or 3.x LAN.

Programming a LAN-based remote-control utility means choosing a transport protocol such as NetBIOS or IPX to shuttle screen and keyboard messages back and forth. Because Control and SlaveIPX use IPX, you don't have to load the Novell NetBIOS emulator to do over-the-wire remote control. However, using IPX also means that the remote-control software won't run on LANtastic, LAN Server, or other NetBIOS-based networks. I plan to add NetBIOS support to future versions.

You run SlaveIPX at the host workstation, the one that you want to operate through the wire. SlaveIPX is a TSR program that takes only 7 KB of RAM. It listens for message packets containing keystroke information from Control. SlaveIPX also watches the video buffer for changes and sends the screen updates to Control at your PC. On the other end, Control sends keystroke information to the SlaveIPX workstation and accepts video-buffer updates from the host.

You run Control at the remote, or controlling, workstation. Control takes a single command-line parameter, the log-on user ID for the workstation you'd like to control. If Fred is logged in and his PC is running SlaveIPX, you'd enter `Control FRED` to start up the remote session. When you want to stop Control, press Control and the 5 key on the numeric keypad. Your keyboard reverts to controlling your PC instead of the remote PC. SlaveIPX stays ready, waiting for the next call.

The slave program intercepts the timer tick interrupt, INT 8h. On every tick (i.e., 18.2 times a second), the SlaveIPX program checks the text video buffer (i.e., monochrome at B000:0000, or color at B800:0000) to see if it should send a screen update to Control. SlaveIPX also sends cursor-size and cursor-location updates. Control hooks the keyboard interrupt INT 9h. When you press a key on the controlling machine. Control sends the event to the SlaveIPX TSR at the remote PC. INT 9h is the low-level keyboard interrupt, so Control gets raw scan codes. It sends keys and shift-key states across the LAN to the host machine.

These programs don't attempt to shuttle screens in graphics mode, handle mouse movements, or print to a remote printer. These might make SlaveIPX and Control more useful, although it wouldn't get you to Windows remote control. If you need these enhancements, add them to the bare-bones versions of SlaveIPX and Control available through the usual sources. You need only MASM (Microsoft Macro Assembler) or TASM (Turbo Assembler) and a linker to create new executable files. ■

MAC/Tom Thompson

Cleaned-Up ARA

AppleTalk Remote Access lets your PowerBook call up a Mac at work and appear as a node on the office AppleTalk network. You can view files, copy them to the office network, and print them, just as if you were there. The only problem with ARA is that it has a clunky interface that uses a Control Panel to enter configuration settings and then an application to dial and establish the connection.

ARAClient, shareware written by Ron Duritsch, consolidates both the setup and access procedures into one convenient Control Panel. You enter the modem settings, phone number, user ID, and password into ARAClient and click on a button to make the connection. You can also save these values into a file for later use. ARAClient saves filed connection information into a stand-alone application that automatically makes the connection when launched.

UNIX/Ben Smith

An Old Friend Extended

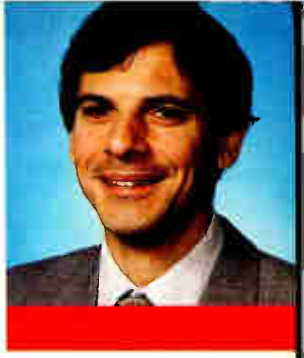
Yes, I have heard the joke: "Friends don't let friends use `vi`." But `vi` is an old friend to many a Unix user. Compared to `emacs`, it's small and simple—yet it does everything you need.

Chris and John Downey have developed a freely available version of `vi` with extensions (hence the name `xvi`). Although `xvi` is not an X Window System application, it does have multiple windows and buffers, 8-bit character support, multiple command buffers (i.e., it can repeat more than one command), and on-line help.

Even though `xvi` was originally developed for the Amiga, it's been ported to almost every popular operating system except the Mac OS. If your fingers (and mind) are already conditioned to `vi`, you will enjoy this old friend in this more sophisticated and more portable incarnation.

Editor's note: *Software Corner highlights public domain, freeware, and shareware programs. The programs are available electronically. See "Program Listings" on page 5 for details. We solicit your contributions. We pay $50 for any program we use. Write to: Software Corner, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*

World Radio History



JON UDELL

SIMPLE MAPI DELIVERS

You've probably heard that Windows for Workgroups comes with built-in mail and mail-enabled scheduling. You may not realize, though, that it is also a platform for building mail-enabled applications. The key to this kingdom is the first incarnation of MAPI, Microsoft's Messaging API. A major piece of WOSA (Windows Open Services Architecture), MAPI aspires to make mail a standard Windows system service, just as ODBC (Open Database Connectivity) does for SQL (see "Connecting Windows to Data with ODBC," January BYTE).

The simplest MAPI-aware applications will present Send menu items (or toolbar buttons) so you can mail a file or a range of files from your word processor or spreadsheet. In Windows for Workgroups, for example, File Manager's toolbar sports a Send File button. More fully MAPI-enabled programs will route forms, distribute software, and manage work flow.

Unfortunately, MAPI isn't yet as mature as ODBC. Developers are rapidly making the WOSA vision of multiple service providers a reality for ODBC. I just learned that both Watcom's and Raima's newest SQL products support ODBC. I fully expect that the WordBasic macro and the supporting DLL I built to access dBase and SQL Server data through ODBC will converse successfully with these new databases and many others.

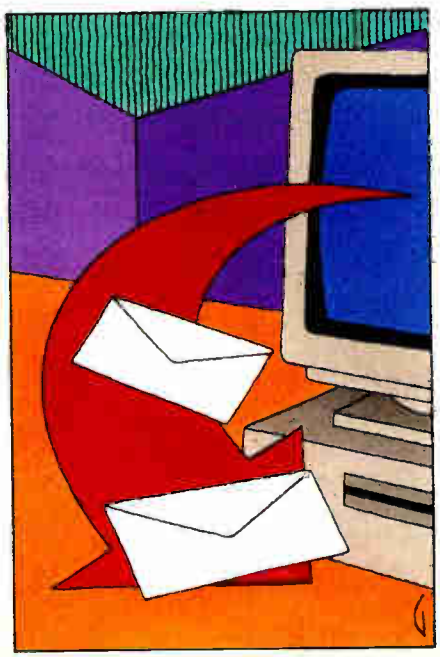
The situation with MAPI is different. The shipping version, called *simple MAPI*, is inseparably bound to Microsoft Mail. The first beta version of an *extended MAPI* open to alternate mail transports, address books, and message stores won't be available until you read this. So don't plan on running MAPI-enabled software over MHS, Vines, SMTP, or other popular mail transports anytime soon.

Using Simple MAPI

Despite this limitation, you can do quite a lot with simple MAPI today. Comprising just a dozen function calls and a few basic data structures, it's a surprisingly powerful tool. I began exploring simple MAPI using the MAPI custom controls included in the professional edition of Visual Basic 2.0. In just a few minutes, I created a Visual Basic mail notifier that periodically polled my mailbox and popped up a message box when it spotted a piece of unread mail. Although trivial, it served a useful purpose. Windows for Workgroups doesn't provide a lightweight notifier, so you have to keep Mail—a hefty program—loaded all the time to check for incoming messages.

The Visual Basic custom control does a great job of encapsulating the MAPI data structures—a message, along with its lists of recipients and attachments—but the result wasn't the lightweight notifier I'd envisioned. The next step was to re-create the program in C. That was straightforward, too. `LoadLibrary` and `GetProcAddress` gave me the addresses of the entry points in MAPI.DLL that I needed: `MAPILogon` (to establish a session), `MAPIFindNext` (to enumerate unread messages in the inbox), `MAPIReadMail` (to peek at the contents of new incoming mail), and `MAPIFreeBuffer` (to free memory allocated by MAPI for message storage). You can do this in any language that can call a DLL and can represent a message and its associated lists.

Microsoft's new E-mail API is powerful yet easy to implement



When a mail-enabled program logs on to the mail system, it can display the same log-on dialog box that Mail itself uses, or, if it knows a valid name and password, it can bypass that dialog box and silently establish a session. Both approaches have their uses. When interaction is necessary, a standard look (as with the Windows 3.1 common file, print, and font dialog boxes) tells you to expect standard behavior. Developers who've worked with both MAPI and the VIM (Vendor-Independent Messaging) API cite VIM's lack of an embedded common user interface as a drawback.

MAPI Functions

Simple MAPI provides two functions for sending mail. `MAPISendDocuments`, which always prompts with standard dialog boxes for recipients and sending options, works even with minimally capable languages like WordBasic that can't pass message structures as parameters. If you're using a more robust language, you can use `MAPISendMail` and skip the addressing and attachment dialog boxes. An unattended program using this function can send a message (with a list of file or OLE attachments) to a list of recipients. Other MAPI functions enable programs to save and delete messages, build recipient lists using the address-book dialog box, resolve a name to an address-book entry, and view

ILLUSTRATION: JOSEF GAST © 1993

World Radio History

or edit an address-book entry.

Every MAPI message has an associated type. These types conform to a three-part syntax. If I send you a standard Microsoft Mail message, its type will be IPM.Microsoft Mail.Note. The first field denotes interpersonal mail, the second identifies the sending application, and the third further categorizes the message. Other IPM message flavors common in Windows for Workgroups define message receipts and requests for meetings.

Simple MAPI also recognizes message types beginning with IPC, which stands for interprocess communications. IPM messages show up in your inbox when you run Mail, but IPC messages don't. Suppose I'm a network administrator receiving frequent automatic status reports—via E-mail—from nodes on a network. Instead of cluttering up my inbox, the reporting nodes and monitoring application might use the invisible IPC channel.

Hitting the Wall

Why not just stash IPM messages in a designated folder accessible to the standard Mail client? Here's where simple MAPI starts to run out of gas. Its concept of a message store is extremely limited. It knows only about a single folder: Mail's inbox. You can't use simple MAPI to create a new folder or set the current folder to be other than the inbox. Extended MAPI, by contrast, defines a rich message store comprising a hierarchy of folders and provides functions to create, move, copy, delete, and search those folders. There may, in fact, be several message stores, so extended MAPI also provides a function to enumerate them.

Like message stores, transports and address books can multiply in extended MAPI. Novell's MHS, for example, comprises both a store-and-forward mail transport and a directory of users. A MAPI implementation would make MHS one of several transports that are available to MAPI clients and merge the MHS directory into the system address book. At this point, MAPI starts to look a great deal like ODBC. As more service providers appear on the scene, diverse message systems—MHS, SMTP, and even fax—will become accessible to Windows applications that use MAPI.

Such integration today requires specific collaboration between clients and gateways. Extended MAPI aims to generalize that relationship, granting any Windows application common access to all the message systems enabled on a given machine. Moreover, you will enjoy a unified view of those diverse systems. When you address a note to a mixture of E-mail and fax recipients, you'll always work with the same address-book dialog box, whether you initiate the action from a minimally mail-aware application or from a full-blown mail client.

Extended MAPI Objects

All the objects that an extended MAPI client can manipulate—including message databases, messages, attachments, folders, address books, users, and distribution lists—support a common interface for querying and setting properties. Additional common interfaces support streaming text to and from messages and attachments, and arranging lists or hierarchies in tabular form for search or display.

The function `GetContentsTable`, for example, works polymorphically to enumerate flat objects like distribution lists and attachment lists, while `GetHierarchyTable` examines tree-structured

IN NETWORK PRINTING, YOUR ONLY DECISION SHOULD BE WHICH CASTELLE TO BUY.

Castelle's family of high-performance print servers: LANpress – external devices supporting up to four printers or plotters; JetPress – internal cards for installation in HP printers.

There's a long list of questions you have to answer on how to manage your network printers. Fortunately, the answer to all of them is short and sweet. Namely, Castelle.

For example: How can I get faster printing? And how can I save money? The answer to both questions is easy. Buy a Castelle LANpress™ or JetPress® print server. They're complete. No extra software or hardware to buy, no need to allocate a PC for printing. And everyone on your Novell or UNIX network will enjoy faster printing.

Where should I put my printers? Thanks to Castelle, anywhere on your network.

How about reliability? Over the years, Castelle has satisfied tens of thousands of customers with 100% Novell compatible print servers. And we keep them satisfied with great service, including a toll-free customer service hotline.

So, when should I decide to buy a Castelle print server? Right now. On a risk-free 30-day trial offer. Just call our 800# for the dealer near you.

yes NetWare Tested and Approved

CASTELLE

Enhancing your network productivity.

1•800•289•7555

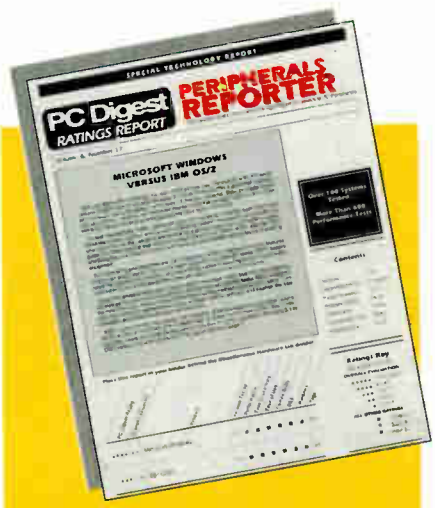
Ask for DEPT. 4238

Castelle, 3255-3 Scott Blvd., Santa Clara, CA 95054. (408) 496-0474. FAX (408) 496-0502. LANpress is a trademark and JetPress is a registered trademark of Castelle. Other brand and product names are trademarks or registered trademarks of their respective holders. © 1993 Castelle. All rights reserved.

World Radio History

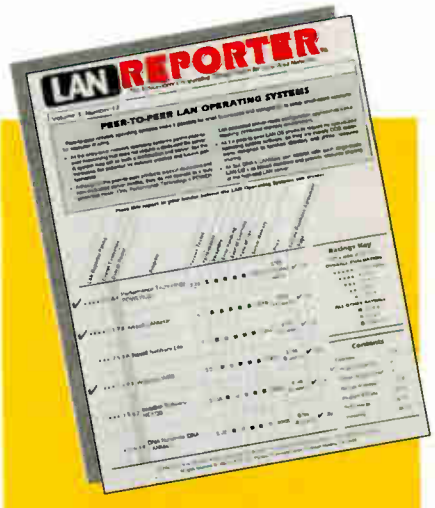
Circle 161 on Inquiry Card.

Choose only the best:



SYSTEMS

SOFTWARE



LANs

Be sure the products you buy give you the best value for the money. Subscribe to National Software Testing Laboratories (NSTL) Ratings Reports.

Only NSTL Ratings Reports authoritatively evaluate the major products in each category. Head-to-head. Feature-by-feature. Against precise, objective benchmarks.

Each report compares product costs, speed, features, versatility and compatibility in a real-world, applications-based environment like the one you perform in every day. These comprehensive reports contain no ads. No distractions. Just timely test results and recommendations.

NSTL Ratings Reports help you make more confident purchases. You'll minimize the risk of spending tight budget dollars on products that don't meet vendor claims or aren't compatible with your current technology. Plus, you'll keep abreast of upgrades, new product releases, and the advantages and limitations of the products you're considering.

Get full control of the planning and buying process — subscribe today.

NSTL NEWSLETTERS ARE NOW PART OF THE BYTE FAMILY OF PUBLICATIONS!

PHONE

603-924-2589

FAX

603-924-2603

CHECK ONE

☐	**PC Digest RATINGS REPORT** — Unbiased evaluations of the latest PC systems and peripherals. Color notebooks. 486DX2 systems. SCSI disk drives. PostScript printers. CD-ROMs. 9600 V.42 bis modems. DAT backup devices. Mouses. Hard disk controllers.	$445. 20 ISSUES
☐	**Software Digest** — The definitive monthly source for independent, third-party tests and verifications of PC application software. Executive word processing. Business graphics. Project management. Graphical spreadsheets. SQL front ends. Communications. Windows backup programs. Databases.	$445. 12 ISSUES
☐	**LAN REPORTER** — Monthly test results of the hardware and software you need to tie your computer equipment together. Wireless LANs. WANs. Operating systems. Ethernet network adapters. Servers. Bridges. Gateways. E-mail. Network monitors.	$445. 12 ISSUES

MONEY-BACK GUARANTEE
If at any time you are not COMPLETELY satisfied, you will receive a full refund for all unmailed issues.

2 FREE ISSUES
Include payment with your order (check or credit card) and receive 2 additional issues with our compliments.

MAIL

Complete this order form and mail to:
BYTE/NSTL, One Phoenix Mill Lane,
Peterborough, NH 03458.

NAME

COMPANY NAME

COMPANY ADDRESS

CITY/STATE/ZIP

PHONE

PAYMENT INFORMATION:

☐ Check enclosed

☐ Please bill me P.O. # required

Charge my: ☐ Visa ☐ MasterCard ☐ AMEX

ACCOUNT NUMBER

EXPIRATION DATE

SIGNATURE

Orders outside North America: Please add US $20. for airmail delivery.

BT493

Circle 71 on Inquiry Card.

World Radio History

objects like address-book containers and folders. Tables acquired by means of either of these functions support common search, sort, and navigation protocols.

To support the multiprovider scenario, extended MAPI defines a trio of interfaces to which message store, address book, and transport providers must conform. For the most part, MAPI.DLL, like ODBC, will play the role of a driver manager that loads DLLs. Then it will get out of the way so those DLLs can do the real work. However, MAPI.DLL will directly implement certain key services such as memory management and event notification.

In general, service providers will ask MAPI to allocate memory, and clients will ask MAPI to free it. Because a central authority brokers requests from both sides, ownership conflicts won't arise. There's also a chaining function that a provider can use to grow complex, nested structures that a client can nevertheless free by calling MAPI with a single base pointer.

The event-notification service is particularly elegant. A client that wants to be notified when the contents of a particular folder change issues a call to the folder's provider. It in turn sends a client-supplied folder ID and callback function along to the *notification engine* in MAPI.DLL. When the provider changes the folder's contents, it alerts MAPI, which takes care of notifying all clients that have registered interest in the folder.

MAPI in Your Future

Microsoft plans to roll out extended MAPI with a future version of Windows, probably in 1994, and promises that applications written to simple MAPI today will run unmodified on extended MAPI when it's available. Message-enabled applications previously confined to a Microsoft Mail straitjacket will suddenly be able to connect to a rich assortment of message systems. And at the same time, extended MAPI's superior facilities for organizing, searching, and storing message data will encourage the development of new mail-enabled applications more ambitious than those feasible today with simple MAPI.

Do developers buy into this plan? Yes and no. The author of a leading mail-enabled forms program told me his principal concern is to get that program onto as many mail platforms as possible. A multiprovider version of MAPI would do the trick, but so would a multiprovider version of VIM. Currently, he's forced to support the early, uniprovider versions of both APIs to get coverage of just two mail systems—Microsoft Mail and cc:Mail. Both MAPI and VIM promise to decouple from proprietary transports and push beyond their current Windows (and, for VIM, OS/2) implementations to DOS, Unix, and the Macintosh. But E-mail developers aren't sitting on their hands waiting for all this to happen.

In the meantime, it's hard to go wrong with simple MAPI. Windows for Workgroups is going to put Microsoft Mail and MAPI onto a lot of desktops. Users of Windows for Workgroups will come to expect that applications notice the mail system and react by offering Send options. It's so easy to satisfy that expectation that there's no reason not to. A developer who supports DDE or OLE must make a major commitment. Simple MAPI, by contrast, lives up to its name—it really is a cinch. ■

Jon Udell is a BYTE senior technical editor at large. You can contact him on BIX as "judell" or on the Internet at judell@bytepb.byte.com.

Circle 70 on Inquiry Card.

World Radio History

ASK BYTE

Running CD-ROMs in Parallel

I have an NEC Intersect CDR-73 external CD-ROM drive connected to my Amiga 2000. I recently purchased a Librex T386SX/Notebook and would like to use the CD-ROM drive with it. Because my notebook cannot use SCSI peripherals directly, I am looking for ways to connect external SCSI devices to either the parallel printer port or the PCMCIA slot. How do I do so?

Bryan Brown
Silver Spring, MD

I'm not aware of any PCMCIA SCSI adapters. Parallel-port adapters seem to be all the rage these days, and two companies attract most of the attention. Always Technology (Westlake Village, CA, (818) 597-1400) and Trantor Systems (Fremont, CA, (510) 770-1400) both make parallel-port SCSI adapters that should do the trick.

Always' AL-1000 supports a full host of SCSI devices and comes with ASPI (advanced SCSI programming interface) drivers. It should handle your CD-ROM drive. If you have a bidirectional port, the AL-1000 will give you data at rates of up to 250 KBps. Trantor's T338 MiniSCSI and T348 MiniSCSI Plus both come with CD-ROM support. If your Librex machine has a bidirectional parallel port, you'll want to investigate the T348 MiniSCSI Plus. Freeport Data (Fremont, CA, (510) 505-0567) makes two similar products: the Freeport/25 and Freeport/50 (25- and 50-pin SCSI, respectively) adapters.

MSCDEX comes with most drives, or you can get a copy as part of Corel SCSI, a universal SCSI driver that handles many different SCSI drives, from Corel Systems (Ottawa, Ontario, Canada, (613) 728-8200). Because these products are always being upgraded, you should check with the manufacturer to make sure that the Intersect CDR-73 is one of the supported drives.

—Howard Eglowstein

Dynamic Arrays

Regarding Daryl F. Watson's C programming problems (Ask BYTE, December 1992), I had the same problems when I started programming. For a program to execute another program or an operating-system command and return to the mother program, ANSI C provides the `system()` function with prototype in `stdlib.h` (e.g., `system ("rog1.exe")` will execute `prog1` in DOS).

Dynamically allocating multidimensional arrays is not as tricky as your reply says, although it requires a programmer's logic. For example, to allocate a 2-D array with six columns and nine rows, you define a pointer that indicates an array of six pointers, each pointing to its own array of nine floats. Listing 1 shows how to do it in C++.

The solution in ANSI C follows similar lines. As a physicist, I use multidimensional arrays so often that I have defined functions with templates to handle this business. This lets me dynamically allocate memory for multidimensional arrays of any object in a single line.

Michael Chen
Riverdale, MD

There are two items of importance in your listing: The first is the `system()` *function; the second is the concept of dynamic-array allocation.*

On the first point, note that the I/O of any program or process started with `system()` *is completely independent of the parent program, your C code. It doesn't even return the exit status of the program, only the exit status of the command interpreter (e.g., command.com or /bin/sh). This is acceptable if you only want to initiate another program from within yours.*

The second point is also valid, but only in a limited context. It is in the definition of the word dynamic *that our views differ, and it's from this difference that the problem becomes either trivial or complex. I'll define dynamic-array allocation in this way: the ability to expand or contract the size of an array based on the dynamic conditions within a running program.*

To allocate memory once during the program is no problem, but when you want to add to the size of the array, many things can go wrong. The C++ operator `new` *and the C function* `malloc()` *return a pointer to a block of memory. Even sequential calls to these operations will not give you the next sequential address so that you could have merely concatenated the new with the old, to create a contiguous array.*

Assuming that you plan to allocate an entirely new block of memory when it comes time to change the size of the array, you face some inconveniences: You must copy valid contents of the old array to the new array before you free the space on the old one; you can't use more than half of the free heap space, because you must maintain two copies of the array during the copy; and your heap space will become fragmented and limit the size of your arrays even more.

The solution is to manage the heap with your own routines for dynamically changing the size of arrays. Some of our longtime readers may recall that Rick Grehan offered such routines in "If Memory Serves..." (August 1989 BYTE).—Ben Smith ■

Listing 1: *Dynamically allocating multidimensional arrays.*

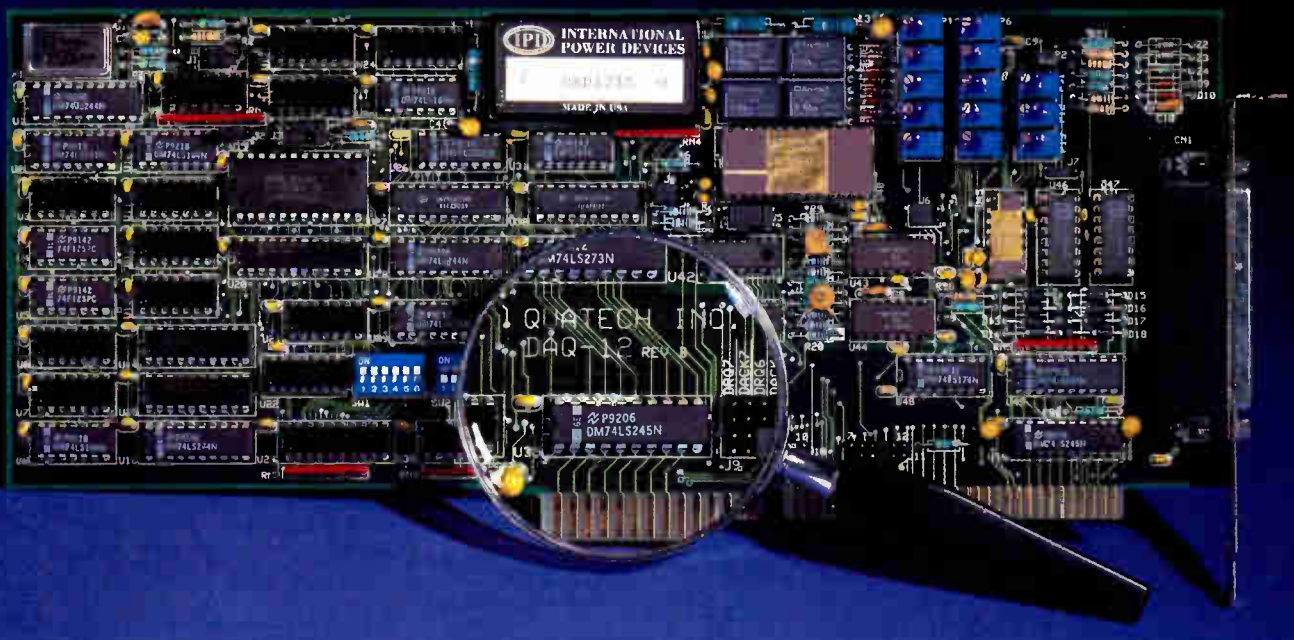
```
float **ptr;
//Allocate memory for 6 pointers.
ptr=new float *[6];
//Now allocate memory for
//6 arrays, each with 9 floats.
for(int i=0; i<6; i++)
        ptr[i]=new float[9];
//Now we can use the array!
ptr[3][5]=1.2;
```

The BYTE Lab welcomes your questions. Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. You can also send BIX mail c/o "editors."

We read every letter, but due to the volume of mail received, we cannot guarantee a response. We edit all letters for clarity and brevity.

World Radio History

If your board doesn't say Quatech Inc., you may be missing something...



Ask a Quatech sales Engineer to show you the value of quality, service and support.

- Quatech manufactures a complete line of data acquisition, communication, and Micro Channel boards for the PC AT/XT, PS/2 and compatible computers.
- Quatech's user friendly software drivers enable our full featured adapters to support most popular operating systems.
- Quatech's adapters are backed by our free on-line technical support.

Made in U.S.A.

For a free catalog call: 800-553-1170

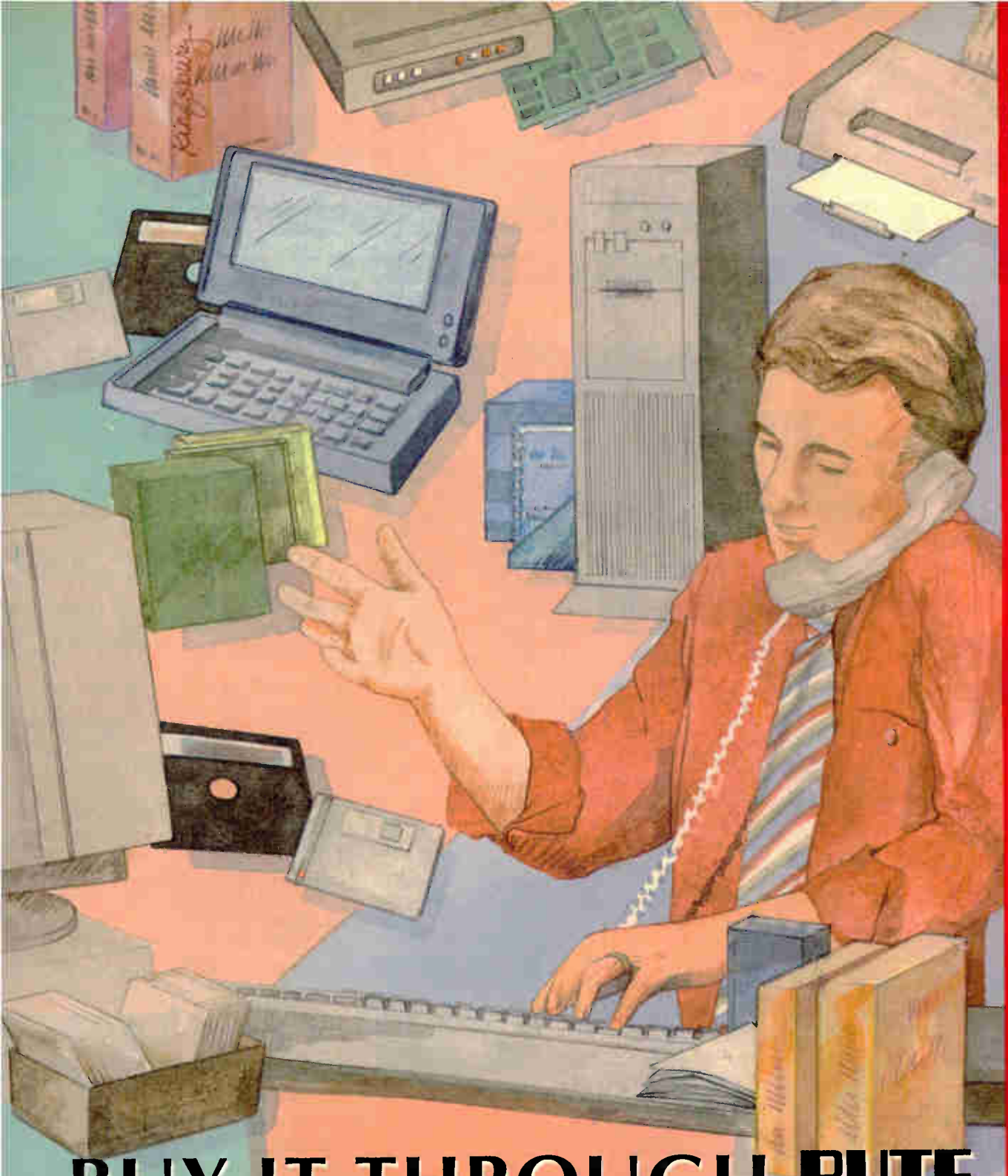
International: Australia/Interworld Electronics 03-563-7066, Canada (Western)/Interworld VCR 604-984-4171 (Toronto office 416-513-7027), England/Diamond Point International 634-722-390, Finland/Lab Hitech OY 358-0-804-2522, France/Elexo 33-1-69302880, Germany/Jupiter Electronic Systems 06181/75041, Israel/RCM Ltd. 972-03-5447885, Italy/N.C.S. Computer Italia 0331/770-016, Netherlands/ACAL Auriema 040-816565, Korea/Sam Boo Enterprise Co. 82-2-538-4001, Spain SANTA Barbara SA 34-3-203-9916, Singapore Bliss Services Pte Ltd (65) 338-1300. IBM PC-XT, AT, PS/2 and MicroChannel are registered trademarks of IBM Corp.

QUATECH

662 Wolf Ledges Parkway
Akron, Ohio 44311 U.S.A.
216-434-3154

Circle 125 on Inquiry Card.

World Radio History



BUY IT THROUGH BYTE

Mail Order

The latest offerings from vendors supplying products of all leading manufacturers at extremely competitive prices.

218

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.

241

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.

251

ILLUSTRATION: SUSAN KINGSBURY

World Radio History

CAD AT THE SPEED OF THOUGHT.

PLAIN TALK ABOUT YOUR NEED FOR SPEED

AND THE DIFFERENCE BETWEEN ISA, EISA AND VL-BUS

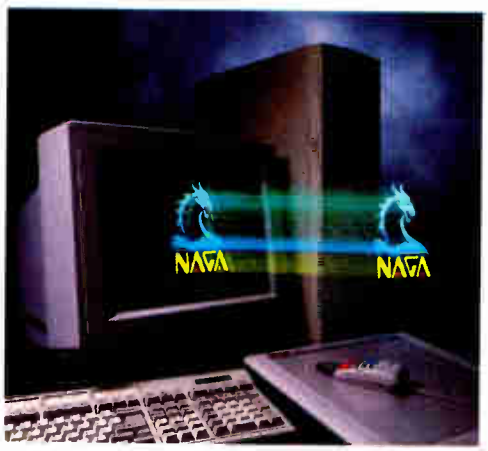
FAST:
ISA transfers data up to 3MB/second on an 8 bit wide databus

FASTER:
EISA offers 32MB/second transfer rates on a 16 bit wide databus

FASTEST:
NAGA's VL-Bus™ system is capable of transferring raw data on a 32 bit wide databus at the rate of 132MB/second

SYSTEM BOTTLENECKS CAUSE LENGTHY REDRAWS

Redraws take a long time because data displayed on your monitor is bottlenecked. The databus, peripherals and CPU aren't operating on the same bandwidth—the number of bits able to pass through the system's narrowest bottleneck—causing delays.



You've looked at a zillion ads. It seems like everyone's selling the same thing. You want the fastest 486 or 386 available at the lowest price. And now, everyone's talking ISA, EISA and VL-Bus™. And how much more speed you need.

CAD, IMAGING OR GRAPHIC DESIGNERS: WORK 50 TIMES FASTER AND SMARTER.

For CAD, imaging or graphic design users, VL-Bus' speed advantages are incredible! Without all the wasted time spent waiting for screen redraws, you'll work up to 50 times faster—and smarter.

VESA® VL-Bus, transparent to operating systems and software, is truly the new standard of performance—which more than 120 manufacturers of systems, chipsets and peripheral boards have adopted for their most powerful products.

NAGA'S QUALITY COMMITMENT TO YOU

- 2-Year Warranty on ALL Components
- Lifetime 800 Number for Service & Support
- FREE! 12-Month On-Site Service Contract**
- Next-Day Replacement Part Warranty
- 45-Day Money-Back Satisfaction Guarantee—No Questions Asked
- 24-Hour BBS Technical Support

FREE! OVER A $1,200 VALUE CAD SOFTWARE SOLUTION WITH ANY CAD VL SYSTEM!

- Autodesk Generic CADD 6.0*: PC Magazine's Editors' Choice CAD package for superior 2D CAD design, layouts and drawings.
- Silver Screen 2.2: a true 3D CAD and solid modeling software solution.
- AutoPack Tutor for AutoCAD: an interactive tutorial for beginning and advanced AutoCAD ver. 11 or 12 users.

CAD ELITE SOLUTION 486-EISA/VL

- Intel 80486 Processor (Integrated Math Coprocessor)
- 8MB RAM (exp. to 256MB)
- 256K RAM Cache (exp. to 512K)
- 210MB <15 ms IDE Hard Disk
- Teac 1.2 & 1.44 Floppy Drive
- 32 Bit VL/IDE I/O Controller
- 32 Bit VL-Bus 2MB
- 20" Flat N/I SVGA (1280x1024)
- 101 Enhanced Keyboard
- Vertical Case with 250W Power & 2nd Fan
- CalComp 12x12 Digitizer
- CAD SOFTWARE BUNDLE

486DX-33 MHz **$3,695**
486DX2-50 MHz **$3,795**
486DX2-66 MHz **$3,995**

CAD SOLUTION 486-VL

- Intel 80486 Processor (Integrated Math Coprocessor)
- 8MB RAM (exp. to 32MB
- 64K RAM Cache (exp. to 256K)
- 210MB <15 ms IDE Hard Disk
- Teac 1.2 & 1.44 Floppy Driv
- 32 Bit VL/IDE I/O Controller
- 32 Bit VL-Bus 2MB
- 15" Flat N/I SVGA (1280x10
(For 17" monitor, add $50
- 101 Enhanced Keyboard
- Vertical Case with 250W Power & 2nd Fan
- CalComp 12x12 Digitizer
- CAD SOFTWARE BUND

486DX-33 MHz **$2,695**
486DX2-50 MHz **$2,795**
486DX2-66 MHz **$2,995**

ORDER TODAY TOLL FREE
1-800-568-6242
Fax orders: 602/820-3153
Direct & international line: 602/820-3294
Hours: 7 a.m. to 7 p.m. Mon-Fri., 9 a.m. to 4 p.m. Sat. & Sun., MST
Purchase orders accepted from Fortune 1,000 Companies & Universities.
Commercial leasing available.

MasterCard, VISA, Discover, American Express and CBA

NAGA
Systems Corporation
Smart Computer. Smart Solution. Smart Choice.

1520 West Mineral Road
Tempe, AZ 85283

*Commercial leasing based on 10% purchase option plus applicable sales tax. Leasing not available in certain states. Lease programs available for businesses less than two years o
**12-month on-site service may not be available in certain remote locations. Intel is a trademark of Intel Corporation. Other brand names are trademarks of their respective compani
Prices, configurations and components vendor subject to change without notice. Prices do not include shipping or applicable sales tax. AutoCAD is a registered trademark of Autodes

1-800-568-6242

Circle 209 on Inquiry Card (RESELLERS: 210).

Rack Mount Computers - Motherboard or Passive Backplane

Use external monitor
Up to 6 drives

8.75" high

Mono or color monitor
Up to 5 drives

8.75" high

14" color monitor
Up to 3 drives

12.25" high

Rack Mount Monitors

10" mono or color monitor

8.75" high

14" mono or color monitor

12.25" high

Enclosure for most desk top monitors

14.0" high

Rack Mount Keyboards

Drawer mounted keyboard

1.75" high

Drawer for desk top keyboards

3.5" high

Vertical-mount, sealed membrane keyboard

5.25" high

Rack Mount Printer

Dot matrix printer with industrial rating

12.25" high

Call for our other Rack Mount computer and "enclosure only" product offerings.

RECORTEC, INC.

1290 Lawrence Station Road, Sunnyvale CA 94089
Tel. [408] 734-1290 Fax: [408] 734-2140

1-800-729-7654

Circle 197 on Inquiry Card (RESELLERS: 198).

World Radio History

LIFETIME ★ WARRANTY 100% GUARANTEED

MEMORY SUPER SOURCE

1 x 9 $CALL SIMMS
70 NS
4 x 9 $CALL
CALL FOR LATEST SIMM PRICES

HARD DRIVE SUPER PRICES $CALL

FAST DELIVERY, GREAT SERVICE AND LOW PRICES

Quantum
FUJITSU
Maxtor
Seagate
MICROPOLIS
CONNER
WESTERN DIGITAL

Apple

MATH CO-PROCESSORS

INTEL		CYRIX		IIT	
8087 5MHZ INTEL	49.00	83D87D/X-16 16MHZ CYRIX	89.00	2C87-8 8MHZ IIT	59.00
80B7-2 8MHZ INTEL	99.00	83D87D/X-20 20MHZ CYRIX	89.00	2C87-10 10MHZ IIT	59.00
80B7-1 10MHZ INTEL	89.00	83D87D/X-25 25MHZ CYRIX	89.00	2C87-12 12MHZ IIT	65.00
80287-6 6MHZ INTEL	45.00	3D87D/X-33 33MHZ CYRIX	89.00	2C87-20 20MHZ IIT	69.00
80287-8 8MHZ INTEL	49.00	83D87D/X-40 40MHZ CYRIX	99.00	2C87-16 16MHZ IIT	89.00
80287-10 10MHZ INTEL	59.00	83S87SX16 16MHZ CYRIX	79.00	3C87-20 20MHZ IIT	89.00
80287XL-10 10MHZ INTEL	75.00	83S87SX20 20MHZ CYRIX	79.00	3C87-25 25MHZ IIT	89.00
80287XLT 12MHZ INTEL	75.00	83S87SX25 25MHZ CYRIX	79.00	3C87-33 33MHZ IIT	89.00
80387SX-16 16MHZ INTEL	85.00	82S87XL CYRIX	79.00	3C87-40 40MHZ IIT	89.00
80387SX-20 20 HZ INTEL	85.00			3S87SX-16 16MHZ IIT	75.00
80387DX-16 16MHZ INTEL	89.00			3S87SX-20 20MHZ IIT	75.00
80387DX-20 20MHZ INTEL	89.00	WEITEK		3S87SX-25 25MHZ IIT	75.00
80387DX-25 25MHZ INTEL	89.00	3167-20MHZ WEITEK	295.00	3S87SX-33 33MHZ IIT	85.00
80387DX-33 33MHZ INTEL	89.00	3167-25MHZ WEITEK	395.00	AMD	
80487SX-20 INTEL	499.00	3167-33MHZ WEITEK	495.00	80C287-10 AMD	59.00
OVERDRIVE SX.DX33	749.00	4167-25MHZ WEITEK	445.00	80C287-12 AMD	59.00
OVERDRIVE SX.DX25	599.00	4167-33MHZ WEITEK	695.00		
OVERDRIVE SX.DX20	499.00				

SIMM-SIPP MODULES

	EACH	12+		EACH	12+
4MB X 9-80NS SIMM-PC	CALL	CALL	256K X 9-100NS SIMM	CALL	CALL
4MB X 9-70NS SIMM	CALL	CALL	256K X 9-80NS SIPP	CALL	CALL
4MB X 9-60NS SIMM	CALL	CALL	256K X 9-70NS SIMM	CALL	CALL
1MB X 9-100NS 9 CHIP SIMM	CALL	CALL	256K X 9-60NS SIMM	CALL	CALL
1MB X 9-80NS 3 CHIP SIMM	CALL	CALL	256 X 36 -- 1MB	CALL	
1MB X 9-80NS 9 CHIP SIMM	CALL	CALL	512 X 36 -- 2MB	CALL	
1MB X 9-70NS 3 CHIP SIMM	CALL	CALL	1 X 36 -- 4MB	CALL	
1MB X 9-70NS 9 CHIP SIMM	CALL	CALL	2 X 36 -- 8MB	CALL	
1MB X 9-60NS 3 CHIP SIMM	CALL	CALL	4 X 36 -- 16MB	CALL	
1MB X 9-60NS 9 CHIP SIMM	CALL	CALL	8 X 36 -- 32MB	CALL	
1MB X 9-53NS 3 CHIP SIMM	CALL	CALL	1MB X 40 -- 80NS -- 4MB SIMM		
1MB X 9-53NS 9 CHIP SIMM	CALL	CALL		CALL	
16MB X 9-70NS SIMM	CALL	CALL	4MB X 9-70NS SIPP	CALL	
16MB X 9-60NS SIMM	CALL	CALL	4MB X 9-60NS SIPP	CALL	
			2MB X 40 -- 80NS -- 8MB SIMM		
				CALL	

MAC QUADRA 700, 900
4MB KIT MQ2707 476
16MB KIT N/A 476
32MB KIT N/A 1106
64MB KIT N/A 2196
PERSONAL LASER WRITER LS
512K KIT 35401/4 75
PERSONAL LASER WRITER NT
1MB KIT MQ219 84
4MB KIT N/A 299
LASERWRITER IINTX
1MB KIT M6005 87
4MB KIT M6006 142
LASERWRITER IIFNX
1MB KIT MQ277 47
4MB KIT MQ2727 136
16MB KIT N/A 476
LASER WRITER IINTX
1MB 99
4MB 198

AST
AST PREMIUM EXEC 286-12, 386SX/20
1MB MOD 5008140001 $ 84
4MB MOD 5008140003 116
AST PREMIUM EXEC 386SX/25, 25C
1MB MOD N/A 98
4MB MOD 5008140041 116
BRAVO MS 286-16, 386SX/16
512K KIT 5005100012 34
2MB KIT 5005100002 76
4MB KIT 5005100003 116
BRAVO MS 486-25
2MB KIT 5007080005 86
8MB KIT 5007080001 282
PREMMINIM 386S/25, 433
386S/I.25B, 486S/I.25, 486SX/20
PREMIUM 386SX/16, 486-SXW
EXP BOARD 5007080033 43
2MB KIT 5007080005 66
4MB MOD 5007080004 136
8MB KIT 5007080002 312
0-32MB E-C 5008160001 279
PREMIUM 386SX/20
2MB MOD 5007080003 43
2MB KIT 5007080005 66
4MB MOD 5007080004 136
8MB KIT 5007080002 312
0-32MB E-C 5008160001 279
PREMIUM 386
1MB MOD M0248 199
2MB MOD N/A 329
1MB MOD N/A 329
4MB MOD N/A 662
MAC PORTABLE BACKLIT
1MB MOD N/A 135
2MB MOD N/A 202
3MB MOD N/A 315
4MB MOD N/A 398
HDS
512K KIT N/A 76
1MB E-C N/A 129
1MB KIT N/A 48
MAC PLUS
512K N/A 27
1MB KIT MQ219 84
4MB KIT MQ2707 136
MAC CLASSIC
1.5MB E-C M6361LL/A 56
512K KIT N/A 27
2MB KIT MQ219 84
MAC CLASSIC II
2MB KIT MQ219 84
4MB KIT N/A 138
8MB KIT N/A 276
MAC LC
512K KIT N/A 27
2MB KIT MQ219 84
4MB KIT MQ2707 136
MAC SE/30
1MB KIT MQ218 47
4MB KIT MQ2707 136
8MB KIT N/A 619
MAC II
1MB KIT MQ218 47
4MB KIT MQ2707 136
16MB KIT N/A 552
MAC LC
1MB KIT MQ218 47
2MB KIT MQ219 84
4MB KIT N/A 138
512K VRAM 47
MAC LC II
2MB KIT MQ219 84
4MB KIT N/A 138
8MB KIT N/A 220
MAC IISI
1MB KIT MQ218 47
4MB MOD M0514LL/A 80
4MB KIT MQ2707 136
16MB KIT N/A 552
32MB KIT N/A 1104
64MB KIT N/A 2208
MAC IIFX
1MB KIT MQ218 47
4MB KIT MQ2707 136
16MB KIT N/A 619
MAC IIVI
1MB KIT M0376LL/A 143
2MB KIT N/A 161
4MB KIT N/A 288
8MB KIT N/A 576
16MB KIT N/A 1152
32MB KIT N/A 2304
MAC IICI
1MB KIT MQ218 47
2MB MOD M0514LL/A 80
4MB KIT MQ2707 136
8MB KIT N/A 268
MAC IICX
1MB KIT MQ218 47
4MB KIT MQ2707 136
16MB KIT N/A 619

NEXT
WESTSTATION
WESTSTATION CUBE
16MB KIT N/A $ 625
WESTSTATION COLOR
1MB MOD N/A 55
WESTSTATION EXPANSION
4MB MOD N/A 198

COMPAQ
LTE 5000 PROCESSOR
512K MOD 117077001 $ 107
LTE 286
1MB KIT 117081801 65
4MB KIT 117081802 84
8MB KIT 117081803 127
LTE 386S/20
1MB MOD 121125001 66
4MB C-C 121125002 192
LTE LTE 286 20
2MB C-C 179789001 128
4MB C-C 179788002 192
8MB C-C 179788003 304
SLT/286
1MB MOD 110235001 69
4MB MOD 110237001 210
SLT 386S/20
1MB MOD 118300001 80
2MB MOD 118300001 186
4MB MOD 118300001 156
PORTABLE III
512K KIT 107331001 40
1MB KIT 107332001 80
INTERFACE 107808001 110
EXP BOARD 107811001250
PORTABLE 386
1MB KIT 107651001 118
INTERFACE 107707001 125
4MB E-C 107653001 202
4MB KIT 107653001 202
PORTABLE 486C
2MB MOD 118685001 78
4MB MOD 118690001 175
8MB MOD 176877001 260
DESKPRO 286
1MB KIT N/A 79
0-16MB E-C N/A 79
DESKPRO 386S
1MB MOD 113131001 65
4MB MOD 113132001 172
DESKPRO 386
1MB E-C 110807001 299
2MB E-C 108069-71-001 267
4MB E-C 108070001 299
8MB E-C 108070-72-001 396
16MB E-C 108071001 596
32MB E-C 108072001 799
DESKPRO 386S
1MB E-C 115430001 188
4MB E-C 115634001 229
8MB E-C 115635001 340
DESKPRO 386/20
2MB MOD 113131001 65
4MB MOD 113132001 172
DESKPRO 386/20E
1MB E-C 115440001 148
4MB E-C 115645001 236
8MB E-C 115646001 340
DESKPRO 386/25
2MB MOD 115144001 94
8MB MOD 115651001 260
16MB MOD 115652001 520
32MB MOD 115653001 1040
DESKPRO 386/25E
1MB MOD 115680001 49
2MB MOD 115689001 79
4MB MOD 115690001 175
8MB MOD 126877001 260
8 SOCK-EC 129160001 291
DESKPRO 386/33
1MB MOD 115680001 49
2MB MOD 115689001 79
4MB MOD 115690001 175
8MB MOD 118700001 260
PROLINEA 3/75S, 3/75ES
2MB KIT 141738-001 88
8MB KIT 141742-001 240
PROLINEA 4 33
1MB MOD 141562-001 43
2MB MOD 141563-001 65
4MB MOD 141564-001 108
8MB MOD 141685-001 205
SYSTEMPRO
1MB MOD 115144001 94
8MB MOD 115651001 260
16MB MOD 115652001 520
32MB MOD 115653001 1040
SYSTEMPRO/I 386/25
386-33 486S/25
1MB MOD 118684001 49
2MB MOD 118689001 79
4MB MOD 118690001 175
8MB MOD 118700001 260
4MB MOD 118690001 175
8MB MOD 118700001 260
8 SOCK-EC 129150001 291
CONTURA
1MB 139498001 215
8MB 139499001 378

AT&T
SAFARI 6BX/20
2MB E-C 37660 $ 149
4MB E-C 37661 349
6286/6SX
1MB KIT 37722 175
6300, 6/20MC/6SX
1MB KIT 37714 125
4MB KIT 37716 283
6386/SX
2MB KIT 37336 78
0-8MB E-C N/A 179
2MB KIT MQ219 84
8MB KIT 37261 79
STAR SERVER 486/33E
4MB KIT 37344 233
16MB KIT 37345 885

QMS
QMS PS 410
1.4MB E-C N/A $ 199
2MB E-C N/A 157
4MB E-C N/A 275
QMS 815, 815MB, 815
1.6MB E-C N/A 179
2.6MB E-C N/A 218
4.6MB E-C N/A 279
5MB E-C N/A 359

NCR
SYSTEM 3000 MODEL 3290
PC3290
2MB KIT 3299K107 $ 379
0-16MB E-C N/A 129
MODEL 3218 ELPC386SX-16
MODEL 3215 ELPC386SX-20
2MB KIT 3299K107 179
8MB KIT 3299K108 500
MODEL 3315 PC3386SX/20-87
1MB KIT 3299K105 139
2MB KIT 3299K106 179
8MB KIT 3299K108 500
MODEL 3329 PC3386SX/MC/N
2MB KIT 3471292 180
0-32MB E-C N/A 205
PC486 MC25
2MB KIT 3314K102 275
8MB KIT 3314K104 499

DELL
320M, 212M LT
1MB MOD 3133203 $ 95
4MB MOD 3103204 186
325P, 320D, 333D, 333P, 325SX, 433P, 486D, 486P
1MB MOD 3102525 80
2MB MOD 3102389 115
4MB MOD 3102567 175
486D, 486P
16MB KIT 3102625 600
425, 425i, 433
486DE, 486SE, 486TE
2MB MOD 3102466 115
4MB MOD 3102467 175
8MB KIT 3102468 345
16MB KIT 3102469 600
32MB KIT 3102630 1300
NOTEBOOK 8X/25
1MB CALL
2MB CALL
4MB CALL
NOTEBOOK 325NC
2MB CALL
4MB CALL
8MB CALL

EPSON
NE-SL 20, 25, 25C
2MB MOD A808731 $ 129
4MB MOD A808781 199
NB-25
1MB MOD A808501 110
4MB MOD A808511 190
EQUITY LT-286E
1MB MOD A808191 128
EQUITY LT-386SX
2MB MOD A808361 235
EQUITY 286 PLUS
1MB KIT A808231 52
4MB KIT A808151 80
EQUITY 386SX/16 PLUS
EQUITY 386/20 PLUS
1MB KIT A808231 52
2MB KIT A808181 88
4MB KIT A808631 291
EQUITY 386/25 PLUS
EQUITY 486SX/25 PLUS
1MB KIT A808231 52
2MB KIT A808181 88
4MB KIT A808631 291
486/33 486SX/25 VISA & TOWERS
2MB KIT A808591 SCALL
4MB KIT A808631 SCALL
8MB KIT A808673 SCALL
EPL 6000
4MB E-C 154401 104
4MB E-C N/A 185
8MB E-C N/A 310
EPL 7000 LP
2.4MB E-C C822031 225
4MB E-C C822061 349
1MB KIT N/A 59
1.5MB KIT N/A SCALL
EPL 7500 LP
2.4MB E-C C822051 SCALL
2MB E-C C822021 SCALL
1MB KIT N/A 59
ACTION LASER II
1MB E-C 80
2MB E-C 150
4MB E-C 185
1MB E-C 210

ALR
ALR POWERFLEX
ALR FLEX CACHE 33MSLE
512K KIT 129005512 $ 26
1MB KIT 129010000 49
2MB KIT 129020000 98
4MB KIT 129040000 196
ALR BUSINESS VEISA
ALR BUSINESS VEISA ADVANT
ALR HPS
1MB KIT 129010000 49
4MB KIT 129040000 196
15MB KIT 129165000 525
32MB KIT 129320001 1024
ALR BUSINESS STATION
ALR POWER PRO
ALR POWER PRO ARRAY
ALR POWER PRO MC
ALR POWER FLEX PLUS EV
1MB KIT 129010000 49
4MB KIT 129040000 196
15MB KIT 129165000 525
ALR POWER CACHE 486 486E
ALR MICROFLEX 386
2MB KIT 129020000 98
4MB KIT 129040000 196
32MB KIT 129160000 1054
ALR FLYER 32LCT
1MB KIT 129010001 53
4MB 129018040 155
8MB KIT 129040816 525
ALR FLYER 320T
1MB M0332LL/A 98
4MB M0332LL/A 246
8MB 357

LASER PRINTER MEMORY
FUJITSU RX 7100, 7200M
2MB $ 295
KONICA LP3110 3115
1MB 140
2MB 210
3MB 280
KYOCERA F17000 F3300
1MB
1-2-3 4MB CALL
KYOCERA F820 F1800
F1600M F2000 F2400
1MB 80
OKIDATA 4 PLUS + 8E
1MB 129

EVEREX
TEMPO LX
2MB MOD N/A $ 82
TEMPO CARRIER
2MB MOD N/A 152
STEP SYSTMS 386/S, 386SX/20
512K KIT N/A 21
1MB KIT N/A 43
2MB KIT N/A 87
4MB KIT N/A 178
8MB KIT N/A 312
16MB KIT N/A 625
386/25 33 SERVER 386
386/25 486S/20, 486/15A SERVER 486
1MB KIT N/A 63
2MB KIT N/A 178
16MB KIT N/A 625
64MB CACHE 79
386S-33 STEP OLD VERSION
4MB 581 399
64K CACHE MOD 582 150

hp
HP VECTRA 286/12
1MB KIT D1640A $ 49
4MB KIT D1354A 78
0-16MB E-C N/A 78
386/16N 20M
2MB KIT D2406A 78
4MB KIT D2404A 265
DS/16S
1MB KIT D1640A 59
4MB KIT D1354A 78
DS/20S 25C/20C
1MB KIT D1640A 59
4MB KIT D1842A 156
386/25C
2MB MOD D2381A 84
4MB MOD D2152A 258
486S/25
1MB MOD D2150A 47
4MB MOD D2151A 153
486/25T, 33T
2MB MOD D2381A 84
4MB MOD D2152A 258
9000/375, 380
8MB KIT H9829B 450
16MB KIT H9829C 852
32MB KIT H9829E 1745
9000/400
8MB KIT H9879B 456
16MB KIT H9879C 852
9000/400S
8MB KIT H9829B 456
16MB KIT H9829C 852
9000/400T
2MB KIT H9829C 258
8MB KIT H9829B 456
16MB KIT H9829C 852
9000/433
8MB KIT H9829B 456
16MB KIT H9829C 852
32MB KIT H9829E 1745
DESKJET 500C, 500 PLUS
2MB MOD N/A 64
LASERJET II, IID
1.4MB E-C H3344B 78
2.4 E-C H3344B 107
4MB E-C H3344B 164
8MB E-C H3344B 59
LASERJET IIP, IIL
MID 4MB
1-4MB E-C H3347B 98
2-4MB E-C H3347B 98
3-4MB E-C H3347B 98
4MB E-C H3347B 159
8MB E-C N/A 59
LASERJET IIISI
1MB MOD C2063A 47
4MB MOD C2065A 148

IBM
W5153 NOTEBOOK
2MB MOD 07G1879 $ 129
4MB MOD 07G1880 199
8MB MOD 07G1881 299
1400SX M333X LAPTOP
2MB MOD 0663995 99
4MB MOD 0663996 149
8MB MOD 0663997 249
P70 386
2MB MOD 6450604 75
0-2MB E-C 6450605 79
P75 486
2MB MOD 6450902 77
4MB MOD 6450128 149
PS/1 P86
2MB MOD 1057035 34
4MB MOD 1059931 85
PS/1 386SX
512K MOD 1057035 34
4MB MOD 1059934 85
4MB MOD 92F9694 139
MODEL 25
2MB KIT 92F955 29
MODEL 25 286
512K KIT 6133481 24
2MB KIT 30H3360 79
0-16MB E-C N/A 79
MODEL 30 286
512K KIT 6133481 24
2MB KIT 30H3360 79
0-16MB E-C N/A 79
MODELS 35SX, 35LS, 40SX
1MB MOD 6450883 42
2MB MOD 6450604 75
4MB MOD 6450128 149
8MB MOD 6450129 299
MODELS 55SX, 55LS
2MB MOD 6450604 75
4MB MOD 6450128 149
8MB MOD 6450129 299
MODEL 57SX
2MB MOD 6450902 77
4MB MOD 6450128 149
8MB MOD 6450130 299
MODELS 70 061, 70 161
2MB MOD 6450902 77
4MB MOD 6450128 149
8MB MOD 6450130 299
MODEL 80
1MB MOD 92F8225 195
MODELS N 40T, N 40T/E
1MB MOD 6450606 75
2MB MOD 6450607 149
MODELS N 41T, N 41SX
1MB MOD 6450606 75
2MB MOD 6450607 149
MODEL 90XP HD STORAGE
OGS 009
1MB MOD 6450902 77
4MB MOD 6450128 149
8MB MOD 6450130 299
MODEL 95XP HD STORAGE
OGS 095
1MB MOD 6450902 77
4MB MOD 6450128 149
8MB MOD 6450130 299
MODEL 95XP/HD STORAGE
OJB, DJD
MODEL 95XP HD STORAGE
OGS 095
MODEL 95XP/HD STORAGE
OJB, DJD, DJF, DKD, DKF
1MB KIT 92F9795 77
4MB MOD 6450128 149
8MB MOD 6450130 299
16 BIT EXPANSION CARD FOR MODELS 50 60 55SX
65SX 55LS MAXIMUM TWO CARDS PER MACHINE
0-32MB E-C 6450609 195
1MB MOD 6450603 42
2MB MOD 6450604 75
4MB MOD 6879977 149
8MB MOD 6879978 299
8MB MOD 6450129 299
32 BIT EXPANSION CARD FOR MODELS 70 80 90 95XP
TWO CARDS PER MACHINE
2.5MB E-C 6450609 195
1MB MOD 6450603 42
2MB MOD 6450604 75
4MB MOD 6879977 149
8MB MOD 6879978 299
8MB MOD 6450129 299
PS/2 386SX
1MB KIT H183332 59
2MB MOD H183334 99
4MB MOD H183335 157

NEC
ULTRALITE 286E
1MB OC PC2221 $ 84
4MB MOD PC2222 199
ULTRALITE SX, SLX
2MB MOD PC4471 157
4MB MOD PC4472 330
ULTRALITE SL, SLX/20
2MB MOD PC4471 166
4MB MOD PC4472 349
ULTALITE SL SLX/25
2MB MOD PC4721 166
4MB MOD PC4722 349
4MB MOD PC4723 679
PROSPEED 25S
2MB MOD PC2121 88
2MB MOD PC2176 129
4MB MOD PC2177 249
PROSPEED 33MS
2MB MOD PC3121 129
4MB MOD PC3122 429

PROSPEED 386SX
1MB MOD PC2121 88
2MB MOD PC2176 129
4MB MOD PC2177 249
PROSPEED 486SX
1MB MOD OP4106204 88
4MB MOD OP4106205 199
POWERMATE PLUS 20
2MB E-C OPCH751X 199
4MB E-C APCH751X 349
POWERMATE PLUS 25
1.5MB E-C APCH752 210
2.5MB E-C APCH753 299
3MB E-C N/A 379
POWERMATE SX
2MB E-C APCH853 316
4MB E-C APCH853 446
8MB KIT N/A 699
POWERMATE SX PLUS
1.7MB E-C APCH854 279
2MB E-C N/A 279
4MB E-C APCH852E 379
8MB E-C N/A 579
POWERMATE SX/16
2MB E-C OP4108201 213
4MB KIT N/A 84
POWERMATE SX/20
2MB E-C OP4108103 84
4MB KIT N/A 149
POWERMATE 286C, 286 PLUS
2MB E-C APCH856SR 252
2.5MB E-C N/A 285
4MB KIT N/A 535
POWERMATE 386/20
1MB MOD APCH855E 299
2MB MOD APCH855E 399
POWERMATE 386/25
2MB MOD APCH855S 285
4MB MOD APCH855S 725
8MB BARE APCH857X 725
POWERMATE 386/25S
2MB KIT OP4105201 82
4MB KIT OP4105202 174
8MB KIT OP4105203 346
POWERMATE 386/33E
2MB KIT OP4106101 166
POWERMATE 386/33N
2MB KIT OP4106201 82
4MB MOD OP4106202 174
16MB MOD OP4106206 600
POWERMATE 486/25E
2MB KIT OP4108103 84
4MB KIT OP4108205 225
16MB MOD OP4106206 600
SALEFLYWHEEL MODEL 90 & 95
2MB MOD OP4897 130
SALEFLYWHEEL MODEL 95
2MB MOD OP4898 125
SALEFLYWHEEL MODEL 2
2MB MOD 4892 130

Canon
LPB 4 -4PLUS
1MB MOD S632240 $ 143
1-2MB E-C S63730 145
2MB E-C N/A 261
LBP-8III
1.4MB E-C S631300 79
2.4MB E-C S631886 118
4MB E-C S631302 149
LBP-8III, 8PLUS
1.5MB E-C S633340 145
2.5MB E-C S633250 281
3MB E-C S633260 377

SUN
SPARCSTATION ELC
4MB MOD X1040 $ 172
16MB MOD X1150 609
SPARCSTATION IPX
4MB KIT X1041 172
16MB MOD X1151 609
SPARCSTATION 2
16MB KIT X1156 580
SPARCSTATION 330
8MB KIT X1155 406
32MB KIT X134A 2258
SPARC1, 1+54 (2), 4/40, 60, 65
4MB KIT X1042 (4) X 1 164
SPARC SLC (4/20)
4MB MOD X1150 173
4/110
4MB KIT X1160 609
SPARC II, 4/40, 4/50, 65, 75
530, 370
16MB KIT X1158 (4) W 406
4 330, 4 370
8MB KIT X1088 406
32MB KIT N/A 2208

Panasonic
CP-170, CF-270, CF-370
1MB MOD CPBA165 $ 82
4MB MOD N/A 144
KX-P4410 P4420 KX-P4450
1.4MB E-C KXP441 62
2.4MB E-C KXP441 112
4MB E-C N/A 199
8MB E-C N/A 199
KX-P4430
1MB E-C KXP440 108
KX-P4455
1.4MB E-C KXP443 92
2.4 MB E-C KXP441 172
4MB E-C N/A 199
8MB E-C N/A 199
KX-P4450
2MB E-C KXP4455-2 197

SHARP
PC 5220
1MB MOD C6621B $ 90
PC 5441
2MB KIT CE641D 98
PC 6541
2MB MOD CE852B 291
PC 8541
2MB MOD N/A 145
PC 4780, 8270D 250
1MB MOD CE7418 145
JX9560PS LASER
1MB E-C JX9544U 86
JX9560PS, 9560PS
1MB C-C N/A 129
2MB C-C N/A 242
4MB C-C N/A 484

TOSHIBA
T1000SE
1MB E-C PCPA2311U $ 66
2MB E-C PCPA312U 116
T1000LE
1MB E-C PCPA2311L 66
2MB E-C PCPA312L 116
4MB E-C PCPA2701U 168
8MB E-C PCPA2702U 300
T1000SE
1MB E-C PCPA2311U 66
2MB E-C PCPA312U 116
T2000
1MB E-C PC1PA8316UP 95
2MB E-C PCPA2004U 168
4MB E-C PCPA2001U 168
8MB E-C PCPA2002U 346
T2000SX
1MB E-C PC1PA8312U 172
2MB E-C PCPA2004U 306
T2000SXE T2200SX
1MB E-C PCPA2001U 168
4MB E-C PCPA2002U 346
T3200SX
1MB PCPA2000U 138
2MB E-C PCPA2001U 168
4MB E-C PCPA2002U 346
T4400SX T4400SXE T5400
1MB E-C PC1PA8316UP 150
2MB E-C PCPA2004U 246
4MB E-C PCPA2002U 346
8MB E-C N/A 768
T5200
1MB MOD PC1PA8306U 95
T1600
1MB MOD PC3PA8312U 95
T2100
2MB KIT PCPA8341U 85
T3100SX
1MB MOD PC1PA8306U 95
2MB MOD PCPA8306U 145
4MB MOD PCPA8310U 144
T3200
1MB MOD PC6PA7137U 144
T3200SX
1MB KIT PCPA8341U 83
2MB KIT PCPA8342U 144
T3200SXC
1MB KIT PC1PA8318U 83
2MB KIT PC1PA8319U 144
T5100
1MB MOD PCPA8313U 92
T5200 T5200C T8500
1MB KIT PCPA8306U 95
4MB KIT PCPA8313U 262
PAGELASER 6
2MB E-C N80090 114
4MB E-C N80100 174

Zenith
MASTERSPORT 286
1MB MOD ZA2121 $ 116
MASTERSPORT 386SX
2MB MOD ZA3621 181
MASTERSPORT386SX 386SX/L
2MB MOD ZA44 99
SLIMSPORT
1MB MOD ZA18095 133
2MB MOD ZA18064 199
4MB MOD ZA18071 365
TURBOSPORT 386
1MB MOD ZA3034ME 133
TURBOSPORT 386E
1MB MOD ZA3034ME 143
4MB MOD ZA3035ME 222
SUPERSPORT 286
1MB MOD ZA18066 95
2MB MOD ZA18064 199
4MB MOD ZA18071 399
SUPERSPORT SL
2MB MOD ZA18064 199
4MB MOD ZA18071 399
SUPERSPORT SX
2MB MOD ZA18064 199
4MB MOD ZA18071 399
HEWLETT PACKARD LS/12
1MB MOD 110
ZA18096 ALPHA
2MB MOD 199
ZA18067 BETA
Z-286LP PLUS
1MB KIT 75051 95
0-16MB E-C N/A 79
Z-386SX/20, Z-386SX/20E
2MB KIT 75051 95
0-16MB E-C N/A 79
Z-386/20, 25, 33, 33E
1MB MOD Z3800MH 42
4MB MOD Z3800MH 126
Z-486/33ET
4MB KIT ZA4200M2 166
16MB KIT ZA4200M4 535

MAGNAVOX
NOTEBOOK METALIS 286
386SX
1MB MOD $ 186
4MB MOD 266
MS380 380 386SX, 286
1MB KIT 63
2MB KIT 83
4MB KIT 150
MS, PII, MX 1200, 286
MS, PII, MX 1600, MCP100
PM40CD, 386SX-16
MS PRIZE20, MS40CD
386-25SX, MS3300, 386-33
MS486, 486SX
1MB MOD 43
4MB SIMM 175
T3100SX
1MB MOD PC1PA8306U 95
2MB MOD PCPA8306U 145
4MB MOD PCPA8310U 144
T3200
1MB MOD PCPA7137U 144
T3200SX
1MB KIT PCPA8341U 83
2MB KIT PCPA8342U 144
T3200SXC
1MB KIT PC1PA8318U 83
2MB KIT PC1PA8319U 144
T5100
1MB MOD PCPA8313U 92
T5200 T5200C T8500
1MB KIT PCPA8306U 95
4MB KIT PCPA8313U 262
PAGELASER 6
2MB E-C N80090 114
4MB E-C N80100 174

OKIDATA
OL 400
1MB E-C 70014701 $ 91
2MB E-C N/A 129
OL 800, 800N
1MB E-C 70015201 95
2MB E-C N/A 199
4MB E-C N/A 199
OL 830, 840
2MB E-C 70016501 185

BROTHER
HL-4, 4V, 4PS
1MB E-C MB410 $ 125
2MB E-C MB411 165
4MB E-C MB440 245
HL-6, 6V, 6PS
1MB E-C MB810 185
2MB E-C MB820 225
MFC-4100, 8100, 2-425
1MB KIT N/A 49

KINGSTON
SX/NOW! CPU PROCESSOR UPGRADES
AGI-1886A & L
AST PREMIUM 286, BRAVO 286
COMPAQ DESKPRO 286
DELL 310, 316, 325D
PORTABLE III PSAI
DESKPRO 386/16 20 25E 25I 33
EPSON EQUITY II, III PLUS
IBM PS/2 50 60 70 80, SLC 75 76
ZENITH AT, XT 286
HP VECTRA ES 12 ES 16
NEC POWERMATE 286 + PORTABLE +
2MB KIT 9146C2002 $ 299
2MB KIT 9146C3003 340
1MB KIT 9146C3004 399

LAPTOP & NOTEBOOK
ALTIMA LAPTOP SX
1MB MOD $ 88
2MB MOD 158
4MB MOD 295
CHICONY 386SX
4MB MOD 195
CHAPLET NOTEBOOK
1MB MOD 110
2MB MOD 158
4MB MOD 295
GOLDSTAR GS370 386SX/16
1MB MOD 72
4MB MOD 295
HEWLETT PACKARD LS/12
1MB MOD 110
HEWLETT PACKARD 95LX
128K MOD 82
256K MOD 94
512K MOD 110
1MB MOD 295
2MB 342
4MB 543
HYUNDAI 386SX
4MB MOD 195
LUBBIZ 286
1MB MOD 225
LEADING EDGE DLT 386SX
1MB MOD 85
MITSUBA 286F, 286L, 386SX
1MB MOD 99
4MB MOD 218
PACKARD BELL PB2286NB
1MB MOD 99
4MB MOD 218
PACKARD BELL PB3386NBX
1MB MOD 99
4MB MOD 218
POQUET
128K MOD 82
256K MOD 94
512K MOD 110
1MB MOD 295
4MB MOD 543
SAMSUNG NOTEMASTER 386S
1MB MOD 179
4MB MOD 379
SAMSUNG NOTEMASTER 386S/20
1MB MOD 179
4MB MOD 379
6MB 495
TAIWAN 1700, 1800 1900MC
4MB MOD 98
SAMPO MB1219
1MB MOD 85
2MB MOD 145
4MB MOD 245
SAMPO MB4425
2MB MOD 145
4MB MOD 245
TAIWON HK386SX
1MB MOD 95
4MB MOD 218
TANDY 1510 20,10 30,10
4MB 345
TANDY 20 20 30/20 80
2MB 345
4MB 545
TULIP LAPTOP
4MB MOD 245
ZEOS NOTEBOOK
2MB MOD 98

SILICON GRAPHICS
4D/30 20, INDIGO R3PC
4D/120 SERIES 200, 300
4D SERIES 1100 200, 300
8MB KIT M4D28 $ 895
32MB KIT M4D32X 1795
4D/20 PERSONAL IRIS
4MB KIT M4D16 795

ACER
ACER
2MB CARD 1120M1 $ 127
2MB CARD 1120T1B0 825
1100SX 1100LS
4MB KIT N/A 156
1100-20
2MB KIT M1000230R 98
1100-33
4MB KIT M1000330A 156
1170, 1170T2, 1170T3
2MB KIT N/A 98
4MB KIT M1000430 156
NEC POWERMATE 286 + PORTABLE +
2MB KIT 9146C3002 $ 175
8MB KIT 9146C3003 295
16MB KIT 9146C3004 788

MOTHER BOARDS
ONE BOARD SOLUTION
386/486
386/486-64K Cache no CPU $200.
386/486-256K Cache no CPU $250.

OPTI/UMC MOTHER BOARDS
3860X-25 CASHE W/CPU	$180
3860X-33-64K CACHE W/CPU	199
3860X-33-256K CACHE W/CPU	249
3860X-40-64K CACHE W/CPU	210
3860X-40-256K CACHE W/CPU	260
4860X-33-64K CACHE W/CPU	490
4860X-33-256K CACHE W/CPU	540
4860X-50-256K CACHE W/CPU	749

EXPANSION BOARDS
SIMMpli-RAM™ for the PS/2-16 Up to 16 MB on memory for PS/2-16 Models 50 & 60
Set Quick Micro Channel interface. Uses compact SIMM or 4M composite SIMMS
SIMMpli-RAM™ for the PS/2-25 Up to 32 MB of memory for PS/2 Models 70 & 80
Set Micro Channel interface. Uses compact SIMM or 4M composite SIMMS
$195
$295
RAMpAK™ From 1MB to 16 MB of memory. 16-bit ISA (PC AT) bus compatible. Self-configuring, no jumpers or software setup required. Supports extended or LIM 4.0 expanded memory modes
$109
RAMpAT!-Plus™ Up to 16MB of memory. Half-card plugs into 8-bit or 16-bit ISA expansion slots Hardware support for LIM 4.0 expanded mode. Self-installing software
$145
AST Rampage Plus $148 BOCA BRAT 90 W/2MB $169.

DYNAMIC RAMS
1MB X 1-100NS	.95	256K X 1-80NS	.80	64K X 4-120NS	1.75
1MB X 1-80NS	.20	256K X 1-70NS	1.80	64K X 4-100NS	2.10
1MB X 1-70NS	4.25	256K X 1-60 NS	2.20	64K X 4-80NS	2.25
1MB X 1-60NS	4.70	256K X 4-100NS	4.35	64K X 1-150NS	1.50
256K X 1-150NS	1.50	256K X 4-80NS	4.45	64K X 1-120NS	1.75
256K X 1-120NS	1.55	256K X 4-70NS	4.50	64K X 1-100NS	1.95
256K X 1-100NS	1.70	256K X 4-60NS	4.75	256K X 9 STTATIC RAM	$109
1 x 4-80NS	21.00	DIPP		AAA280CP-08 (256x1)	2.65
1 x 4-80NS	21.00	STATIC ZIPP		AAA280CP-07 (256x1)	2.85
1 x 4-80NS	21.00	ZIPP		AAA280CP-06 (256x1)	3.05

CACHE
8 X 8-15	5.00
32 X 8-15	16.00
8 X 8-20	5.00
32 X 8-20	7.00
8 X 8-25	5.00
16 X 4-25	5.00
8 X 8-30	4.00

The difference between their prices and ours is simply too great to ignore. No wonder we've been around

SINCE 1984

(AND WHAT AUDACITY THE COMPETITION HAS TO CLAIM THAT THEY WON'T BE UNDERSOLD)

CONTROL memory upgrades — *"experts in portable intelligence"*

TOSHIBA MEMORY

T2200SX, T2000SXE, T2000SX, T2000, T5100, T3200SX, T3100SX, T3100e, T1600, T1200XE, T1000XE/SE/LE, and T1800, T1850, and T1850C

2MB..$ 77
4MB..$158
8MB..$280

*ALL CARDS ARE FAST 70ns

LASER PRINTER MEMORY

WE OFFER MEMORY FOR ALMOST ALL BRANDS AND MODELS OF LASER PRINTERS AT ROCK-BOTTOM PRICES. JUST CALL OR FAX YOUR REQUIREMENTS, AND WE WILL RESPOND IMMEDIATELY WITH OUR BEST PRICES.

PCMCIA V2.0 FAX/MODEMS FOR YOUR COMPUTER NOW IN STOCK

MORE LAPTOP/NOTEBOOK MEMORY

AST PREMIUM EXEC 4MB	$120
BCC AVANTI MODEL #025 2MB/4MB	$161/$322
COMMODORE CLT286/386 2MB	$ 93
EVEREX TEMPO/LX 2MB/4MB	$ 93
GRID 1720/1750 2MB	$ 98
MITAC 3025D/3025F 4MB	$214
NEC ULTRALITE/286F 4MB	$208
NEC ULTRALITE/III 2MB/4MB/8MB	$105/$173/$303
NEC ULTRALITE SL20/20P 2MB/6MB	$105/$244
NEC ULTRALITE SL25C 2MB/4MB/8MB	$105/$173/$303
PANASONIC CF170/270/370 1MB/2MB	$58/$98
PANASONIC CF-470/480 2MB/6MB	$158/$385
SANYO MBC-17NB/18NB 2MB	$93
SHARP PC-7700/7750 4MB MEMORY BOARD	$389
SHARP PC-8041/8081 1MB MODULE	$53
SHARP PC-8501 COLORSTAR 2MB	$119
TANDY 1500HD/2810HD/3810HD 1MB/2MB	$58/$98
TANDY 2820/3820/3830 2MB/6MB	$158/$385
TI TRAVELMATE 4000 & WinSLC 4MB/16MB	$221/$CALL
ZEOS 285/386SX NOTEBOOK 2MB	$93
ZENITH MASTERSPORT SX/SL/SLE/SLC 2MB	$96
ZENITH Z-NOTE 2MB/8MB	$113/$311

DESKTOP/WORKSTATION MEMORY

APPLE MAC IIfx 4MB	$151	CPQ PROLINEA 4/33 4MB	$146
APPLE MAC cx/SE/SWIVC/CX 4MB	$150	CPQ PROLINEA 3/25 8MB	$281
AST BRAVO LC 3/33s 2MB/8MB	$78/317	CPQ SYSTEMPRO 2MB/8MB	$98/$377
AST BRAVO 486/25 & 4/33 2/8MB	$102/$330	CPQ SYSTEMPRO/LT 4/8MB	$153/$325
AST BRAVO LC486 4/8/16MB	$153/$307/$585	DECpc 433 & 433 PORTABLE 8MB	$281
AST CUPID-33 2/4/8MB	$102/$165/$330	DELL 316SX 2MB	$78
AST PREMIUM 386/486 4MB/8MB	$165/$330	EPSON 386/33 4MB/8MB	$146/$291
AST PREMIUM 386/25,33 1MB/2MB	$51/$102	EPSON EISA SERIES 2/8MB	$87/$325
AST PREMIUM 386C 4MB	$156	EPSON EQUITY486Plus 4MB	$156
AST PREMIUM II 4MB/8MB	$165/$330	HP 700/RX TERMINAL 4MB/8MB	$153/$325
AST PREMIUM SE 4/50 32MB	$1352	HP XSTATION 700/RX 8MB	$325
AT&T 6386 2MB/4MB	$70/$141	HP VECTRA T/U SERIES 4/8MB	$153/$325
IBM 34F2933 4MB	$153	NCR 386SX/S & 486/MC 8MB	$281
IBM 6450128 4MB	$153	NEC POWERMATE 386/25s 8MB	$312
IBM 6450129 8MB	$325	SUN X104C/IPC/1/1+ 4MB	$156
IBM 6450130 8MB	$325	SUN ELC 4MB/16MB	$153/$585
IBM 6450603 1MB	$48	SUN SLC 4/20 4MB	$153
IBM 6450604 2MB	$79	SUN SPARCSTATION 16MB	$585
CPQ DESKPRO 4MB/8MB	$135/$260	ZENITH 386 1MB/2MB	$48/$79
CPQ DESKPRO 386s 4MB	$153	ZENITH Z-STATION4MB/16MB	$153/$585
CPQ PROLINEA 4/33 8MB	$294		

PCMCIA SRAM MEMORY

AST POWEREXEC, DEC PALMTOP, DELL 320SLi, GRID GRIDPAD, HP 95LX, IBM PC RADIO, MOMENTA PENTOP, NCR 3125 NOTEPAD POQET, SHARP PC3000/3100, SHARP PC-6700/6741/6781/6785, SHARP PC-6800/6841/6881/6891, ZEOS POCKET PC

512K $87 1MB $157 2MB $281

COMPAQ LAPTOP MEMORY

CONTURA 2MB/4MB/8MB	$98/$145/$268
LTE386s/20 1MB/4MB	$ 88/$156
LITE/20 & LITE/25 1MB/4MB/8MB	$ 88/$156/$299
PORTABLE 486 & 486C 2MB/4MB/8MB	$79/$153/$325
LTE/286 1MB/2MB/4MB	$45/$91/$150
SLT386s/20 4MB	$163

FULLY-CONFIGURED NOTEBOOKS

AST PREMIUM EXEC 386SX/20 200MB LCD W/ 8MB	$1923
AST POWEREXEC 386 EL/25SL 60MB LCD W/ 10MB	$1663
AST POWEREXEC 386EL/25SL 80MB LCD W/ 10MB	$1847
AST POWEREXEC 386EL/25SL 120MB LCD W/ 12MB	$2215
AST POWEREXEC 386EL/25SL PASSIVE COLOR 120MB W/ 12MB	$2859
AST POWEREXEC 486/25SL 80MB LCD W/ 12MB	$2662
AST POWEREXEC 486/25SL 120MB LCD W/ 12MB	$2846
AST POWEREXEC 486/25SL 200MB W/ 12MB	$3122
AST POWEREXEC 486/25SL 80MB PASSIVE COLOR W/ 12MB	$3306
AST POWEREXEC 486/25SL 120MB PASSIVE COLOR W/ 12MB	$3490
AST POWEREXEC 486/25SL 200MB PASSIVE COLOR W/ 12MB	$3766
AST POWEREXEC 486/25SL 80MB ACTIVE COLOR W/ 12MB	$4226
AST POWEREXEC 486/25SL 120MB ACTIVE COLOR W/ 12MB	$4410
AST POWEREXEC 486/25SL 200MB ACTIVE COLOR W/ 12MB	$4686
IBM THINKPAD/300 386SL/25 80MB LCD W/ 12MB	$2457
IBM THINKPAD/300 386SL/25 120MB LCD W/ 12MB	$2644
IBM THINKPAD/700 486SLC/25 80MB LCD W/ 16MB	$3084
IBM THINKPAD/700 486SLC/25 120MB LCD W/ 16MB	$3279
IBM THINKPAD/700C 486SLC/25 120MB ACTIVE COLOR W/ 16MB	$4646
SHARP PC-6340 386/20 40MB LCD W/ 2MB	$1000
SHARP PC-6785 386SL/25 80MB LCD W/ 8MB	$1774
SHARP PC-6881 386SL/25 80MB ACTIVE COLOR W/ 8MB	$2905
SHARP PC-6891 386SL/25 120MB ACTIVE COLOR W/ 8MB	$3090
SHARP PC-7700 486SX/25 124MB LCD W/ 8MB	$2403
SHARP PC-7750 486DX/33 124MB LCD W/ 8MB	$2816
TEXAS INSTRUMENTS TM3000/120MB LCD W/ 6MB	$2183
TOSHIBA T1800 386SX/20 60MB LCD W/ 10MB	$1324
TOSHIBA T1800 386SX/20 80MB LCD W/ 10MB	$1476
TOSHIBA T1850 386SX/25 80MB LCD W/ 12MB	$1750
TOSHIBA T1850 386SX/25 120MB LCD W/ 12MB	$1978
TOSHIBA T1850C 386SX/25 80MB PASSIVE COLOR W/ 12MB	$2464
TOSHIBA T1850C 386SX/25 120MB PASSIVE COLOR W/ 12MB	$2647
TOSHIBA T2200SX 386SX/20 60MB LCD W/ 10MB	$1695
TOSHIBA T2200SX 386SX/20 80MB LCD W/ 10MB	$2118
TOSHIBA T3300SL 386SL/25 80MB LCD W/ 18MB	$2985
TOSHIBA T3300SL 386SL/25 120MB LCD W/ 18MB	$3163
TOSHIBA T4400SX 486SX/25 120MB LCD W/ 18MB	$3007
TOSHIBA T4400SX 486DX/25 120MB LCD W/ 18MB	$3368
TOSHIBA T4400SX 486SX/25 200MB LCD W/ 18MB	$3485
TOSHIBA T4400SX 486DX/25 200MB LCD W/ 18MB	$3847
TOSHIBA T4400C 486SX/25 120MB ACTIVE COLOR W/ 20MB	$4049
TOSHIBA T4400C 486DX/25 120MB ACTIVE COLOR W/ 20MB	$4411
TOSHIBA T4400C 486DX/25 200MB ACTIVE COLOR W/ 20MB	$4935
TOSHIBA T4500 486SX/20 80MB LCD W/ 20MB	$3007
TOSHIBA T4500 486SX/20 120MB LCD W/ 20MB	$3181
TOSHIBA T4500 486SX/20 120MB ACTIVE COLOR W/ 20MB	$4402
TOSHIBA T5100 386DX/16 100MB GAS PLASMA W/ 4MB	$1968
TOSHIBA T6400 486DX/33 200MB GAS PLASMA W/ 36MB	$5142
TOSHIBA T6400 486DX/33 200MB ACTIVE COLOR W/ 36MB	$7148
TOSHIBA T6400 486DX2/50 200MB GAS PLASMA W/ 36MB	$5403
TOSHIBA T6400 486DX2/50 200MB ACTIVE COLOR W/ 36MB	$7671
ZENITH NOTEBOOKS (ALL MODELS)	$CALL

HP 95LX PALMTOP

PCMCIA 2400B MODEM/9600B FAX
NOW IN STOCK AT $230

MATH COPROCESSORS

80287-10/12	$ 64
80387SX-25	$ 80
80387DX-33	$ 81
80387DX-40	$ 95
80487SX	$430

SHARP PC-6700, 6741, 6781, 6785, 6800, 6681, 6891 RAM UPGRADES
2MB $88 4MB $158

We are listed in the TOSHIBA TECHNICAL INFORMATION GUIDE as "the least expensive memory manufacturer approved for Toshiba laptops and notebooks."

TOSHIBA T1200XE /T3100SX
2MB $79 4MB $168
TOSHIBA T4400/T6400
2/4/8/16MB $98/$158/$280/$694
TOSHIBA T5200/T5200C/T8500
2MB/8MB $91/$265
TOSHIBA T3300SL
2/4/6/16MB $78/$143/$208/$644

TOSHIBA T4400

213MB INTERNAL HARD DRIVE
UPGRADE KIT IN STOCK !!!

EXTERNAL HARD DRIVE KITS (19 OZS. BATTERY-POWERED)
20, 40, 60, 80, 130, AND 213MB
SIZE-PERFECT FOR LAPTOPS

TOSHIBA T5200 486 CPU UPGRADE

NOW IN STOCK.

APPLE POWERBOOK MEMORY

	2MB	4MB	6MB	8MB	10MB
100	$ 94	$169	$247	X	X
140	$ 94	$143	$209	X	X
145	$ 94	$143	$209	X	X
170	$ 94	$143	$209	X	X
160	X	$207	$250	$402	$480
180	X	$207	$250	$402	$480
210	X	$169	$234	$299	X
230	X	$169	$234	$299	X

ALL MEMORY UPGRADES COME WITH A LIFETIME WARRANY & A 48 HOUR EXCHANGE GUARANTEE !

IBM LAPTOP MEMORY

CL57SX 2MB/4MB/8MB	$160/$247/$434
L40SX 2MB/4MB/8MB	$87/$153/$325
N33SX 2MB/4MB	$87/$153
N51SX2MB/4MB/8MB	$105/$184/$390
N51SLC 2MB/4MB/8MB	$105/$184/$390
THINKPAD 2MB/4MB/8MB	$160/$247/$434
PC RADIO PCMCIA SRAM 512K TO 2MB	

SE HABLA ESPANOL
pregunte por Hector

tote-a-lap

550 Pilgrim Drive, Ste.F, Foster City, CA 94404
PHONE : (415)578-1901 FAX: (415)578-1914
ORDERS ONLY : 1-800-9-LAPTOP
(PRIOR APPOINTMENTS ARE NEEDED FOR WILL-CALLS, PLEASE)

TERMS AND CONDITIONS: All sales final. We charge a 25% re-stocking fee on all refused shipments and pre-approved returns. Prices are subject to change without notice, and reflect all cash discounts. Warranty on all merchandise, except memory upgrades, is thru the original manufacturer only, unless previously agreed upon and stated on our invoice. All software, plus all merchandise that include a rom bios, are not returnable for credit, and are subject to an even exchange only. We accept purchase orders from credit-worthy institutions, although prices may be slightly higher on some items. We will not ship to any account with an overdue balance. Purchase prices at the time of sale are final. Memory upgrades guaranteed 100% compatible or your money back. You have NO RISK buying our CONTROL memory upgrades. *ALWAYS INSIST ON* **CONTROL**.

Circle 196 on Inquiry Card.

World Radio History

Ask for your copy of the ACP Computer Hotline

ACP-Our 17th Year of Superstore Deals!

CALL 1-800-FONE-ACP TOLL-FREE ORDERS

Hard Drives

Western Digital
High performance "Caviar" series with 1" height, Cache Flow™ and 32K buffer.

AC280	80Mb	1" 3.5"	14ms	IDE .... Call
AC2120	125Mb	1" 3.5"	14ms	IDE .... Call
AC2200	200Mb	1" 3.5"	14ms	IDE .... Call

Maxtor

7080A	80Mb	1" 3.5"	15ms	IDE .... Call
7120A	120Mb	1" 3.5"	15ms	IDE .... Call
LXT213A	213Mb	1" 3.5"	15ms	IDE .... Call
MX1240	1.2Gb	1" 3.5"	15ms	IDE .... Call
Panther	1.2Gb	$Call	Panther	1.7Gb Call

Conner Peripherals

30104	120Mb	3.5"	19ms	IDE .... Call
3204	200Mb	3.5"	16ms	IDE .... Call

Hard Drive Specials
Seagate ST3283 249Mb IDE 499.95
Somsung 100Mb IDE 299.95
Seagate Wren 340Mb ESDI 599.95
Brand Tech 200Mb IDE 379.95
Call for Quantum, Micropolis, Seagate. Controllers from Ultrastor, Always, WD etc.

Backups

Colorado

DJ10	120Mb Tape Drive internal	199
DJ20	250Mb Tape Drive Internal	268
Trakker 120 Tape Backup		358
Trakker 250 Tape Backup		428

Syquest (with cartridge)
44Mb kit SQ555, SQ400, SQ01(16 bit) . 419
44Mb external 499
88Mb kit SQ5110, SQ800, SQ01(16 bit) 529
88Mb external 629

GrassRoots Floptical
Floptical 21 Mb (external) ..... Call
Floptical 21 Mb (internal) ..... Call

Floppy Disk Drives

Toshiba

ND04DG	360K	5.25" HH	PC/XT	59
ND08DEG	1.2Mb	5.25" HH	PC/AT	72
ND3561GR	1.44Mb	3.5" HH	w/AT Kit	72

ACP
1.2 Mb 5.25" .. 66 2.88Mb 3.5" ..... Call
1.44Mb 3.5" .... 67 **All In One** 3.5/5.25 149

MultiMedia

Creative Labs
Complete all-in-one MPC compatible upgrade kit includes: Panasonic CD Drive, Sound Blaster Pro, five CD's, Microsoft SW MultiMedia Kit Int/Ext 545/625
Sound Blaster 1.5/Professional 88/187

MEDIA VISION
Pro Audio Spectrum 16
Absolutely the finest sound board for true MultiMedia MPC applications.
ProAudio Spectrum 16 197
CDPC Subsystem (external) 989
Pro 16 Multimedia System 898
MediaVision Fusion CD (external) . 399
CD ROM Sys w/Sound, Speakers, 4 CD's: Compton's Carmen, Ultima, Wing Comm
Fusion CD 16 (Int/Ext). 498/548

Compton's Encyclopedia CD
Standard version with World Atals 49
Interactive version, NEW! 249

CD ROM Drive Special
Mitsumi CD ROM (internal) 350ms 199
MPC Compliant. Kodak Photo CD ready

Input Devices

Advanced		Logitech	
3-button Mouse	15	Mouseman	75
101 Keyboard	58	Mouse (OEM)	35
Mouse+Windows	88	Cordless Mouse	88
Microsoft		Trackman	78
Serial Mouse	69	Trackman Port.	94
Ballpoint	98	Scanman 32	128
Ballpt+Windows	148	Scanman 256	258
Microspeed		**CH Products**	
PC Trac	78	FlightStick	49
PC Trac bus vers	88	Joystick Machlll	call

IBM Compatible Cards

Advanced		Interface	
Monochrome	38	Parallel Card	29
Color Card	48	Serial Card	35
EGA Card	48	Multi I/O	59
VGA		IDE 16-bit	19
512K, 800x600	53	IDE Multi I/O.	69
512K, 1024x768	68	**Modems**	
1Mb, 1024x768	88	2400bps internal.	39
Windows		2400bps external.	69
1MbAccelerator	149	**Memory**	
		AT 0-8Mb(simm)	99
		XT 0-8Mb(IC's)	99

Chips and SIMM's

dRAM

Qty	1	25
256x1-100	1.49	1.35
256x1-100	1.59	1.45
256x4-80	4.79	4.59
1Mbx1-100	4.05	3.95
1Mbx1-80	4.49	4.39

SIMMs

Qty	1	12
1Mbx9-80	35	34
1Mbx9-70	36	35
1Mbx8-80	32	31
4Mbx8-70	129	126
4Mbx9-70	139	135

Call for VIDEO RAMS & CACHE RAMS
Over 20,000,000 IC's in-stock including
We Specialize in Memory Modules

Math Coprocessors

Intel		Cyrix	
387SL Mobile	78	387SX(16-25)	73
80387DX (all)	85	387DX(20-33)	88
80387SX (all)	78	387DX/40	108
RapidCAD	248	80287(all)	78
8087	29	**Intel Overdrive**	
80287-10	89	486DX-33	649
80287-20	89	486SX-25	489

Memory Upgrades

Notebooks/Laptops

AST PowerExec	4Mb	Windows	$178
AST PowerExec	16Mb		1325
Compaq Contura	4Mb		169
Compaq Contura	8Mb		369
Compaq Lite4/25C	4Mb		239
Compaq Lite4/25C	8Mb		399
HP95LX Palmtop	2Mb		call
TI TravelMate3000	2Mb		87
TI TravelMate4000	4Mb		218
Toshiba T4400/6400	4Mb		187
Toshiba T4400/6400	8Mb		388
Zenith Z-Note	2Mb		168

Toshiba T4400/16Mb $799
Apple Powerbook 140/170-6Mb $249
IBM ThinkPad 2Mb..$158 8Mb..$449

Call for all Notebook Memory Upgrades!

Laser Printers *Call for "0"K Boards*

Canon LBP-4,4Lite,4Plus	1Mb	118	2Mb	168
Canon LBP-8III, 8III Plus	2Mb	169	3Mb	199
Compaq PAGEMARQ15/20	8/16Mb	299/599		
Epson ActionLaser II			2Mb	138
HP LJ IIIsi, 4, 4M, XL300	4Mb	148	8Mb	298
HP LaserJet IIP,III,IIIP,IIID	2Mb	98	4Mb	158
HP LaserJet II, IID	2Mb	98	4Mb	158
Panasonic 4410/4430	2Mb	118	4Mb	188
Panasonic 4420/4450i	2Mb	118	4Mb	188
OkiLaser 400	1Mb	78	2Mb	98
TI MicroLaser Turbo, XL	1Mb	69	4Mb	269

Computer Memory Upgrades

AST Bravo 4/33, 486/25	2/8Mb	88/299
Compaq ProLinea 3/25s, 25zs	2/8Mb	88/288
ProLinea 4/25s, 4/33, 4/50	2/8Mb	88/308
IBM ValuePoint except Cxx	4/16Mb	158/578
IBM PS/2 Model 90, 95	2Mb	88

Call for all Computer Memory Upgrades!

Micronics® Motherboards

486DX/33 ISA	$799	486DX2/50 VL	$1049
486DX2/50 ISA	899	4000LB Video	199
486DX2/66 ISA	1079	486DX/33 EISA	999
486DX2/66 VL	1399	486DX2/50 EISA	1299

Advanced Motherboards

80286/12MHz	$69	486DX/33MHz	$499
386SX/25MHz	119	486DX/50MHz	999
386DX/40MHz	199	486DX2/50MHz	699
486SX/25MHz	229	486DX2/66MHz	949

Video Graphics Cards

ATI

Graphics Ultra Pro 1/2Mb	428/518
Graphics Ultra Pro 1/2Mb	288/328
Graphics Ultra 512K/1Mb	248/288
Graphics Vantage 512K/1Mb	188/218
VGA Wonder XL24 512K/1Mb	128/148
VGA Integra 83	VGA Basic 16 65
Stereo F/X Soundboard	109

Diamond

SpeedSTAR Stealth w/1Mb	229
Speedstar 24X 24-Bit Color w/1Mb	158

Orchid Fahrenheit 1280 w/1Mb ... 275

Video Seven

WIN VGA Accelerator w/1Mb	149
1024i Plus VGA 512K	79
VRAM II ERGO 1Mb	239

$429
ADS Prime Time TV

122 channel cable-ready TV-Tuner with scalable windows and complete software kit. 4watt stereo 429
ADS VGA TV Elite
Converts VGA to Big Screen TV ... 349

Advanced Computers

486 High Performance CPU's • Plus all New! MultiMedia PC

486 SuperVGA System

Includes:
- 486DX/33 w/256k Cache
- 4Mb RAM
- 1Mb SVGA Card
- 120Mb HardDrive
- 1.2Mb 5.25" Floppy
- 1.44Mb 3.5" Floppy
- IDE Controller
- 101 Keyboard
- 14" SuperVGA .28 Color Monitor and more!

intel inside

ACP's Sale Price **$1499**

photo may vary

Call for MiniTower and Tower configurations... plus EISA, SCSI, Local Bus, and 486DX2/50, 486DX2/66 and 486DX/50

486 MultiMedia System

Complete MPC compliant MultiMedia system utilizing the most popular components available in the industry today. Internal CD-ROM drive and 16-bit SoundBlaster Technology. Plus Free Software preloaded. All completely assembled, tested ready to plug in and play!

Includes:
- 486SX/25 w/32k Cache
- 4Mb RAM
- 1Mb SVGA Card
- 120Mb Hard Drive
- MPC Internal CD-ROM Drive
- 14" SuperVGA Color Monitor .28
- 1.44Mb 3.5" Floppy
- Amplified Speakers
- 2 Serial, parallel
- MiniTower Case
- 16-bit Sound Card
- 1 Year warranty on-site with GE

Preloaded Software
- Kodak Photo CD, Mammals, Microsoft Bookshelf, Beethoven, Works, Windows 3.1, DOS 5.0, Levingson Power Accounting, 386MAX, Quicken 2.0, Mayo Family Health Book, King's Quest V, HSC Interactive MultiMedia Authoring Tool & Audio Tracks

ACP's Sale Price **$2599**

PC Special
286/12Mhz $269
3.5" Floppy 1Mb • Kb

COMPAQ

ProLinea 3s/25 w/84Mb	999
ProLinea 4/25s w/240Mb	1499
Contura 3/20 w/84Mb	1499
Contura 3/25 w/84Mb	1699
Contura 3/25 w/120Mb	1899
Contura 3/25c w/84Mb	2299
Contura 3/25c w/120Mb	2499
Compaq LTE Lite/25c w/84Mb	3499
Compaq LTE Lite/25c w/120Mb	3699

Call for Toshiba's New **T6400M Color for MultiMedia**

TOSHIBA®

T1800 Satellite 60Mb	1099
T1850 Satellite 80/120Mb	1599/1799
T1850C Satellite w/120Mb Color	2399
T3300SL 80/120Mb	1949/2149
T4400SX LCD/Plasma 120Mb	2399/2599
T4400C Color 120Mb	3499
T4500 80/120Mb	2399/2599
T4500C Color 120Mb	3799
T6400DXC Color 200Mb	6199

$77.77
Symantec Norton AntiVirus v2.0
Cure infected systems plus on-going preventative care. Plus 24-hour Virus FAX-Line for new viruses updates.
Symantec Q&A Database v4.0 $179
ACP Special Bundle.....
Norton Desktop for Windows 59.95 plus FREE! Z-nix Mouse all for only ....
(Quantities Limited)

Okidata OL810 LED Printer
Super improved hi-resolution LED printer. 5 year guarantee on LED printhead which has no moving parts. 8 ppm! OLB10
"See the Difference"
$1095
OL400 Printer $599

Windows Accelerator Increases Performance!
Diamond Computer Systems, Inc.

Speed Star 24X
...make your 386 perform like a 486
SpeedStar 24X .... $158 Stealth .. $229

Hayes

New! OPTIMA® Low Cost Fax
Now get v.42bis data modem plus up to 14.4FAX with Hayes high performance and compatibility. Plus SmartCom EZ and FAX software.

OPTIMA® 24 + FAX 96	$158
OPTIMA® 96 + FAX 96	378
OPTIMA®144 + FAX 144	475
OPTIMA® 24/SC EZ	128
OPTIMA® 96/SC EZ	348
Pocket Edition® 2400	118

SII Seiko CM1450

New low pricel SVGA .25mm non-interlaced multi-scanning monitor.
CM 1450 14" $439
CM 1760 17" (.25mm) 1099

SHARP *NEW!*
Color 386SL/20 NoteBook

•Only 4.9 LBS.!
•2Mb RAM • 80Mb
PC6881C Color Notebook .. 2699
PC6785 LCD Notebook 1699

Canon®
Canon® Authorized Reseller
NEW LOW PRICES!

BJ10ex Portable	$299
BJ20ex Portable	364
BJ200 Inkjet	339
LBP-4SX Laser Printer	899
LBP-8SX Laser Printer	1288
BJ330 Printer (B/W)	599
BJC 800 (Color)	1799
BJC 820 (Color)	1999
BJ 300 BubbleJet(B/W)	399

ACP Special
Modem Bundle $39.95
2400 Baud, FREE Prodigy Software
Save now while supply lasts!

Advanced Computer Products, Inc.

VISA MasterCard American Express MMC

1310 E. Edinger, Santa Ana, CA 92705 • FAX 714-558-8849 • Toll-Free 1-800-FONE ACP • Sales 714-558-8813

Prices subject to change without notice. No surcharge on credit card. Credit cards not charged until we ship. 100% risk free return guarantee! If you are not 100% satisfied just return insured within 15 days complete with all materials in new resaleable condition with original invoice. ACP will immediately exchange product or issue ACP credit less shipping for future purchase. No Returns on software Special Purchase

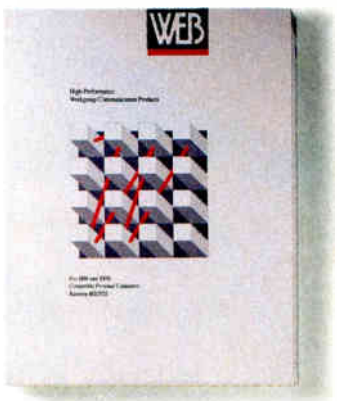
Circle 180 on Inquiry Card (RESELLERS: 181).

World Radio History

THE BUFFALO COMPLETE NETWORK DEFINITELY IS.

Intel® EtherExpress™ cards automatically configure themselves. No jumpers to deal with.

Coaxial network cable, BNC connectors, T connectors, terminators and cable stripping tool.



The WEB® Network Operating System — LAN Times 1992 Best of Times award winner.

Fast, unlimited toll-free technical support to the US and Canada. Any questions?

	Microsoft Windows for Work groups	Eagle NetWare Life	Artisoft LANtastic AE-2	Buffalo/WEB Complete Network
Full Windows & DOS Support	No	No	No	Yes
NetWare Compat. (NCP Sup.)	No	No	No	Yes
Unlimited Toll Free Tech Sup.	No	No	No	Yes
Intel Auto Config. Ethernet	Yes	No	No	Yes
Money-Back Guarantee	None	None	30 day	45 day
Price (2 Node Network Kit)	$850.00	$615.00	$699.00	$495.00
▶ Read Av. / Write Av.	N/A	28.28 / 28.18	40.88 / 47.42	289.2 / 178.48

LAN Times Network Drive Performance—KB per second (Higher is better)

Now there's a network that offers something no one else can—everything.

It's the Buffalo Complete Network.™ You get all the hardware, software, cable, connectors, and terminators you'll need to set up your network, all in one box. We even throw in a cable stripping tool.

For performance, it features the WEB operating system. Just check out the chart above and see why LAN Times said WEB's throughput speed "made us rub our eyes and blink and blink again."

Installation is fast and easy. The Intel EtherExpress cards are completely auto configurable so there are no difficult jumper settings. *And* they automatically adjust for 8 or 16 BIT card slots.

There's a 45 day money-back guarantee, and unlimited, toll-free technical support —answered by technicians, not voice-mail.

So is the Buffalo Complete Network really complete? Definitely.

Response Code: 43CN3

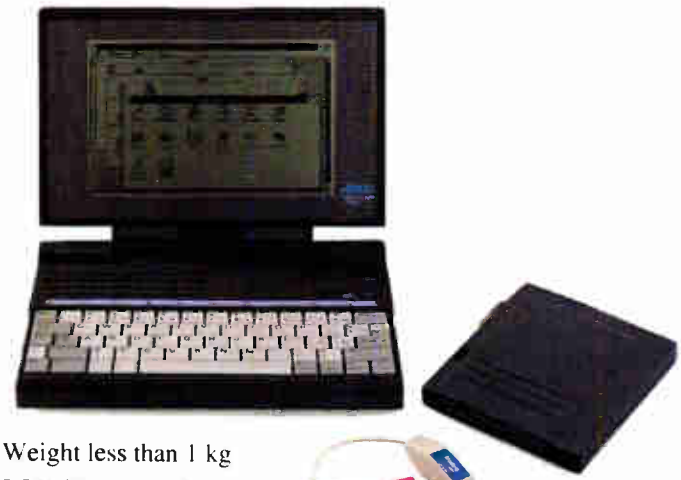
Complete Network is a trademark of Buffalo Products, Inc. Buffalo is a registered trademark of MELCO, Inc. WEB is a registered trademark of WEBCORP. WEBCORP is a trademark of WEBCORP. INTEL is a registered trademark of INTEL Corp. Other brands and product names are trademarks or registered trademarks of their respective owners.

Circle 185 on Inquiry Card.

World Radio History

TRAVEL LIGHT, TRAVEL NEAT, TRAVEL SMART...

ABC BICOM B260*i*



- Weight less than 1 kg
- PCMCIA 2.0 Interface
- 60 Mb Hard Disk
- 2 Mb RAM
- No adapters needed

- Weight 2.2 lbs. (Bicom and Battery)
- Dimension 8.78" x 6.36" x 1.22"
- True 16 bit AMD Lonestar Processor, 386SX Class Performance
- 5 "AA" size NiMH Batteries
- 60 MB Hard Disk Drive
- 2MB RAM expandable to 4MB on board and 16MB with memory card
- PCMCIA 2.0/JEIDA standard port for memory card and I/O card
- 640 x 400 resolution LCD screen supports CGA, AT&T mode and all Windows graphics
- 64-key keyboard
- 1 parallel (bi-directional)/ 1 serial
- External FDD port for optional Floppy Drive
- DR-DOS 6.0, File Transfer Software & Serial Download Cable
- Built-in Personal Data Manager software
- Built-in Programmable Power Management Software
- Universal AC/DC adaptor
- Carrying Case

Options: External Floppy Drive, SRAM Memory Cards, 9624 IC Card Fax/Modem, Mini-trackball, External Keyboard, extra batteries.

ABC COMPUTERS®

1-800-336-2280

ABC Computer (USA) Corp.
2531 237th Street, Suite 122, Torrance CA 90505
310-325-4005 Fax 310-325-6369

NOW ONLY $795

MasterCard VISA

30-Day Money Back Guarantee

All brand names are registered trademarks of their respective owners.

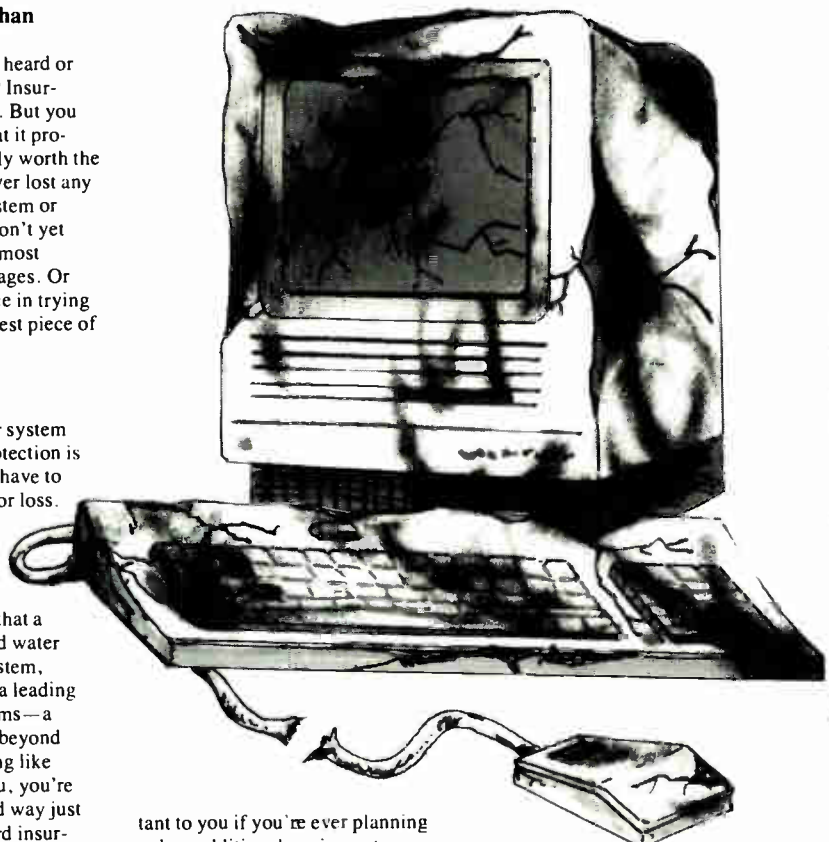
Circle 178 on Inquiry Card (RESELLERS: 179).

World Radio History

Never again worry about computer theft or damage

What could be better than full replacement?
By now, you've probably heard or read about SAFEWARE® Insurance for microcomputers. But you may still wonder just what it protects, or whether it's really worth the investment. If you've never lost any part of your computer system or software, you probably don't yet realize the limitations of most standard insurance coverages. Or the agonies you could face in trying to recover even the simplest piece of peripheral equipment.

What do you mean it's not covered?!
Operating your computer system without SAFEWARE protection is fine as long as you don't have to worry about an accident or loss. But what if you came to your office one morning to find you'd been robbed? Or your home had been ransacked? Or that a pipe had burst and caused water damage? Or that your system, too, had fallen victim to a leading destroyer of micro-systems—a power surge? All events beyond your control. If something like this should happen to you, you're likely to find out the hard way just how limited your standard insurance policy's protection really is. And no matter how little or how much you have invested in your computer system, discovering that it's not covered can be an expensive lesson.



Now you can be sure
SAFEWARE was developed by an insurance professional who was shocked to learn that his very own personal computer was at risk. Can you imagine? What he discovered was that his homeowners insurance policy excluded coverage as soon as he began operating his first business program. Even his simplest spreadsheet voided coverage. Because most homeowners policies *won't cover any equipment used for business*, no matter how infrequently. Out of this need was born SAFEWARE. A simple, easy-to-understand coverage you can count on. Full replacement coverage of hardware, media and purchased software, after a low $50 deductible.

With SAFEWARE there's no need for you to schedule equipment or software as you do with the "rider" type of policies. So your coverage can grow with your system, providing protection for its full value rather than for each individual item. This will be especially important to you if you're ever planning to buy additional equipment or software. Even just one peripheral.

What the editors reported
Publication editors have discovered the news about SAFEWARE and have reported to their readers.
Computer Decisions: . . . "Your personal computer might not be safe at home. If it is not insured, then you're running the risk of losing the thousands of dollars you've invested . . ."
Personal Computing: . . . "Replacing hardware may be more of a problem than you thought it would be . . . That's why (a computer consultant) suggests that you get the computer insured."
Wall Street Journal: . . . "[SAFEWARE] introduces coverage that insures home computers regardless of use. The usual premium: about $75 a year."

No risk offer
SAFEWARE is a comprehensive plan of insurance, which means that it covers *all* hardware, *all* purchased software, and *all* media. Your complete system is protected against theft, fire, accidental damage. SAFEWARE even covers damage caused by power surges . . . the leading destroyer of microcomputers.

And, now, SAFEWARE is available on a *no risk* basis. If you are not completely satisfied with the protection afforded by SAFEWARE, you may return the contract for a full refund within the first 10 days after you've received it.

Thousands have said "yes!"
Since it was first introduced in 1982, thousands of computer owners, like you, have said "*yes*" to the SAFEWARE offer. Owners of systems from the smallest portable micros to larger sophisticated business systems are finding that SAFEWARE offers the most affordable and complete security. And the simplest peace of mind available to ensure carefree computing.

The cost: pennies a day
As you can see from the table, the annual premium for a typical system consisting of a $2,000 processor, a disk drive and printer worth $2100, and $900 in software, is just $69. And you can save even more since the cost of insurance for personal computers used for business may be tax deductible. To determine your rate of coverage, just add up your total system value. Then, find the premium in the table.

Easy to order
Choose from three simple ways to pay for your complete SAFEWARE protection: Call the toll-free phone number listed and we'll charge your premium to your VISA or MasterCard. Or, you can mail us the coupon below along with your check. Or, send us the coupon and charge to your credit card.

Total Hardware, Media & Software System Value	Annual Premium
Up to $ 2,000	$ 49
$ 2,001-$ 5,000	$ 69
$ 5,001-$ 8,000	$ 89
$ 8,001-$11,000	$109
$11,001-$14,000	$129
Call toll-free for rates on higher coverages	

It is an underwriting requirement that you insure your system for full replacement cost.

800-848-3469

Phones open 8 a.m. to 10 p.m. Eastern Time Monday through Friday
9 a.m. to 5 p.m. Saturday

SAFEWARE

SAFEWARE, The Insurance Agency Inc.
2929 N. High St.
P.O. Box 02211
Columbus, OH 43202

With SAFEWARE you get...

- Full replacement coverage.
- Freedom from worries of fire, theft or accident.
- Ultimate in power surge protection.
- Costs as low as $49 a year.

Yes, my computer needs immediate protection. Please issue my SAFEWARE Insurance Policy.

Name_____
Street_____
City_____
State_____ Zip_____
Phone_____
Total System Value $_____
☐ Check Enclosed ☐ VISA
☐ MasterCard
Card #_____
Exp. Date_____
Sign here_____

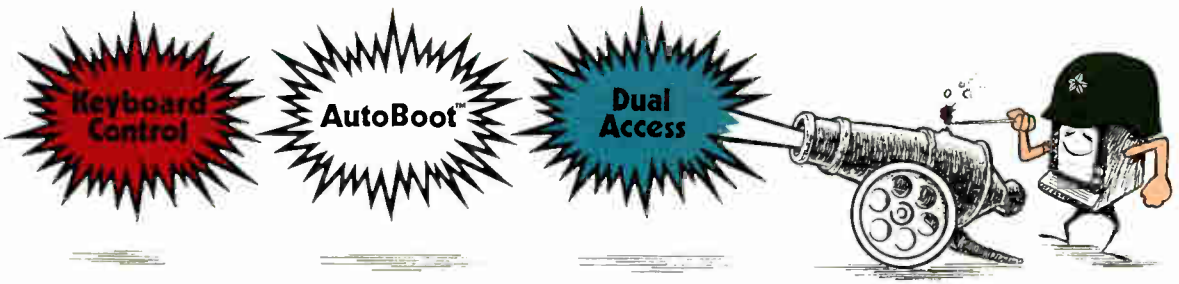
No risk. You may return contract for full refund within 10 days. Coverages and limits are subject to the terms, conditions and exclusions in the policy. Offer differs in Texas and Kansas. Void where prohibited.

Mail to: SAFEWARE:
2929 N. High St.
P.O. Box 02211
Columbus, OH 43202
T-BYTE

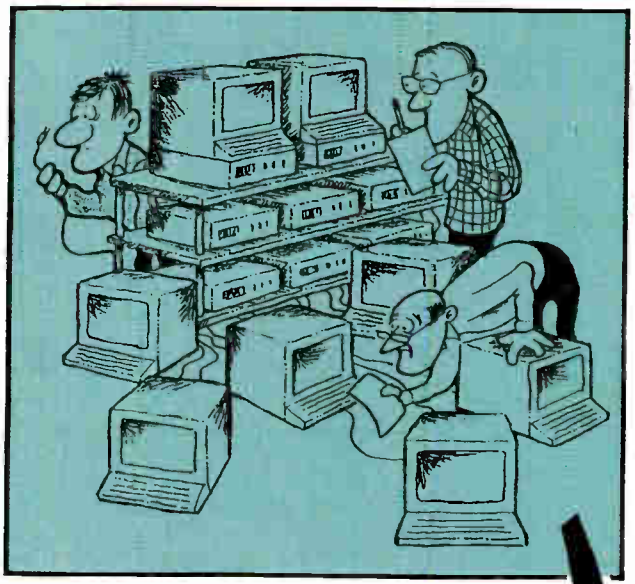
World Radio History

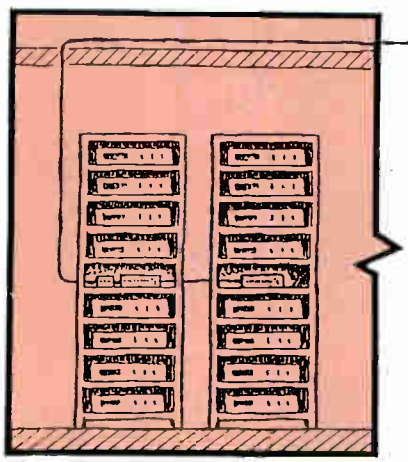
CONTROL UP TO 96 PC FILE SERVERS WITH 1 KEYBOARD AND MONITOR USING...

COMMANDER™

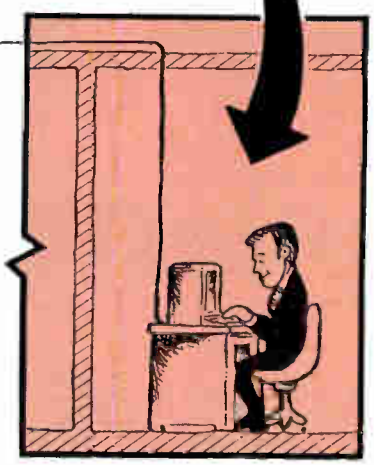


- Select via Keyboard
- Dual access up to 250 feet away (optional)
- No external power
- Mix PC, PC/XT, PC/AT and PS/2
- "AutoBoot™" Feature boots attached computers without operator intervention
- Able to Broadcast to all attached computers





- 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

2800-H Bob Wallace Ave.
Huntsville, Alabama 35805
(205) 534-0011
Fax (205) 534-0010

Dealer Program Available

PC, PC/XT, PC/AT and PS/2 are trademarks of International Business Machines Corp.

Circle 187 on Inquiry Card (RESELLERS: 188).

World Radio History

HARD DRIVE SALE

NEW REDUCED PRICES

Seagate

MODEL	SIZE	SPEED	TYPE	PRICE
ST225	20MB	65MS	MFM 5.25"	$149
ST4096	80MB	28MS	MFM Full HT	$349
ST251-1	42MB	28MS	MFM 5.25"	$239
ST351A (1" high)	42MB	28MS	IDE 3.5"	$159
ST3120A (1" high)	105MB	18MS	IDE 3.5"	$259
ST3144A (1" high)	130MB	16MS	IDE 3.5"	$289
ST3283A (1" high)	240MB	12MS	IDE 3.5"	$449
ST1480N	426MB	14MS	SCSI 3.5"	$999
ST4766N	660MB	15MS	SCSI/FH	$899
ST41200N	1037MB	15MS	SCSI/FH	$1499

CONNER

MODEL	SIZE	SPEED	TYPE	PRICE
CP3000 (1" high)	40MB	19MS	IDE	$159
CP3008E	80MB	19MS	IDE	$228
CP3010A (1" high)	120MB	19MS	IDE	$288
CP3017AA (1" high)	170MB	17MS	IDE	$329
CP30204	209MB	15MS	IDE	$399
CP3544A	525MB	15MS	IDE	$969
CP3540	540MB	12MS	SCSI	$999

Maxtor

MODEL	SIZE	SPEED	TYPE	PRICE
2585 (2 ½ " Drive)	80MB	17MS	IDE	$249
7120A (1" high)	130MB	15MS	IDE	$273
7213A (1" high)	213MB	15MS	IDE	$378
72135 (1" high)	213MB	15MS	SCSI	$399
7245A	245MB	15MS	IDE	$399
LXT340A	340MB	15MS	IDE	$648
LXT340S	340MB	16MS	SCSI	$698
LXT535A	535MB	15MS	IDE	$999
PANTHER (FH)	1000MB	13MS	SCSI	$1489
PANTHER (FH)	1500MB	13MS	SCSI	$1729

FUJITSU

MODEL	SIZE	SPEED	TYPE	COST
2622A/S (3.5")	330MB	12MS	SCSI/IDE	$645
2623A/S (3.5")	420MB	12MS	SCSI/IDE	$899
2624A/S (3.5")	520MB	12MS	SCSI/IDE	$949
22665 (FH)	1080MB	14MS	SCSI	$1449
26525 (FH)	1750MB	11MS	SCSI	$2699

MICROPOLIS

1624 (HH)	660MB	15MS	SCSI	$1199
2112 (3.5")	1050MB	10MS	SCSI/IDE	$1688
1598 (FH)	1050MB	14MS	SCSI	$1499
1548 (FH)	1748MB	14MS	SCSI	$2049
1528-15 (FH)	1350MB	14MS	SCSI	$1749
1924 (FH)	2100MB	11MS	SCSI	$2895

SOFTWARE LIQUIDATION

WORDSTAR.

Wordstar 2000 Rel. 3.5

This is not a misprint! These are the exact same ones selling for over $300.00+ from our competitors.
We have thousands in stock
FOR SALE BELOW DISTRIBUTOR COST! LIST $495.00 ea
DEALERS WELCOME
RETAIL BOXED & FACTORY SEALED

$69

100 FOR $55 EACH

Floppy Drives

360K	5.25"	½ HT	$29
720K	3.5"	½ HT	$29
1.2MB	5.25"	½ HT	$58
1.44MB	3.5"	½ HT	$58
	5.25"	MOUNTING	$5

Drive Controllers

8Bit	4 Floppy	$9
8 Bit	4 Floppy High Density	$49
8 Bit	2 Hard Drives MFM	$49
8 Bit	2 Hard Drives RLL	$59
16 Bit	Hard Drive only	$24
16 Bit	Hard and Floppy 1:1 Interface	$34
SCSI	DTC-3280 (Supports 7 drives)	$139
SCSI	Adaptec 1542B	$224
ESDI	DTC-6282-24	$149
IDE	Hard and Floppy	$29
IDE	Hard and Floppy w/IO	$39
Cables	Hard Drive	$9
Cables	Hard and Floppy	$14

AST COMPUTER Memory

MODEL#	MEMORY	PART#	PRICE
NOTEBOOK 286/12 286SX/20	4MB MOD	500814-003	$148
NOTEBOOK EXEC SX/-5; SX/25C	4MB MOD	500814-004	$148
POWER EXEC 3/25S, 3/25SI-C	4MB MOD	500984-001	$168
	16MB MOD	N/A	$1298
AST POWER EXECL EL	2MB MOD	500984-004	$99
	4MB MOD	500984-001	$169
	8MB MOD	500984-002	$599
	16MB MOD	500984-003	$1245
POWER PREMIUM 486/50D	8MB EXP KIT	500780-001	$279
4/33, 3/33, 4/66D, PREMIUM II	16MB EXP KIT	N/A	$598
386/25, 33, 486/33, 2020	4-32 MB EXP BRD	500818-001	$298
		500780-004	$298
AST PREMIUM 386C/386-16	4MB KIT	500510-008	$198
AST PREMIUM 386	4MB KIT	500510-004	$198
AST PREMIUM II, 386SX/16; 386SX/20, 486 33 & 33T	4MB MOD	500780-004	$198
BRAVO LC 425S, 4/33S, 4/50D, 4/66D	2MB KIT	500987-001	$98
	4MB MOD	500987-002	$198
	8MB KIT	500987-003	$348

NEVADA COMPUTER

Free Modem with PS/2 Memory Purchase!

SPRING CLEARANCE

WE WON'T BE UNDERSOLD!

COMPUTER PERIPHERALS, INC.

2400 BAUD MODEMS

2400 Internal, ½ Card for IBM PC, XT, AT and compatibles. CCITT V.22bis, V.22 and Bell 212A. Auto dial/Auto answer. Supports Comm 1-4/IRQ 2-5. Software included. **$39**

2400 External, same as above plus 8 LED status lights. **$69**

PS/2 1200 Baud IBM modem **$19**

FAX MODEM

9600 BPS Group III Facsimile, 2400 BPS Hayes Compatible Modem, True Background Send and Receive, Menu Driven, Command Line, Normal and Fine Modes, Half Card, One Year Warranty

$58

For laptops $198

CPU's intel

386SX		386DX		486DX/SX	
80386 SX/16	$29			80486 DX/25	$299
80386 SX/20	$39	80386 DX/20	$39	80486 DX/33	$399
80386 SX/25	$49	80386 DX/25	$71	80486 DX/50	$540
80386 SX/33	$59	80386 DX/33	$89	80486 DX-2/50	$489
				80486 DX 2/66	$699
				80486 SX/25	$209
				80486 SX/20	$124

Kingston TECHNOLOGY CORPORATION CPU UPGRADES

386 & 486 Processor Upgrades for your system! Now you can use Windows in enhanced mode, get true multitasking & background operation for Windows 3.1, OS/2, & other 386 specific software. Processor upgrades offer dramatically increased system performance & easy installation & improves your systems performance by up to 350%. Available for most machines.

25Mhz SX/NOW (upgrade from 386 to 386SX)	$288
33Mhz SX/NOW (upgrade from 386 to 386SX)	$318
486SX 25 (upgrade from 386 to 486SX)	$428
486DX 33 (upgrade from 386 to 486SX)	$899

intel COPROCESSORS

8088 BASED MACHINES:		80286 BASED MACHINES:		80386 BASED MACHINES:	
80C87-5 5MHz	$49	80C287-6MHz	$29	80C387-16MHz	$69
80C87-8 8MHz	$69	80C287-8MHz	$29	80C387-25MHz	$59
80C87-10 10MHz	$89	80C287-10 MHz	$69	80C387-25MHz	$69
		80C287-XL	$84	80C387-33MHz	$79
		80C287-XLT	$99	80C387-SX16	$69
				80C387-SX20	$89
				80C387SL	$99

Overdrives

80486 SX16/SX20	$499
80486 SX25 or DX25	$549
80486 SX33 or DX33	$699
RAPID CAD	$299

Cyrix COPROCESSORS AND CPU's

Plug compatible with Intel, and faster! 5 year warranty.

CYRIX	83D87-33Mhz	$88
CYRIX	83D87-40Mhz	$104
CYRIX	83D87-SX25Mhz / SX33	$88
CYRIX	80486DLC-25 (made by TI)	$128
CYRIX	80486DLC-33	$185
CYRIX	80486SLC-25	$119

Largest selection of Memory! Call if you don't see it!

IBM PS/2 Memory

FREE MODEM With PS/2 memory purchase

MODEL #	MEMORY	PART#	PRICE
PS/1 and 386/SX	2MB	92F9935	$78
	4MB	92F9694	$138
PS/2 30/286; Adpt Brd 1497259	512K	30F5348	$35
PS/2 30/286,25/286; Adpt Brd 1497259	2MB	30F5360	$89
PS/2 35SX, LS, 40SX,70-E61; 061; 121 Adpt Brd 6450609; 34F3011; 34F3077 XStation 120 & 130	1MB	6450603	$49
PS2 50, 50Z, 55SX, 60, 65SX	2-8MB	1497259	$259
	2-16MB	6450609	$308
PS/1 Consultant, Essentials & Expert models x43, x44 & PS/Valuepoint all models except Cxx series	4MB	N/A	$159
	16MB	N/A	$699
PS#2 70-A21; A61; 821; 861; PS/1 Consultant, Essential & Expert models x11, x13 & x14, PS/Valuepoint Cxx series	2MB	6450608	$79
PS/2 35SX; LS, 40SX, 55SX; LS, 65SX, LS, XStation, PS/Valuepoint Cxx series & adapter board 34F3001 or 34F3007	4MB	34F2933	$148
PS/2 90 XP, 95 XP, P75 (Pairs), 56 57 (all)			
PS/1 Pro 2123	2MB	6450902	$84
	4MB	87F9977	$148
PS2 90, 95 XP, P75 (Pairs) 56, 57, (all) PS/1 Consultant, Essential, Expert x11, x13 & x14, PS/1 Pro 2123, RS/6000	4MB	6450128	$148
	8MB	6450130	$298
Exp. boards for 50, 50Z, 55SX, 60,65SX			
2-8MB	2MB	1497259	$258
PS2/2 35SX; LS; 40SX	8MB	6450129	$289
PS2 70's and 80's	2-8MB	6450605	$249
	2-14MB	34F3077	$289
	4-16MB	34F3011	$388
PS/2 80-A21; A31; A61	4MB	6451060	$198
PS/2 80-041	1MB	6450375	$68
PS/2 80-111; 311; 121; 321; 081; 161	2MB	6450379	$89

IBM Laptops

PS/2 MD CL57SX Color, Notebook, Thinkpad 700, 700C, 300	2MB	07G1419	$168
	4MB	07G1420	$239
	8MB	07G1421	$389
PS/Note N45SL	2MB	92F8857	$98
	2MB	92F8804	$98
PS/2 Model N51, N82, Notebook SLC, SX	2MB	07G1826	$88
	4MB	07G1827	$158
	8MB	07G1828	$308
Laptop N33SX	2MB	79F0999	$88
	4MB	79F1000	$148
L40SX	8MB	79F1001	$288

In Touch with Tomorrow

TOSHIBA Laptop & Notebook Memory

MODEL	MEMORY	PART#	PRICE
T2000SX	2MB CARD	PA8311U	$99
T1000 SE/LE/XE	2MB CARD	PA8312U	$99
T2000SX/T1000 LE	4MB CARD	PA8314U	$168
	8MB CARD	PA8315U	$308
T1200 XE	2MB BOARD	PA8306U	$92
T1600	2MB BOARD	PA8302U	$85
T2000 SXE/T2200SX	2MB CARD	PA2000U	$89
	4MB CARD	PA2001U	$168
	8MB CARD	PA2002U	$328
T3100	2MB MOD	PA7135E	$199
T3100 E	2MB MOD	PA8341U	$88
T3100 SX	2MB BOARD	PA8308U	$88
	4MB BOARD	PA8310U	$158
T3200 SX	2MB MOD	PA8307U	$88
	4MB MOD	PA8309U	$158
T3200 SXC	2MB MOD	PA8318U	$88
	4MB MOD	PA8319U	$158
T3200	3MB BOARD	PA7137U	$158
T3300SL	2MB CARD	PA2006U	$128
	4MB CARD	PA2007U	$188
	6MB CARD	PA2008U	$288
	16MB CARD	PA2009U	$795
T4400 SX, SXC, T6400 SXC, DXC	2MB CARD	PA2003U	$125
	4MB CARD	PA2004U	$198
	8MB CARD	PA2005U	$348
	16MB CARD	PA2010U	$799
T5100	2MB BOARD	PA8301U	$88
T5200/T5200C/T8500	2MB MOD	PA8304U	$99
	8MB MOD	PA8313U	$298

COMPAQ Memory

MODEL	MEMORY	PART#	PRICE
Portable III	INTFC	107808-001	$99
	EXP BD	107811-001	$249
	2MB	107332-001	$98
Portable 386	1MB	107651-001	$119
	4MB EXP	107653-001	$449
	4MB DAGHT	107654-001	$449
Deskpro 386/16	1-2MB	108069-001	$248
	2MB	108069W71	$348
	1MB	108071-001	$98
	4-8MB	108070-001	$469
	4MB	108072-001	$269
Deskpro 286E; 386-20; 20E; 25, 25E	1MB	113131-001	$59
	4MB	113132-001	$168
Deskpro 386S	4MB Board	113634-001	$218
	4MB Module	112534-001	$179
Deskpro 386-20E, 25E	4MB	113645-001	$218
Deskpro 386/33, 386/33I; 486/25, 33L;50L, Systempro	2MB	115144-001	$102
	8MB	116561-001	$389
	32MB	116568-001	$1498
Compaq "M"	2-64MB	129160-001	$358
Deskpro 286N; 386N; 386SX/20; 20N, Portable 486c, Deskpro M, Systempro LT Series 129160-001, Compaq Pro Signia	1MB	118688-001	$59
	2MB	118689-001	$89
	4MB	118690-001	$148
	8MB	128877-001	$318
Prolina 3/25 & 25Z	2MB	141738-001	$89
	8MB	141742-001	$279
Prolina 4/25si, 4/33, 4/50	2MB Module	141683-001	$98
	4MB Module	141684-001	$168
	8MB Module	141685-001	$318
Compaq Pro Signia	16MB	149320-001	$1295
	32MB	149147-001	$2295
Systempro; Deskpro 6 SKT EXP BRD W/2MB		116569-001	$299

Compaq Laptop & Notebook Memory

Contura Notebook/Laptop	2MB	139497-001	$88
	4MB	139498-001	$168
	8MB	139499-001	$318
Compaq SLT/286	1MEG MOD	110235-001	$99
	4MEG MOD	110237-001	$218
Compaq SLT386	1MEG MOD	118303-001	$89
	2MEG MOD	118304-001	$129
	4MEG MOD	118305-001	$175
Compaq Lte 286	1MEG BRD	117081-001	$79
	2MEG BRD	117081-002	$99
	4MEG BRD	117081-003	$218
Compaq Lte 386/20	1MEG MOD	121125-001	$98
	4MEG MOD	121125-002	$198
Compaq Lte Lite/20, 25	2MEG MOD	129769-001	$138
	4MEG MOD	129769-002	$218
	8MEG MOD	129769-003	$458
Compaq LTE Lite/20 & Lite/25;25C	16MB Card	N/A	$1045
Compaq Lte 486/25C	4MB Card	N/A	$198
	8MB Card	N/A	$378

Simm Modules (Call for current prices)

DESCRIPTION	100NS	80NS	70NS	60NS	53NS
256X9	$9	$10	$11	$15	
1MEGX3		$32	$33	$38	
1MEG X 9	$29	$35	$37	$44	$54
4MEG X 9		$124	$134	$159	
16MEG X 9			$699		
256X36 1MEG (72 Pin)		$50			
512X36 2MEG (72 Pin)		$85	$95		
1X36 4MEG (72 Pin)		$139	$149	$159	
2X36 8MEG (72 Pin)		$289	$298	$329	
4X36 16MEG (72 Pin)		$599	$619	$719	

D-Ram Chips

DESCRIPTION	150NS	120NS	100NS	80NS	70NS	60NS
64 X 4	$1.95	$2.25	$2.45	$2.95		
256X1 STATIC				$1.95	$2.25	
256 X 1	$1.05	$1.25	$1.40	$1.55	$1.95	$2.20
256 X 4		$3.95	$4.45	$4.95	$5.45	$5.95
1MEG X 1		$2.95	$3.45	$3.95	$4.45	$4.75
1MEGX1 STATIC				$4.95	$5.25	
1MEGX4				$17.00	$20.00	$24.00

Laser Printer Memory

	1MEG	2MEG	3MEG	4MEG	5MEG	8MEG
Brother HL-8, 8E, 8D, 8V	$99	$149		$249		
Canon LBP4	$128	$178				
Compaq Pagemark 15 & 20				$319		$638
Epson Action Laser II, 8000	$95		$163		$229	
Epson 6000		$108		$178		
Fujitsu 7100 & 7200	$199	$279				
HP Deskjet 500, 500C	$59 (256K)					
HP2, 2D, 3, 3D, 3P, 2P, 2P+		$104		$164		
HPIII SI	$50			$148		
HP Laser Jet 4, 111SI, XL300				$148		$289
IBM Laser 4019, 4019E (3.5MB)				$169		
IBM Laser 4029				$149		
NEC 90, 290		$118				
NEC 95		$128				
OKI 400		$99				
Packard Bell PB9500		$125		$178		
Panasonic 4410/4430		$119		$178		
Panasonic 4420/44501	$89	$118		$178		
Panasonic 4450	$105					
Panasonic 4455		$139				
QMS 410	$119	$159		$249		
Star LS04	$129	$179		$269		
StarScript 4	$128	$178		$258		
Tosiba Page Laser 6		$119		$178		
TI XL/PS17/PS35	$59					

Major Laptop & Notebook Memory

MODEL	MEMORY	PART#	PRICE
AT&T Safari	2MB	37650	$128
AT&T Safari	4MB	37651	$238
Bondwell B-310	1MB	23050-09100	$128
Dec pc 320 Notebook	2MB Mod	FR-PCIM-BA	$149
	4MB Mod	FR-PCIM-BB	$298
	8MB Mod	FR-PCIM-BD	$345
Dell Laptop 212, 320N, 320NT	1MB Mod	310-3203	$79
	2MB Mod	310-3204	$109
Dell 325N; NC; Notebook P.C.	2MB Mod	310-3210	$148
Dell NL20 & NL25 NTBK	2MB Mod	310-3213	$148
Epson NB-3 Notebook	4MB	A808501	$198
Epson NB-SL/20;25	2MB Mod	A808771	$138
25C Notebook	4MB Mod	A808781	$228
Everex Tempo LX, LX20	2MB	00160	$87
Everex Carrier	2MB	00263-00	$97
Grid 1500	4MB	52587	$198
Grid 1450SX	2MB	6200203	$148
Goldstar GS520, 386SX16	1MB	N/A	$98
Goldstar GS520, 386SX16	4MB	N/A	$298
NCR 3120 Notebook	4MB Mod	3120-K104	$299
NCR 3170 Notebook	4MB Mod	3123-K104	$399
Packard Bell, Magnavox, Mitsuba	1MB	N/A	$88
Packard Bell, Magnavox, Mitsuba	4MB	N/A	$198
Panasonic CF170/270/370	1MB	CF-BA165	$78
Samsung Notemaster 386S	2MB	SNM002	$195
Samsung Notemaster 386S	4MB	SNM004	$395
Sanyo 17NB; 18NB & ZEOS	2MB	MBC-NBMEM2	$95
Sharp 6220	1MB	CE 6218	$98
Sharp 6640	2MB	N/A	$198
Sharp 4700MZ-200	1MB	CE-471	$198
Sharp 8501 Colorstar	2MB	N/A	$398
TI Travelmate 2000	1MB	2568034-0011	$88
TI Travelmate 3000SX; WINSX	2MB	2566996-0001	$98
TI Travelmate 4000, WINDX/25 SX/16, SX25	4MB	2581265-001	$218

ZENITH MEMORY

Z-Note 320L, 320LB	2MB MOD	ZA-3250-5	$168
325L, 325LC	8MB MOD	ZA-3250-4	$488
MASTERPORT 386SL;SLE;SLC	2MB MOD	N/A	$109
MASTERPORT 386SX	2MB MOD	Z-360-1	$118
SUPERSPORT SX/286E - ALPHA	2MB MOD	ZA-180-86	$128
BETA	2MB MOD	ZA-180-87	$278
Z-386/20, Z-386/25, Z-386/33	1MB MOD	ZA-3600-ME	$48
		3800-ME	$48
Z-386/33B, Z-386SX/20 286LP+, Z-LS	2MB MOD	ZA-605-1	$98
Z-486/33ET	4MB KIT	ZA-4200-M2	$178
	16MB KIT	ZA-4200-M8	$588
Z-300/400 SERIES Z-420/SX	4MB MOD	ME-100	$158
Z-425/SX, Z-433/DX, Z-433/SX	16MB MOD	ME-90	$648
Z-SERVER 425SE, 433DE, 450DE	4MB KIT	ME-432	$168
	8MB KIT	ME-102	$318
	16MB KIT	ME-442	$638
	32MB KIT	ME-92	$1219
420SN, 425SH, 433DEH 433DH	4MB MOD	MB-100	$148
450XEN, Z-STATION 325SB, 325N	16MB MOD	MB-90	$648

16 Bit Memory Boards Below Dealer Cost!

Newer Technology

0-8MB 16Bit for 286 and 386, up to 24Mhz, Limm 4.0 and Extended. Uses Dip chips. Extended and Expanded

OK	2MB	4MB	8MB
$19	$89	$159	$299

0-16MB Lim/EMS 4.0, Expanded and Extended, True EMS 4.0 for any 286, 386 and 486 w/ up to 33Mhz CPU speed. Uses Simms

OK	2MB	4MB	8MB	16MB
$49	$139	$204	$352	$653

Memory Boards

Boca AT Plus (Brat 90 uses 1MEG Simms) OK-8MEG Board, 4.0 LIM compatible, Conventional, Expanded & Extended Memory, Supports DOS, OS/2, LIM/EMS & EEMS OK-$94, 2MEG-$159, 4MEG-$228, 8MEG-$358

Brat 80 (uses Dip Chips) $79 (SAME AS ABOVE)

Brat AT + I/O ParSer 0-4MEG $118 OK $118 2MEG $184 4MEG $250

Advantage/2 Memory Board for IBM PS/2 model 50/60. Comes with OK, expandable to 8mb. Uses Simm modules Super Pak utility software. OK-$49 2MB-$139 4MB-$199 8MB-$349

COMPUTER PERIPHERALS, INC. Memory Boards

For 286, 16 Bit, 2MB Expandable to 4MB. (Uses 1MB x 1Dips) Works with IBM AT, and compatibles. Expanded, Extended, 4.0 Lim compatible

2MB	$69
4MB	119

ORDERS ONLY
800-982-2925
HOURS: M-F 7AM-6PM / SAT 10AM-3PM
FOR TECHNICAL & CUSTOMER SERVICE QUESTIONS CALL: (702) 294-0204 FAX ORDERS, INQUIRIES AND EXCESS INVENTORY LISTS TO: FAX (702) 294-1168

TERMS: SHIPPING: UPS (Min. $8.25) Shipping charges are non refundable. NET 30 Accepted. Purchase orders from Universities, Fortune 1000 & Government Agencies Personal Checks, COD add $5.00 (Cashiers check required) *Best prices on same items under same terms. We ship by UPS, DHL, FEDERAL EXPRESS AND PARCEL POST

CONDITIONS: 20% Restocking Fee on refunds within 30 days. No refunds or exchanges after 30 days - WARRANTY REPLACEMENT ONLY. ALL PRICES FINAL. PRICES SUBJECT TO CHANGE. Mfg. part #'s for convenience only. Trademarks are registered with their respective Co.'s. 386, 387, 287, SX, are trademarks of Intel Corp.

VISA DISCOVER AD $493

684 Wells Road
Boulder City, NV
89005

NEVADA COMPUTER

Circle 193 on Inquiry Card.

World Radio History

WIRELESS NETWORKING BY MOTOROLA

EMBARC℠ from Motorola, delivers information to moving targets

Users roam the nation and stay in the loop

Portability doesn't have to mean isolation from important, timely information, thanks to EMBARC wireless networking.

Anywhere in America's top 200 cities, users stay 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 targeted industry news briefs from HeadsUp.™ They can even have their important databases routinely updated—automatically!

All that's required 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. It installs in minutes and is ready to operate—without wires, faxes or phones.

Equip your whole team and send 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.

EMBARC service is available for DOS-based laptops and notebooks, HP 95LX palmtops and Macintosh Powerbooks.

EMBARC℠

Circle 211 on Inquiry Card (RESELLERS: 212).

®, Motorola and NewsStream are registered trademarks of Motorola, Inc. All other product and company names are the property of their respective owners. © 1993 Motorola, Inc.

World Radio History

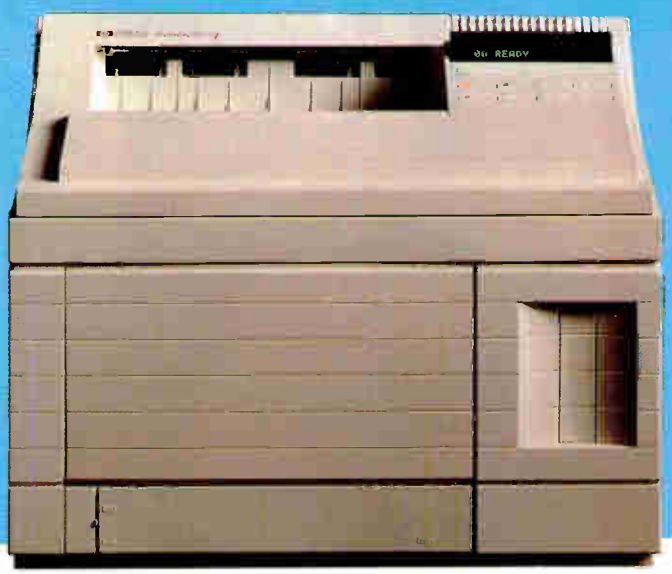
HIGH SCORING TEAMS

HEWLETT-PACKARD & MANCHESTER

INTRODUCING THE PRINTER
YOU HAVE BEEN WAITING FOR
THE
HEWLETT-PACKARD

LASERJET 4 PRINTER

BETTER RESOLUTION
FASTER THROUGHPUT
IMPROVED PAPER HANDLING
MORE FONTS
INCREASED FLEXIBILITY



- True 600 x 600 dpi Resolution
- Improved Resolution Enhancement Technology
- Microfine Toner Engineered Specifically for 600 dpi Printing
- Standard 250 Sheet Input Paper Tray, Plus Multi-Purpose Tray (For 100 Sheets or 10 Envelopes)
- 250 Sheet Output Tray
- More Built-in Typefaces: 45 Internal Scalable Typefaces
- Fast RISC Processor and I/O for Faster Printing of Complex Graphics
- "Hot" I/Os Enabling the Printer to Automatically Switch Between All Ports, and Send Messages Back to the Host
- Improved Printer Drivers
- Built-In TrueType for Optimum Performance in Windows Applications
- 2MB Standard, Expandable to 34MB
- Many Options to Allow Improved Flexibility

SYSTEMS INTEGRATION
NETWORKING CONNECTIVITY
CAD/CAM RISC/UNIX

HEWLETT PACKARD
Authorized Dealer

MANCHESTER EQUIPMENT COMPANY, INC.

"The Computer Supply and Equipment Experts"

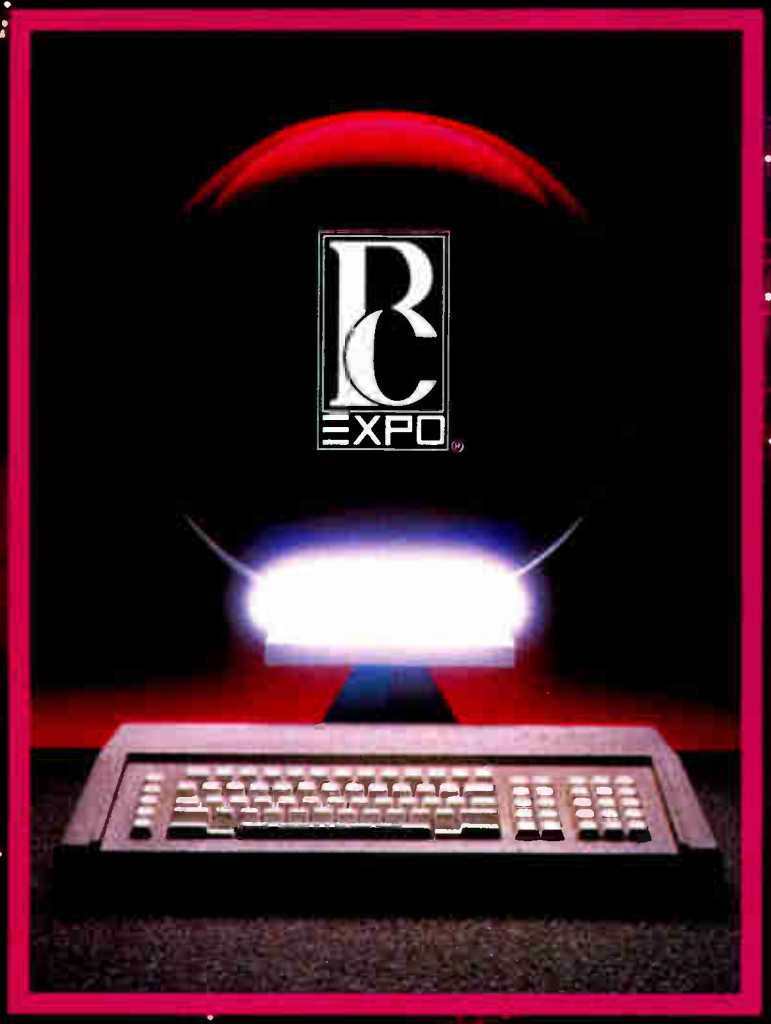
50 MARCUS BLVD. ■ HAUPPAUGE, NY 11788 ■ (516) 435-1199 ■ (212) 629-6677

New York City: (212) 629-6969 ■ Boca Raton: (407) 241-7900 ■ Tampa: (813) 888-8809 ■ Boston: (617) 455-8300

Circle 577 on Inquiry Card.

World Radio History

KEY INTO THE FUTURE...



AT PC EXPO TODAY

Travel into the next decade as PC EXPO embarks on an entirely new era of computing. You'll journey into the future of Windows, pen-based computing, multimedia and open systems. You'll tour the more than one-half million square feet of exhibition space showcasing a universe of the latest programs and services. And you'll explore a galaxy of new products that link today's information services with tomorrow's innovative technologies.

Catch a glimpse of the future at PC EXPO

JUNE 29, 30 & JULY 1, 1993

JACOB K. JAVITS CONVENTION CENTER
11th Avenue at 34th Street
New York City

For more information call today!
800-829-3976 ext. 9202

PC EXPO IN NEW YORK

It's the one computer trade event guaranteed to leave you light years ahead of your competition.

Foreign Buyer Program

Circle 556 on Inquiry Card.

BLENHEIM

PC EXPO in New York is produced and managed by Bruno Blenheim Inc.
Fort Lee Executive Park, One Executive Drive, Fort Lee, NJ 07024 • 800-829-3976 • 201-346-1400 • Fax 201-346-1602

World Radio History

EasyCAD 2– the #1 Rated CAD Software

Number 1 in user satisfaction–PC Week poll.

In competition against other top CAD software for performance, hardware compatibility, ease of use and value, EasyCAD 2 handily won the award that counts most–User Satisfaction (1989, 1990). Now the best is even better.

You Pay Only $199.00 for the Program CAD Users Rate Number 1.

PC WORLD said it best, "This easy-to-learn program is blindingly fast, and its flexibility, wealth of features and

excellent user interface match those of professional programs costing thousands of dollars more."

In fact, because it is written entirely in assembly language experts say EasyCAD 2's speed rivals CAD packages costing up to twenty times more. So why spend well over $2000 to get

what EasyCAD 2 can deliver for just $199.00?

Expanded, productivity-boosting associative dimensioning.

EasyCAD 2's associative dimensioning feature allows you to rotate, stretch or change the scale factor of a drawing and all dimensions are instantly updated to reflect the change. This includes ordinate, angle, radius and diameter as well as other dimension formats. You never have to erase or re-enter dimensions.

Whisk through even the largest drawings.

An enhanced memory manager lets you work through the largest drawings faster than ever.

Plot to file means you can store drawings on disk now and send it to the printer later. And it supports PostScript printer fonts and line weight controls.

More features, less money–guaranteed.

No other CAD software gives you so many features for so little money (and a 30-day money back guarantee): Customizeable pull-down menus, script and macro capabilities that automate complex or repetitive tasks, DXF for exchanging drawings and files with other CAD programs and spread sheets. The list goes on.

Call 1(800)874-4028 now for more information, plus the name of your nearest dealer. If you already own EasyCAD, ask about our special trade-up programs.

EVOLUTION
EasyCAD 2
COMPUTING

437 S. 48th St., Ste. 106
Tempe, AZ 85281-9936
1(800)874-4028

© 1992 Evolution Computing
EasyCAD2 is a registered trademark of Evolution Computing

World Radio History

TAIPEI

COMPUTEX '93 International Computer Show June 1-5, 1993

Computers • Peripherals • Software • Office automation systems • Software

Data communications • Applications • Mass storage • Components

The biggest, most important computer show in Asia. Your point of access to thousands of opportunities!

Organizers:

CHINA EXTERNAL TRADE DEVELOPMENT COUNCIL

TAIPEI COMPUTER ASSOCIATION

Sponsor:

TAIPEI WORLD TRADE CENTER

Venue: TAIPEI WORLD TRADE CENTER EXHIBITION HALL, 5 Hsinyi Rd. Sec. 5, Taipei, Taiwan, R.O.C.
Tel: 886-2-725-1111 Fax: 886-2-725-1314 Telex: 28094 TPEWTC Branch Offices: CETDC, Inc., New York
Tel: (212)532-7055 Fax: (212)213-4189 Far East Trade Service, Inc., San Francisco Tel: (415)788-4304
Fax: (415)788-0468 Far East Trade Service, Inc., Chicago Tel: (312)819-7373 Fax: (312)819-7377

Circle 557 on Inquiry Card.

World Radio History

FREE On-Site Service Nationwide For One Year!

386DX 40 64K Cache 4 Meg **$1175**

486DX 33 256K Cache 4 Meg **$1575**

486DX2 50 256K Cache 4 Meg.....**$1625**

486DX 50 256K Cache 4 Meg **$1775**

486DX2 66 256K Cache 4 Meg.....**$1775**

486 VESA Local Bus
w/24 bit 16 Million true color video.....Add **$100**

All Systems Include:

- 130 Meg hard disk (14.5 ms)
- 1.44 Meg floppy drive
- 1.2 Meg floppy drive
- SVGA 1024 X 768 .28 14" color monitor
- SVGA card (trident) 1 Meg
- 220 Watt desktop or mini tower
- 2 serial, 1 parallel, 1 game, IDE 2HD/2FD
- 101-Key enhanced keyboard
- 1 year parts and 5 years labor
- **1 YEAR ON-SITE SERVICE**
- **FCC B AND UL APPROVED**

P.S. Personal Solution
COMPUTERS

One Hollywood Drive
North Grafton, MA 01536
508-839-3289 fax 508-839-6236

800-685-3981

Monday-Friday: 10am-10pm
Saturday: 10am-6pm
Sunday: Noon-6pm

Circle 562 on Inquiry Card.

No surcharge for credit cards.

MasterCard VISA DISCOVER

World Radio History

Circle 560 on Inquiry Card.

❖ ADVERTISERS ❖

Run a full- or half-page 4-color ad reaching a portion of BYTE's U.S. readers at unbelievably low rates — right here in this section!

Call today to learn more about BYTE's unique *Regional Advertising Section*, located in our prominent *Buyer's Guide*.

❖

(603) 924-2651 or (603) 924-2637

World Radio History

Oh!

Practice it. Say it out loud a few times. Oh! You'll hear it often and say it yourself at DEXPO. You'll say it when you see new products, or hear new solutions or gain new ideas as you walk through the exhibit hall or attend a conference session. You'll say it when you meet your friends or peers and have discussions about mutual problems. You'll say it time after time as you find the technology that can improve your business.

DEXPO Spring, The Event Of The DEC Open Market is your best opportunity to find the products and solutions to make your DEC and DEC compatible products work better together, to improve productivity, to increase profitability.

Open Systems Conference debut's at DEXPO Spring '93.

Today's information manager has two things on their mind - increased productivity and profitablity without added expense. DEXPO has added a world class conference to open your eyes to new ideas in making your DEC and DEC compatible products work more effectively together. Topics include:

Achieving Enterprise-Wide Open Systems

A Guide to DEC-Other Vendor Integration

- IBM, HP, Sun, Unisys, Pcs, Unix System V

DEC and the Issues of the 90's

- Open Systems
- Operating Systems
- Network Management
- NAS
- Application Development
- DEC's Software Vision

To obtain registration information for DEXPO Spring '93 fill out the form and return either by mail or fax.

DEXPO Spring
Exhibition & Open Systems Conference
June 8 -10, 1993
Inforum
Atlanta, GA

Mail to: Registrar
DEXPO Spring
13760 Noel Road, Suite 500
Dallas, TX 75240

Fax to: 214/385-9003

Yes, I'm interested. Please send more information on:

( ) Attending ( ) Conference ( ) Exhibiting

Name _____

Title _____

Company _____

Address _____

City/State/Zip _____

Phone _____

Fax _____ B

DEXPO®

No one serves the DEC market better, no one can.

Produced by Miller Freeman, Inc.-A member of the United Newspaper Group ©1993 Miller Freeman, Inc.

Circle 559 on Inquiry Card.

World Radio History

PCSources Says . . .
Kenosha Computer Center offers some of the Best Buys in Mail Order!

Join the thousands of satisfied customers who enjoy our combination of price, service, and speed of delivery.

- No Surcharge on MasterCard or Visa!
- Kenosha Computer Center is now in its 6th year!

KENOSHA COMPUTER CENTER

SALES LINE OUTSIDE WISCONSIN

1-800-255-2989

Shipping, customer service & technical assistance call

414-697-9595 ▪ FAX 414-697-0620

VISA, MASTERCARD, AMERICAN EXPRESS ACCEPTED

EPSON

LX 810	$169	LQ570	$235
FX 870	$259	LQ870	$425
FX 1050	$349	LQ1070	$339
FX1170	$345	LQ1170	$569
EPL8000	$1065	LQ2550	$849

Action 3250 ..... $189
Action 1000 6 PPM, 14 fonts $645
Action 1500 6 PPM, PLC5 ..... $789
DFX 5000/DFX 8000 ..... $1259/$2129
Call For Options

TEXAS INSTRUMENTS

Travelmate 3000-WINSX $1749
Travelmate 4000 SX-80mg $2149
Travelmate 4000 WINSX 25-120 ..... $2349
Travelmate 4000 WINDX 120mg $2879
Travelmate 4000 Win SLC/25 ..... $1749
Travelmate 4000 Win DX2/50 ..... $3399
Travelmate 4000 Win SX/25 Color ... $3199
Travelmate 4000 Win DX2/40 Color . $3899
Call For Accessories

OKIDATA

ML320/ML321 ..... $299/$419
ML380/ML590 ..... $219/$419
ML591/ML393 ..... $569/$909
OL 400 Laser/OL 810 ..... $589/$1029
OL 820 Laser/OL 830 ..... $1219/$1259
Okilaser 400 2MG upgrade $119

Panasonic Office Automation

1123/1124i ..... $195/$275
2180/2123 ..... $179/$229
1624/1654 ..... $339/$519
2124/2624 ..... $299/$359
4410/4430 ..... $599/$859
4450i/4451 ..... $1059/$1379
2mg. Upgrade for 4420 & 4450I $125

Kcc Computers

KCC 386 SX-33 w/1.2MB floppy, 2 MG RAM, 40 MG Hard Drive, SVGA Card & Monitor, DOS 5.0, Windows & Mouse $1249

KCC 386-DX-40 w/64K Cache 1.2 MG floppy, 4 MG RAM 106 MG Hard Drive, SVGA Card and Monitor, DOS 5.0, Windows 3.1 and Mouse $1499

KCC 486-DX-33 w/64K Cache, 1.2 MG floppy, 4 MG RAM, 211 MG Hard Drive, SVGA Card and Monitor, DOS 5.0, Windows 3.1 and Mouse $1999

All KCC systems come with a 30 day money-back guarantee. Toll-free technical support. One Year Limited Warranty.

HEWLETT-PACKARD

Laserjet IV w/toner	$1399	Deskjet 500/500C	$399/$509
Laserjet IV M w/toner	Call	Deskjet 550C	$729
Laserjet III P w/toner	$979	Deskjet Portable	Call
Laserjet II P+ w/toner	$809	Laserjet III si	$3249
1 MB Upgrade	$69	4 MB Upgrade	$149
2 MB Upgrade	$99	Options	Call

Canon

BJ 10 EX $245
360 DPI, 37K Buffer, 142 CPS, 6 fonts, IBM & Epson Emulation

BJ 20 ..... $359
Detachable cutsheet feeder, 188 CPS, 360 DPI

BJ 300 ..... $325
600 CPS, 30K Buffer, 3 Fonts, Epson IBM Emulation

BJ 330 ..... $555
Wide carriage. Version of BJ 300

BJC 800 ..... $1779
Color Bubblejet, 360 DPI, 7K Buffer, Epson Emulation LQ2550, 600 CPS, Built-in auto cut sheet feeder

BJ 200 ..... $325
496 CPS, 360 DPI, cut sheet feed, Epson & IBM Emulation

MODEMS & FAX MODEMS

PRACTICAL PERIPHERALS
FAX ME for plain paper fax $169
PRACTICAL PER 9600 INT/EXT ... $199/$229
PRACTICAL PER 14.4 INT/EXT .... $309/$279

HAYES
HAYES OPTIMA 9600 ..... $329
HAYES OPTIMA 14.4 ..... $399
HAYES OPTIMA 14.4 W/FAX $439
HAYES ACCURA 14.4 W/FAX $309

U.S. ROBOTICS
USR 9600 V.32 bis $469
HST 16.9 Int/Ext ..... $499/$549
USR SPORTSTER 14.4 Int/Ext .... $269/$299
USR SPORTSTER 14.4 W/FAX $279
USR DUAL STD EXT $709
World Port 96/96 Fax Modem $439
Intel Satisfaxtions Below

HARD DRIVES & TAPES

SEAGATE, CONNER & MAXTOR
SEAGATE 120 MB 3144A $249
SEAGATE 245 MB 3283 ..... $389
MAXTOR 120/211 ..... $265/$369
MAXTOR 245/340 ..... $389/$599
MAXTOR 535 MB $899
CONNER 120/170 ..... $265/$285
CONNER 200/250 ..... $369/$389
CONNER 510 ..... $799

MICROSOLUTIONS

100 MB or 200 MB ..... $489/$599
External Parallel port hard drive. Perfect for Laptops, PS II's & XT's.

QUANTUM

Hard Card 50XL $239
Hard card EZ 127/240 ..... $325/$529

TAPE BACK UP

Colorado Jumbo 120 ..... $159
Colorado Jumbo 250 ..... $219
Colorado Tracker 120 ..... $339
Colorado Tracker 250 ..... $399
Mountain, Maynard, others ..... CALL

MONITORS

Mitsubishi EGA $239
Mitsubishi Diamond Pro 17" $1069
Mitsubishi HL 6955 20" $1779
NEC Multisync III FGX $609
NEC Multisync IV FGX $709
NEC Multisync VFGX $1245
NEC 6FG $2249
Samsung 14" Sync Master 2 ..... $249
Samsung 14" Sync Master 3 ..... $299
Samsung 15" Sync Master 15 ..... $479
Samsung 17" Sync Master 4 ..... $769

SOFTWARE

Lotus 2.4/3.1 ..... $299/$359
Microsoft Word for Windows $299
Microsoft Windows 3.1 ..... $79
Microsoft DOS 5.0 ..... $69
DBase IV $419
Word Perfect 5.2 ..... $269
C.A. Cricket Paint $89
C.A. SuperCalc $89
C.A. Simply Accounting $125
C.A. Clipper $495
C.A. BPI Value Pak $359
C.A. db Fast $329

BATTERY BACKUP & UPS

AMERICAN
250/400 ..... $109/$165
450/600 ..... $199/$259
900/1200VX ..... $375/$729
SMART UPS 400 ..... $309

TRIPPLITE
BC 250 ..... $105
BC 400 ..... $159
BC 500 LAN $195
BC 600 LAN $259
BC 900 LAN $359

GRAPHICS CARDS

ATI VGA Wonder XL 24 1MB $149
ATI Graphics Ultra + 1MB $279
ATI Graphics Ultra Pro 1MB $439
Diamond Speedstar 1MB $169
Diamond Stealth 24 1MB Local Bus .. $169
Diamond Stealth $219
Orchid Fahrenheit1280 1MB $189
Orchid Prodesigner IIS MC 1MB .. $289
Trident 1280 x 1024 1MB $75

intel

Satisfaxtion Fax Modems
200 2400 V.42/9600 Fax $269
400 14.4/14.4 Fax $369
400 ext 14.4/14.4 Fax $375
Faxability Plus $59
80387-SX co-processor $75
80387-DX co-processor $85
Overdrive Upgrade SX20/25 .... $349/$435
Overdrive Upgrade DX25/33 ... $435/$575

MEMORY PRODUCTS

2 MB IBM 30-286 ..... $89
2 MB IBM 55SX $89
1 & 4 MB SIMMS ..... Call
BOCA RAM AT 2 MB $179
4 MB TI 4000 ..... $199
Ast Premium 4 MB $165
Toshiba, Nec, Zenith, AST, IBM, Compac, Other Manufacturers & Products ..... Call

LASER PRINTERS

2 MB EPSON ALII $139
2 & 4 MB H-P III ..... $99/$159
2 MB OKI 400 ..... $119
2 MB OKI 830/840 ..... Call
2 MB Panasonic 4450i $125
2 MB Panasonic 4410/4430 ..... $125
Other Models & Manufacturers ..... Call

HOUSTON INSTRUMENTS PLOTTERS & SUMMAGRAPHICS DIGITIZERS

Image Maker A&B 11x17 ..... $699
DMP-52 C&D 1 Pen $1979
DMP-161 A to D 8 Pen $2749
DMP-162 A to E 8 Pen $3475
DMP-162R A to E 8 Pen Roll Feed $4749
Summasketch III 12x12 ..... $279
Summasketch III 12x18 ..... $469

MULTIMEDIA & CD ROMS

Media Fusion 16 Kit $499
Pro Audio Spectrum 16 Bit $195
ATI Stereo F/X Card $109
Soundblaster Pro $195
Soundblaster Pro 16 Bit $229
Videoblaster $329
Soundblaster Multi Media $539
NEC CD Express $419
Toshiba 3401 INT 200MS Access $489
Toshiba 3401 EXT 200MS Access $589
SCSI Adapter For Above Drives $189

NETWORKING

NETWARE 2.2 5 USER $489
NETWARE 2.2 10 USER $1079
NETWARE 2.2 50 USER $2099
NETWARE 3.11 5 USER $589
NETWARE 3.11 10 USER $1329
NETWARE 3.11 50 USER $2619
NE 2000 ..... $139
LANTASTIC 10MPS STARTER KIT $449
LANTASTIC 10MPS ADAPTER $199
LANTASTIC FOR WINDOWS $165
3 COM ETHERLINK II $185
3 COM ETHERCARD $279
INTEL ETHER 16 ..... $119
INTEL ETHER 16 20 PAK $1779
SMC ETHER + ELITE 16 ..... $145
SMC ETHERNET 8 BIT COAX $95
XIRCOM POCKET ADAP COAX $299
XIRCOM POCKET ADAP 10 BASE T $299

No charge for MasterCard or Visa. We will ship COD on a cash or casher's check basis only. Shipping & handling 3% – $5 minimum; AK and HI slightly higher. 15% restocking charge on returned items. Purchase orders accepted from Fortune 1000, Government institutions, schools and universities. 2% shipping discount available on orders over $2000 if prepaid by check.

Prices and availability subject to change.

KENOSHA COMPUTER CENTER
2133 91st Street
Kenosha, Wisconsin 53140

KENOSHA COMPUTER CENTER
1-800-255-2989
Circle 561 on Inquiry Card.

World Radio History

Micro-International Inc.

since 1984, world-wide distribution of quality computer systems and components

Intel CPU	486X-25	486DX-33	486DX2-50	486DX-66
Monochrome	$2,160	$2,410	$2,560	$2,720
Color	$3,060	$3,310	$3,460	$3,620

Don't be misled by cheap, low-performance 486SLC designs. With the real Intel 486 power, this notebook computer is the only system you'll ever need in the office or on the road.

HCP Power Notebook Standard Features

- VGA graphics with CCFT backlit LCD screen
  - Mono – 32 gray scale
  - Color – 256 colors
- 4 MB RAM installed (16 MB capacity)
- 120 MB hard disk, 15 ms access time
- 1.44 MB floppy drive
- Nickel-cadmium quick-rechargable battery
- Carrying case
- Built-in trackball (COLOR System Only)
- Serial mouse (MONO System Only)
- Licensed Microsoft Windows 3.1
- Licensed DR-DOS 6.0
- One parallel and two serial ports
- External VGA and keyboard connections
- External numeric keypad
- AC adapter/charger included

Optional Features

Docking station with 2 x 16 bit slot	$160	Upgrade hard drive to 210 MB	$200
Auto cigarette adapter	$ 40	Upgrade hard drive to 450 MB	$720
Memory upgrade to 16 MB	$380	Additional battery	$ 90
Memory upgrade to 8 MB	$160	Battery charger	$ 30
Pocket fax modem (24/96)	$130	Additional AC adapter/charger	$ 50

Micro-International, Inc.

10850 Seaboard Loop
Houston, Texas 77099

MasterCard VISA

National Sales 800/967-5667 Houston 713/495-9096

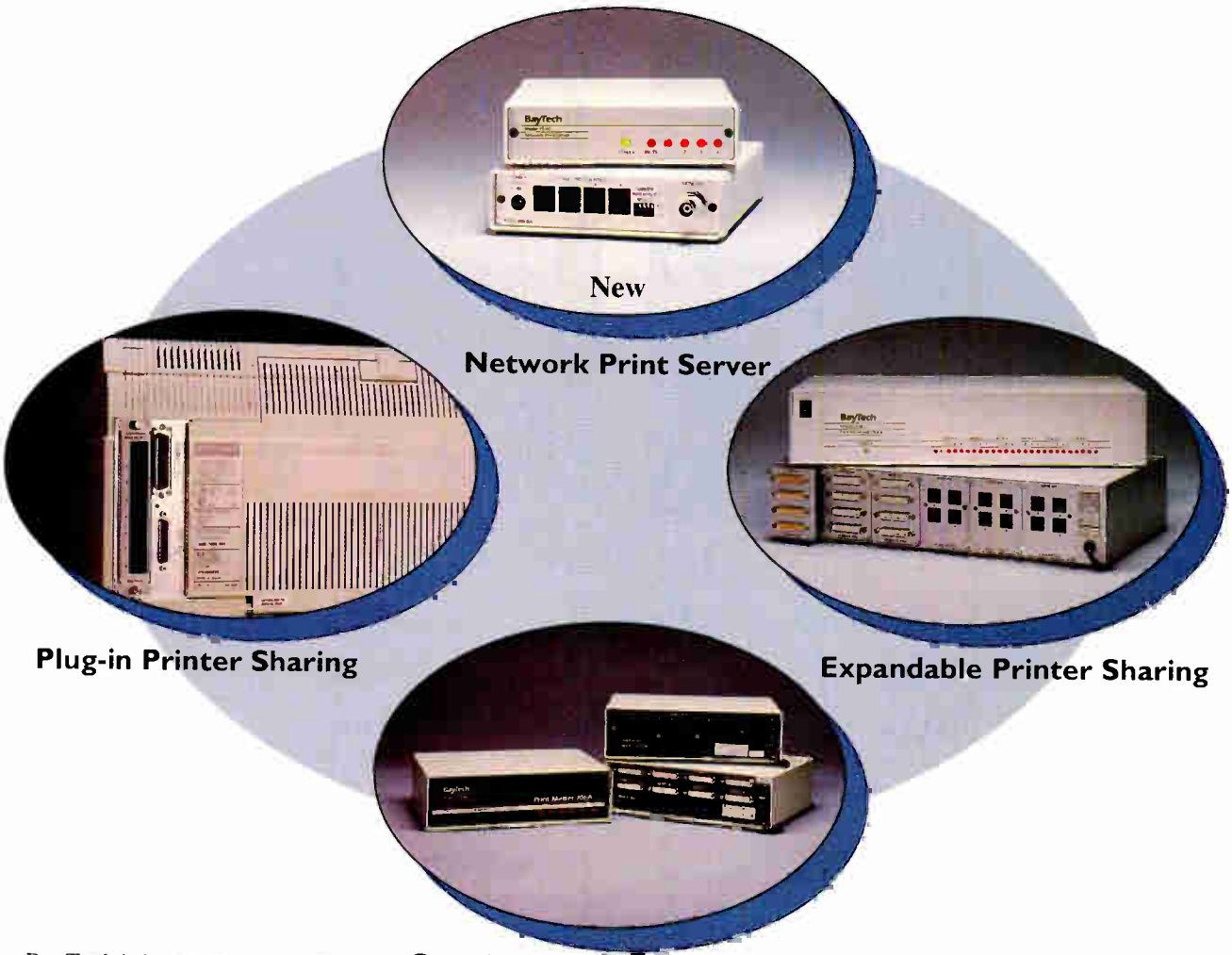
Hours: 9:00 a.m. to 5:00 p.m. Monday-Friday (Central Time)

All systems and components include a one-year warranty and 30-day money-back guarantee.
Price reflects cash or credit card payment. Major corporation purchase orders accepted.

Circle 201 on Inquiry Card (RESELLERS: 202).

World Radio History

Making The Best Better



BayTech brings a new level of quality, performance and affordability to the printer sharing market. BayTech's new products are designed to give you high speed performance never before seen in printer sharing products.

A Complete Product Line

BayTech is the only printer sharing company you will ever need. Our expandable products give you the ability to increase users in an application without completely changing hardware. Our stand-alone products feature 4, 6, 8 and 10 port models with a variety of serial and parallel port combinations. Our plug-in products allow you to easily connect multiple computers to your HP printers. And now, our *NEW* Network Print Server will give you the performance, quality and affordability you expect from BayTech products.

Take the BayTech Challenge

Product Highlights

- *High speed printing 66,000 cps parallel, 46,000 cps serial*
- *Long distance printing to 1000 ft.*
- *4 to 24 port units*
- *Plug-in printer sharing*
- *Modem sharing*
- *Network print servers*
- *Buffers from 256KB to 16MB*
- *Made in the USA*
- *Toll-free technical support*

All product or company names are trademarks of their respective holders.

BayTech *CHALLENGES* you to try our products for 30 days. If you are not completely satisfied we will refund your money 100%, no questions asked.

High Speed Printer Sharing
Parallel/Serial Converters
Statistical Multiplexers
Data Acquisition Controllers
Network Print Servers

Because Resources Should Be Shared

BayTech

Data Communications Products Division
200 N. 2nd St., PO Box 387, Bay St. Louis, MS 39520
Fax: 601-467-4551 Phone: 601-467-8231 or toll-free

800-523-2702

Circle 183 on Inquiry Card (RESELLERS: 184).

World Radio History

MEMORY !! MEMORY !! MEMORY !!

ACER 486sx - 16MB SIMM (4M X 36)	$ 529.00
32MB SIMM (8M X 36)	$ 1,599.00
AMI EZ-FLEX - 64MB KIT (4 SIMMS)	$ 2,799.00
AMIGA 2000 - 16MB SIMM	$ 469.00
AST BRAVO 486LC - 16MB SIMM	$ 469.00
COMPAQ SystemPro - 32MB MODULE	$ 1,199.00
DELL 486's - 16MB KIT (2 SIMMS)	$ 538.00
32MB KIT (2 SIMMS)	$ 1,088.00
MAC IIfx - 16MB SIMM	$ 479.00
MAC QUADRA 950 - 16MB SIMM	$ 469.00
MAC IIci,IIcx,IIsi,QUADRA 900 - 16MB SIMM	$ 469.00
MAC QUADRA 700 & SE/30 - 16MB SIMM	$ 529.00
NeXT TURBO - 16MB SIMM	$ 469.00
SUN IPX,ELC - 16MB SIMM	$ 499.00
SUN SPARC SERVER - 256MB KIT	CALL

OTHER MEMORIES AVAILABLE...

IBM

PS/1 - 2MB	$ 68
4MB	$ 149
M30 - 2MB	$ 79
M50Z,55sx,65sx,70 - 1MB	*$ 45*
2MB	*$ 79*
M55sx,65sx,70 - 4MB	*$ 135*
M70-A21,A61,121 - 2MB	$ 79
M40sx,35sx - 8MB	$ 269
M57sx,90,95 - 4MB	$ 135
8MB	$ 269
M80-041 - 1MB	$ 65
M80-111,121,311 - 2MB	$ 99
M80-A21,A31 - 4MB	$ 180
16-BIT 0K Exp Board	$ 128
32-BIT 0K Exp Board	$ 128

AST

PREM. 386/20C - 1MB KIT	$ 65
PREM. 386/25 - 1MB	$ 45
PREM. 486/25 - 1MB	$ 45
PREM. II 486 - 1MB	*$ 41*
4MB	*$ 139*
8MB KIT	*$ 278*
PREM. II 1MB Exp Board	$ 469

COMPAQ

DP 386/20,20E,25 - 1MB	$ 66
4MB	$ 159
DP 386S/16 - 1MB	$ 66
4MB	$ 159
DP 286N,386N,S/20 - 4MB	$ 135
M-SYSTEMS - 2MB	*$ 79*
4MB	*$ 135*
8MB	*$ 299*
DP 386/33,486/25 - 2MB	$ 96
SystemPro - 8MB	$ 269
0K Exp Brd	$ 335
DP 386S/16 1MB Exp Brd	$ 105
DP 386/20,20E,25,25E 1MB Exp. Board	$ 105

DELL

325D,P;333D,P - 1MB	$ 41
4MB	$ 135
420,425,433 - 2MB KIT	$ 82
4MB KIT	$ 158
8MB KIT	$ 270
450DE,450SE - 2MB KIT	$ 82
4MB KIT	$ 158
8MB KIT	$ 270

HP

Vectra QS-16 - 2MB KIT	$ 129
4MB KIT	$ 229
Vectra 486 - 2MB	$ 79
4MB	$ 135
8MB	$ 269
X-Station 700 Ser. - 2MB	$ 89
4MB	$ 149
8MB	$ 299
9000/400t,425t - 8MB KIT	$ 495
16MB KIT	$ 999
32MB KIT	$1869
9000/425e - 8MB KIT	$ 428
16MB KIT	$ 828

APPLE

II,SE,SE/30 - 1MB	$ 32
Classic - 1MB Exp. Board	$ 54
SE/30,IIci,IIcx,IIsi,LC & Quad. 700,900 - 4MB	$ 115
Quad. 700,900 - 32MB KIT	$1120
IIfx - 16MB KIT	*$ 499*
IIfx - 32MB KIT	$1156
Quadra 256K V-RAM	$ 27
LC 512K V-RAM	$ 44

LAPTOPS

AST EXEC. NB - 4MB	$ 119
COMPAQ LTE386 - 4MB	$ 209
SLT386 - 4MB	$ 168
DELL 316,320 LT - 2MB	$ 99
EVEREX TEMPO - 2MB	$ 78
IBM L40sx - 4MB	$ 135
MAC POWERBOOK - 2MB	*$ 104*
NEC P.S. 286,386sx - 4MB	$ 200
P.S. 386 - 8MB	$ 429
P.S. SX/20 - 4MB	$ 200
PANASONIC CF170 - 1MB	$ 55
T.I. TRVL-MT 3000 - 2MB	$ 80
TOSHIBA 1000 - 2MB	$ 108
2000SXE - 8MB	$ 388
3200SXC - 4MB	$ 160
5200 - 8MB	$ 315

PRINTERS

EPSON 6000 - 4MB	$ 229
HP IIP,III,IIID,P - 2MB	*$ 108*
IIIsi - 4MB	*$ 135*
IBM 4019,4029e - 3.5MB	$ 129
4029 - 4MB	$ 135
OKIDATA 400 - 2MB	$ 129

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

OTHER MEMORIES FOR:
ACER, ALTIMA, APPLE, AST, CHAPLET, COMPAQ, DELL, EPSON, EVEREX, HP, LEADING EDGE, IBM, NEC, NCR, OKIDATA, PACKARD-BELL, PANASONIC, PHILIP, SAMPO, SHARP, SILICON GRAPHICS, SUN MICROSYSTEMS, TANDON, TI, TOSHIBA, TULIP AND ZENITH.

CALL FOR OUR COMPLETE CATALOG

CitiTronics Inc.

TERMS: C.O.D. CASH, VISA OR MASTERCARD.
COMPANY AND UNIVERSITY P.O.'S ACCEPTED UPON CREDIT APPROVAL.

414 CLOVERLEAF DR., UNIT B, BALDWIN PARK, CA 91706

TEL. (818)855-5688 FAX (818)855-5687

ALL PRODUCT NAMES, TRADEMARKS AND REGISTERED TRADEMARKS ARE THE PROPERTY OF THEIR REPSECTIVE COMPANIES.

Circle 200 on Inquiry Card.

World Radio History

MEMORY AND MORE...

30 day Money Back Guarantee
Buy with confidence!

Personal Computer Memory

IBM

PS/1 286, 386SX
2MB 92F9955 ..... $79 4MB 92F9694 ..... $149
PS/1 Consultant , Essential & Expert models x43, x44 & PS/Valuepoint all models except Cxx series
4MB P/N NA ..... $159 16MB P/N NA $579
PS/1 Consultant , Essential & Expert models x76
16MB Kit P/N NA $579
PS/2 25/286, 30/286, & memory adapter 1497259
2MB Kit 30F5360 ..... $79
PS/2 35SX; LS, 40SX, 50Z, 55SX; LS, 65SX; LS, 70, & XStation
1MB 6450603 or 90X8624 ..... $49
2MB 6450604 or 90X8625 ..... $75
PS/2 70-A21; A61; B21; B61, PS/1 Consultant , Essential & Expert models x11, x15 & x16, PS/Valuepoint Cxx series
2MB 6450608 ..... $75
PS/2 35SX; LS, 40SX, 55SX; LS, 65SX; LS, XStation, PS/Valuepoint Cxx series & adapter board 34F3011 or 34F3077
4MB 34F2933 or 87F9977 ..... $149
PS/2 55SX; LS, 40SX, PS/Valuepoint Cxx series
8MB 6450129 ..... $289
PS/2 90 XP, 95 XP, P75 (pairs), 56, 57 (all), PS/1 Pro 2123
2MB 6450902 ..... $79
PS/2 90, 95 XP, P75 (pairs), 56, 57 (all), PS/1 Consultant , Essential, Expert x11, x15 & x16, PS/1 Pro 2123, P5/6000
4MB 6450128 ..... $149 8MB 6450150 ..... $289
Expansion boards for 50, 50Z, 55SX, 60, 65SX
2-8MB w/2MB 1497259 ..... $269
Expansion boards for all models 70 & 80
2-16MB w/2MB 34F3077 ..... $329

NEC

PowerMate 286/12; SX/16 & SX/20
2MB Kit OP-410-8103 ..... $79
PowerMate SX/20
2MB CPU Upgrade OP-410-8101 ..... $169
2MB Exp. Board OP-410-8102+8105 ..... $209
PowerMate 386/33E & 486/25E
2MB OP-410-S101 ..... $189

Hewlett-Packard

Vectra 386/16N, 386/20N, 386/25N PC
2MB D2406A $99
8MB D2404A $319
Vectra 486PC; 25T; 33T; 486s/20; 486/25N; 33N; 50N; 66N
2MB D2381A ..... $89 8MB D2152A $299
4MB D2151A or D2156A $149
Vectra 386/25; 486/25U; 486/33U; 486/50U; 486/66U
2MB D2381A ..... $89 8MB 02152A $299
Vectra 486/25N; 486/33N; 486/50N; 486/66N
16MB D2676A $579

Compaq

ProLinea 3/25s; 3/25zs
2MB 141738-001 .... $89 8MB 141742-001 ... $289
ProLinea 4/25s, 4/33, 4/50
1MB 141682-001 .... $49 2MB 141683-001 .... $89
4MB 141684-001 .. $159 8MB 141685-001 .. $299
DeskPro 386-20, 20e & 25
4MB 115152-001 ..... $169
DeskPro 386s/16
4MB 112534-001 ..... $169
DeskPro 286N; 386N; I Series; 386SX/20; 20N; Portable 486c; M Series expansion boards; SystemPro LT Series
1MB 118688-001 .... $49 2MB 118689-001 .... $79
4MB 118690-001 .. $149 8MB 112877-001 ... $299
DeskPro 386-33; 486-33 & SystemPro
2MB 115144-001 .... $99 8MB 116561-001 ... $289
DeskPro 386M, 486M, SystemPro LT (32-Bit Exp. board)
2-64MB w/2M 129160-001 ..... $359
DeskPro 386/33L, 486/33L, SystemPro
6 Socket Brd w/2MB 116569 + 115144-001 ..... $589

DELL

Power Desktop 325D & P, 333D & P, 433P, 486P & 486D
1MB 310-2505 ..... $59
4MB 310-2507 ..... $149
PowerLine Workstation 420; 25; 33; 50; 450DE/2 & 466DE
2MB 310-2466 ..... $119 4MB 310-2467 ..... $179
8MB 310-2468 ..... $319 16MB 310-2469 ..... $599

Zenith

2-300/400 Series Z-420/SX, Z-425/SX, Z-433/DX, Z-433/SX
4MB ME-100 ..... $159 16MB ME-90 ..... $599
Z-Server 425SE, 433DE, 450DE
4MB ME-432 ..... $179 8MB ME-102 ..... $319
16MB ME-442 ..... $599 32MB ME-92 ..... $1179
Z-Station 325Sn, 420SEh; Sh; Sn, 425Sh, 433Deh; Dh,SOXEn
1MB ME-70 ..... $49 4MB ME-100 ..... $149
Zenith Z-386/20; 25; 33 & 33E
1MB ZA3800ME ..... $49 4MB ZA3800MK $149
Zenith Z-386SX/20, 286LP+, Z-LS
2MB Kit Z-605-1 ..... $89
Zenith 486/33ET; 25E
4MB ZA4200M2 ..... $179 16MB ZA4200M8 ..... $599

AST

Bravo 386-SX, WS/286, 386
2MB 500510-002 .... $89 4MB 500510-008 .. $179
Bravo 3/25s
2MB 500710-004 .... $99 8MB 500824-002 .. $319
Bravo 3/33s
2MB 500962-001 .... $75 8MB 500962-002 .. $359
Bravo LC 4/25s, 4/33, 4/33s, 4/50d, 4/66d
4MB 500987-002 .. $159 8MB 500987-003 .. $259
16MB 500987-004 . $499 32MB 500987-005 .. $999
Premium 386/25; 33; 33T, Premium II 386SX/16; 20; 25
1MB w/WPB 500780-003; 002 ..... $59
Bravo 4/33; 486/25; Premium 4/25; 33TE, Server SE 4/33
2MB w/WPB 500718-004; 780-005 ..... $109
Power Premium 3/33, 4/33, 4/33s, 4/50d, 4/66d, Premium 386/33TE, 486/25, 25E, 25TE, 33, 33E, 33TE, Prem. II 3/25, 33, 486/33, 486SX/20 & Server SE 4/33
4MB 500780-004 .. $145 8MB 500780-001 .. $289

DEC

DECstation 3 series SX; C; Plus; & 425c
2MB PC4XM-CB $99
DECpc 400ST series
4MB PCTAM-CC ..... $189 8MB PCTAM-CD $299

We also stock memory for most discontinued systems!

Kingston TECHNOLOGY CORPORATION

386 & 486 Processor Upgrades

CPU Upgrades (CPU socket) from 286 to 386SX
25MHz SX/Now! ..... $199 33MHz SX/Now! $249
Add a math coprocessor for $75
From 386 to 486
25MHz 486SX/Now! ..... $429 33MHz 486DX/Now! . $659
MicroMaster Upgrades (expansion slot)
From 286 & 386 to 486
25MHz 486SX MicroMaster $829
33MHz 486DX MicroMaster $1299
MicroMaster with 32-bit 70ns Memory
25MHz 486SX w/4MB $999
w/8MB ..... $1179 w/16MB $1519
33MHz 486DX w/4MB $1439
w/8MB ..... $1619 w/16MB $1959

Megahertz CORPORATION

Laptop & Notebook Fax/Modems

for AST, Compaq, IBM, Sharp, TI, Toshiba, Zenith and many other Laptop & Notebook Systems

PCMCIA 2.0 FAX/Modems with XJACK
19,000bps FAX/Modem, Cellular, Autosync ..... $Call
24/9600bps FAX/Modem ..... $Call
Internal FAX/Modems w/MNP-5 & V.42/V.42bis
14,000bps FAX/Modem, Cellular, Autosync $529
96/9600bps FAX/Modem $489
28/9600bps FAX/Modem $229
2400bps Modem $149
External Pocket Modems for any RS-232 Serial Port
14,000bps FAX/Modem, Cellular, Autosync $379
9600bps FAX/Modem $309
24/9600bps FAX/Modem $189

Laptop & Notebook Memory

AST

PowerExec 3/25SL, 3/25SL-C 4MB $179
16MB $1299
Premium Exec 386SX/25, 25C 1MB $69
4MB $129

Compaq

Contura 3/20, 3/25 & 25c 4MB $169
8MB $319
LTE 286 2MB $99
4MB $199
LTE 386s/20 4MB $199
LTE Lite 20; 25; 25c 2MB $139
4MB $219
SLT 286 1MB $99
4MB $279
SLT 386s/20 1MB $89
4MB $199

IBM

ThinkPad 300 2MB $159
8MB $429
PS/2 CL57SX & ThinkPad 700; 700C 4MB $219
8MB $369
N51 Notebook (All) 2MB $179
4MB $249
L40SX & N33SX Laptop 4MB $135
L40SX 8MB $285

NEC

UltraLite & Cellular Workstation 286F 1MB $139
4MB $369
UltraLite & Cellular Workstation SX/20 2MB $179
8MB $599
UltraLite III, SL/25C 2MB $119
4MB $199
UltraLite SL/20, SL/20P 2MB $119
6MB $269
ProSpeed 286, 386SX/16 1MB $109
4MB $209
ProSpeed 386 2MB $149

Panasonic

CF-170, CF-270, CF-370 1MB $54

Texas Instruments

TravelMate 2000 1MB $89
TravelMate 3000, WinSX 2MB $79
TravelMate 4000 4MB $199

Toshiba

T1000SE/LE/XE; 2000; 2000SX/SXe; 2MB $85
T2200 & T1800 Satellite Series 4MB $159
8MB $299
T1200XE, 1600, & 3100E 2MB $85
T3100SX, 3200SX, & SXC Portables 2MB $85
4MB $149
T3200 5MB $149
T3300SL Notebook 2MB $119
4MB $179
T4400 & T6400, SX, SXC Notebook 2MB $129
4MB $179
8MB $349
T5100 2MB $89
T5200; T5200C & T8500 2MB $92
8MB $279

Zenith

Z-Note Notebook (all models) 2MB $159
8MB $369
Z-Sport 325S 2-6MB $139
Z-Sport 4205 & 425S 4MB $189
MastersPort 386SL, SLC, SLe 2MB $99
MastersPort 386SX 2MB $109
SupersPort SX, 286e; SlimsPort 2MB $139
SupersPort 286e; SlimsPort 4MB $279

Grid

1450sx 2MB $149

Magnavox or Packard Bell

286 & 386SX Notebook 4MB $179

Sharp

PC-6220 Notebook 1MB $109

Sanyo or Zeos

Notebook Memory 2MB $79

Everex

Tempo LX Notebook 2MB $79
Tempo Carrier Notebook 2MB $119

Laser Printer Memory

Compaq PAGEMARQ 15 & 20
8MB 126361-001 ... $529 16MB 126361-001 .. $649
Hewlett Packard LaserJet IIISi, 4, 4M & XL300
4MB C2065A ..... $149 8MB C2066A $299
Hewlett-Packard LaserJet IIP, III, IIIP, IIID
2MB 33475B ..... $95 4MB 33477B $159
Hewlett-Packard LaserJet II & IID
2MB 33444B ..... $102 4MB 33445B $160
Hewlett Packard DeskJet 500, 500C
256K 2270078 ..... $59
IBM Laser 4029 All Models
4MB 1183335 ..... $129
Canon LBP-4, 4Lite, 4Plus
1MB S63-2250 ..... $119 2MB N/A $169
Canon LBP-III & BIII Plus
2MB S63-2350 ..... $249 5MB S63-2360 ..... $299
Panasonic 4410 & 4430
2MB KX-P441 ..... $109 4MB N/A $179
Panasonic 4450I & 4420
2MB KX-P441 ..... $109 4MB N/A $179
OkiLaser 400
1MB 70014701 ..... $79 2MB OKI N/A $99
Texas Instruments MicroLaser & XL
1MB 2555739-0001 ..... $49
Epson EPL 6000
2MB IBS401 ..... $99 4MB N/A $169
Epson ActionLaser II, EPL-8000
2MB N/A ..... $149 4MB N/A $259

Expansion Boards

BOCA RESEARCH INC

Memory Boards for any 286 or 386!

Bocaram AT Plus 2-8MB memory board for 80286 & 80386 IBM compatible machines running up to 33MHz. Get conventional, exp. (LIM EMS 4.0) and/or ext. memory, OS/2.
Including 2MB ..... $169 Including 4MB $229
Including 6MB ..... $299 Including 8MB $369

Memory I/O Boards

Bocaram AT I/O Plus 2-4MB memory board, same as AT Plus with 1 serial and 1 parallel port. Uses 1M x 1 DRAM chips.
Including 2MB ..... $199 Including 4MB $279

First Source International

"The Only Source for Computer Upgrades"

- 30 Day Money Back Guarantee
- 100% compatible in form, fit, and function
- All products user installable
- Installation instructions included
- Toll-free technical support
- Thousands of items in stock
- Manufacturer's warranties
- Corporate PO's, APO/FPO's welcome
- Government & Educational pricing
- International orders welcome
- Special volume pricing
- 24-hour fax line

FEDERAL EXPRESS

- Same day shipping
- Overnight delivery available

VISA MasterCard DISCOVER AMERICAN EXPRESS Card

- Visa, MC, AMEX, and Discover accepted
- No surcharge on credit cards
- Call for any items not listed
- We'll meet or beat any advertised price

Toll free from anywhere in the United States or Canada
800/531-9866

International
714/588-9866

Facsimile
714/588-9872

Business Hours
Monday-Friday, 8am-5pm
Saturday, 8am-2pm, P.S.T.

NEW SATURDAY

The Only Source First SOURCE International For Computer Upgrades

Mail orders to:
First Source International, Inc.
36 Argonaut, Suite 140
Aliso Viejo, California 92656 USA

Terms and Conditions: Memory products are third party, manufacturer's numbers are for your convenience. First Source International will refund 100% of the sales price of the product if notified within 30 days of the invoice date. Freight charges are non-refundable. A Return Merchandise Authorization (RMA) number is required for all returns. Items must be returned within 30 days of the invoice date with orginal documentation and packaging. All non-defective returns, unopened, refused, or cancelled orders, and items returned after 30 days of the invoice date will be subject to a 20% restocking fee. Prices and availability are subject to change without notice. Purchase prices at the time or order are final. First Source International cannot be responsible for errors in typography or photography. We will beat any advertised price valid only on identical brands, offer not good for SIMMs or DRAM. Trademarks and registered trademarks are of their respective companies.

CALL THE UPGRADE EXPERTS TOLL FREE 800/531-9866

A0493

Circle 191 on Inquiry Card (RESELLERS: 192).

World Radio History

We Carry

ALPS · ATI · BASF · brother · Canon · CENTRONICS · CITIZEN · COMMER · CREATIVE LABS INC. · CURTIS · Dataproducts · DIGITAL · Dysan · EPSON · EXABYTE · FACIT · FUJITSU · GRAHAM MAGNETICS · GENICOM · Genius · HEWLETT PACKARD · IBM · IOMEGA · KYOCERA · 3M · M. TALLY · maxell · MICROSOFT · Nashua · NEC · OCLI · OKIDATA · olivetti · OLYMPIA · OTC · PACIFIC DATA · Panasonic · Polaroid · QMS · QuickShot · Qume · RICOH · Seagate · SEIKOSHA · SMITH CORONA · SONY · star · SYQUEST · TDK · TEAC · Tektronix · TEXAS INSTRUMENTS · TOSHIBA · TRIPPLITE · Verbatim · WANG

and many more OEM supplies!

ALL LOGOS ARE THE PROPERTY OF THEIR RESPECTIVE COMPANIES.

P.O.S./ATM SUPPLIES
RIBBONS, ROLLERS AND OTHER CHECK PROCESSING SUPPLIES FOR DIEBOLD, IBM, ICL, TEC, EPSON, OMRON, SWEDA AND NCR. (TO QUOTE PRICES, WE NEED PART NUMBERS)

ATTENTION !!!
WHOLESALE DEALERS & VOLUME BUYERS SAVE $$$

DISKETTES

DESCRIPTION	TDK	BASF	MAXELL	3M
5¼" DS/DD	$ 2.75	3.35	3.55	3.75
5¼" DS/HD	4.95	5.35	5.65	5.95
3½" DS/DD	4.35	5.35	5.65	5.85
3½" DS/HD	6.95	8.55	8.75	9.35

FORMATTED

BULK DISKS

5¼" DS/DD	$ 0.20
5¼" DS/HD	0.29
3½" DS/DD	0.34
3½" DS/HD	0.53

(Above Inc. Sleeves & Tabs)

DATA CARTRIDGES

DESCRIPTION	3M	MAXELL	DYSAN
DC-2120	$ 13.95	12.95	11.95
DC-6150	15.25	13.95	12.95
DC-6250	20.95	17.95	16.95
DC-6525	24.95	21.95	19.95

STREAMER CASSETTES

MAXELL		TEAC	
CS-600 HO	$ 11.25	60 MB	CT-600H $ 11.75
CS-600 XO	12.25	150 MB	CT-600N 16.75
CS-600 SX	19.25	600 MB	CT-600F 23.75

4 MM & 8 MM CARTRIDGES

DESCRIPTION	TDK	SONY	EXABYTE
4MM 60 Meter	$ 6.75	8.95	—
4MM 90 Meter	8.75	10.95	Call
8MM 112 Meter	6.75	10.25	12.25

OPTICAL DISKS

DESCRIPTION	MAXELL	BASF	SONY
3½" 512/128 MB	$ 36.00	37.00	39.00
5¼" 512/600 MB	76.00	83.00	89.00
5¼" 1024/650 MB	76.00	83.00	89.00

HEWLETT PACKARD

INK JETS		TRANSPARENCY/PAPER	
HP51604A	$ 7.65	HP51630Z	14.95
HP51606A	19.65	HP51630S	42.95
HP51606C	22.65	HP51636G	36.95
HP51625A	22.65	HP92261K	48.95
HP51626A	20.65	HP17703T	34.95
LASER TONERS		**RIBBONS**	
HP92275A	$ 54.95	HP92151H	4.25
HP92285A	69.95	HP92155A	12.25
HP92291A	96.95	HP92155L	13.95
HP92295A	68.95	HP92156S	8.45
HP92298A	89.95	HP92154B	109.00

We carry a complete line of HP Products
Please call for the lowest prices.

PANASONIC

KX-P115	RIBBON	$ 6.59
KX-P140	RIBBON	8.59
KX-P4450	TONER KIT	25.99
KX-P4450	DRUM KIT	105.99

(CALL FOR OTHER PANASONIC ITEMS)

RICOH

TONER 6000 +	$ 12.95
TONER 80 PLUS	27.95
TONER 150 PLUS	27.95
OPC KIT 80	96.95
OPC KIT 81	96.95
OPC KIT 150	93.95

KYOCERA

TONER	$ 25.00
DEVELOPER	106.00
DRUM	111.00
FUSER	156.00

DIGITAL

LN03X-AC TONER KIT	$ 32.75
LN03X-AD OPC KIT	104.75
TK-50 TAPE CARTRIDGE	16.75
TK-70 TAPE CARTRIDGE	26.75
TK-85 TAPE CARTRIDGE	27.75
RA60-P DISK PACK	595.00

Dec Ribbons & other supplies
Please call for the lowest prices.

IOMEGA

3.5" FLOPTICAL DISK 21 MB	$ 17.00
OPTICAL DISKS 512/1024	194.00
44 MB GOLD BERNOULLI CART	83.00
90 MB GOLD BERNOULLI CART	124.00

SyQUEST (5-year warranty)

10MB DISK CARTRIDGE	$ 114.00
44MB DISK CARTRIDGE	62.00
88MB DISK CARTRIDGE	93.00

CANON

BC-01	INK CARTRIDGE	$ 15.95
BJI-481	INK CARTRIDGE	10.95
BJI 642	INK CARTRIDGE	14.95
BJ-10e	PRINTER	249.00
BJ-20	PRINTER	369.00
BJ-300	PRINTER	439.00
BJ-330	PRINTER	559.00

KODAK

MICRO GRAPHICS FILM

DACO-DL FILM 105 X 125M	$ 218.00
THERMAL PRINT FILM 16MM X 2000'	16.50
DACOMATIC FILM 16MM X 170M	57.30
THERMAL FILM 16MM X 1000'	8.70
THERMAL FILM 105 X 1500'	84.00
IMAGELINK 16MM X 100'	5.80
IMAGELINK 16MM X 215'	10.80
IMAGELINK FS 16MM X 100'	6.00
IMAGELINK FS 16MM X 215'	11.60
IMAGELINK FS 16MM X 1025'	32.70

(QUANTITY DISCOUNTS AVAILABLE)

QuickShot

COMPATIBLES - CONTROLLERS, GAMING/ POINTING DEVICES

SUPER NINTENDO (16-BIT) CONTR.

SUPERCON 2	$ 9.65
SUPERCON 2B	8.05
INVADER 2	11.25
CONQUEROR 2	23.45
MAVERICK 2B	11.05

SEGA GENESIS (16-BIT) CONTR.

PYTHON 3	9.65
INTRUDER 3	18.75
AVIATOR 3	24.05
MAVERICK 3	10.75
STARFIGHTER 3	9.65
STARFIGHTER 3B	8.05
INVADER 3	10.95
CONQUEROR 3	22.95

IBM PC/XT/AT/386/486 CONTR. AND GAMING DEVICES

WARRIOR 5	8.05
WARRIOR 5 PLUS	8.65
WARRIOR 6	10.75
INTRUDER 5	18.75
AVIATOR 5	24.05
SMART GAME CARD	13.35
RAIDER 5	10.75
GAME KIT	25.15
STRAFIGHTER 5	8.05

IBM PC/XT/AT/386/486 POINTING DEVICE

QUICKTRAC 100	15.65
MOUSE 150	9.75
DUOMOUSE	10.55
SOLEPOINTER	26.25

Genius

CLIXes - ERGONOMIC STREAMLINE MOUSE 350-4200 DPI	$ 12.75
MouseOne SERIAL - STARTER MOUSE, 350-1050 DPI	9.95
MouseOne PS/2 STARTER MOUSE, 350-1050 DPI	10.25
MouseToo Serial & PS/2 - SMARTER MOUSE, 350-1050 DPI	24.25
HiTrak - SPACE SAVER MOUSE, 350-1050 DPI	38.85
GS-4500A FOR WINDOWS - BLACK & WHITE HAND HELD SCANNER, 100-400 DPI	84.25
GS-B105A FOR WINDOWS - 256 GRAYSCALE HAND HELD SCANNER, 100-400 DPI	139.00
GS-C105 FOR WINDOWS COLOR HAND SCANNER, 100-400 DPI	270.00
GS-FC60 FLATBED COLOR SCANNER, 600 DPI	897.00
HiPen - PEN COMPUTING PINPOINT PRECISION TABLET, 9"X6"	188.00
HiSketch 1212 - HIGH PRECISION DIGITIZING TABLET, 12" X 12"	215.00
HiSketch 1812 - ULTIMATE IN PRECISION FOR PROFESSIONAL USERS, 18" X 12"	293.00

STARTECH *International*
COMPUTER SUPPLIES

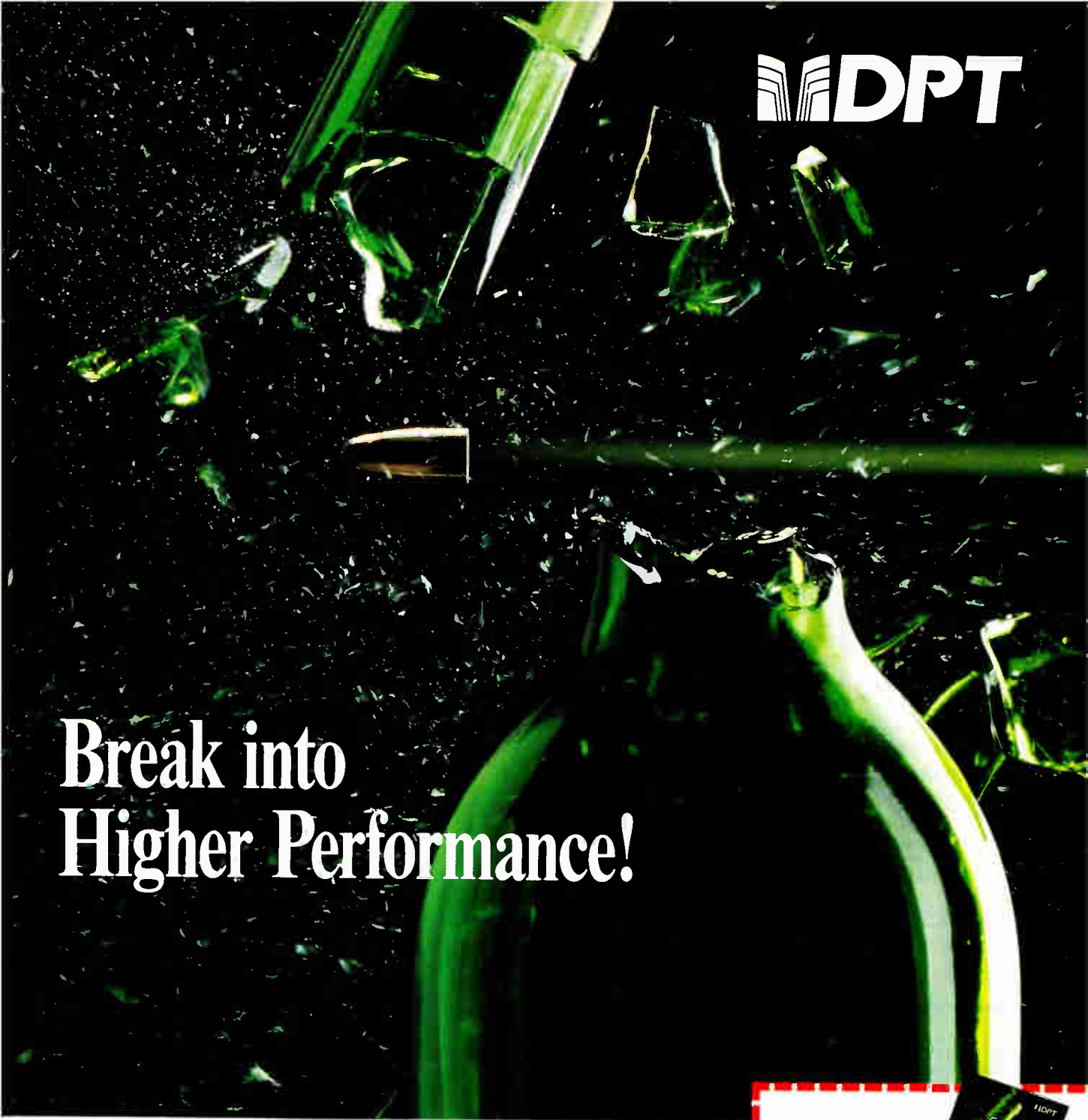
5575 Magnatron Blvd., Suite G
San Diego, CA 92111 USA

TEL: 619-278-2600
FAX: 619-278-2780
TLX: 415779
ANS: STARTECH

WE BEAT ANY PRICE!!

TERMS: C.O.D., BANK DRAFT, WIRE TRANSFER OR L/C AT SIGHT. P.O.'s ACCEPTED FROM RECOGNIZED INSTITUTIONS ON NET 30 DAYS. MINIMUM ORDER $3000.00. PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE. WE CANNOT BE RESPONSIBLE FOR TYPOGRAPHICAL ERRORS.

World Radio History



SmartCache Plus is the SCSI controller that delivers higher performance without a higher price!

Windows, Netware, Unix and other high-end applications need a SCSI controller that delivers top disk I/O performance and a growth path. Only SmartCache Plus delivers both – and costs no more than less advanced controllers!

As the industry's fastest SCSI controller, SmartCache Plus is the easy choice. It's the smart choice, too – because if your system needs a performance boost, you can transform it from a non-caching host adapter into the world's fastest *caching* controller! Expandability is so simple: plug-on modules add caching, up to a total of 16MB of cache memory, and disk mirroring!

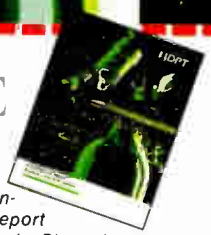
SmartCache Plus is supported by all major operating systems and applications, and provides connectivity to hundreds of SCSI devices. Reliable, scalable and simple to install, SmartCache Plus breaks your system's disk I/O bottleneck without breaking your budget!

All trademarks are the property of their respective owners.

Distributed Processing Technology
140 Candace Drive, Maitland, FL 32751 USA

Circle 189 on Inquiry Card (RESELLERS: 190).

World Radio History



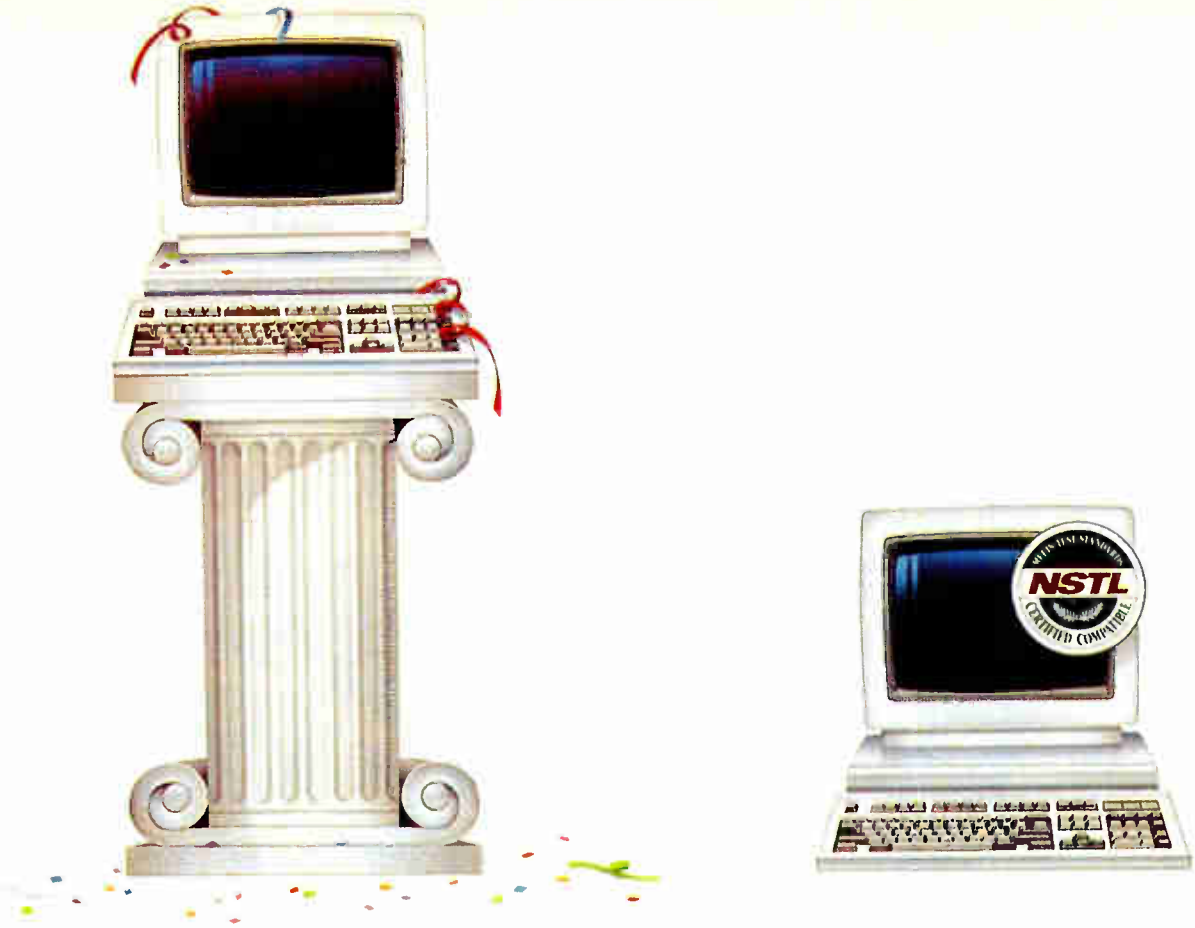
GET THE FACTS!

This free comprehensive Performance Report details the SmartCache Plus advantage over its leading competitor in nine different benchmarks for DOS 5.0, Netware 3.11 and Unix applications. For your copy, contact DPT Channel Marketing today...

TEL. 1-800-322-4DPT

FAX 407-260-5366

1993 SCSI CONFERENCE
MAY 12-14 ▪ CALL FOR DETAILS!



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 113 on Inquiry Card.

World Radio History

MEMORY ...
YOU JUST CAN'T DO WITHOUT IT.

Picture this:

You bought a new software package. You try it out on your computer and soon find yourself working for hours on a sophisticated graphic design. While scrolling through your worksheet, it feels like you are moving through pudding. Your hard disk has a tough time trying to catch up. You then try to print, but the laser printer's buffer is full. You reset it, try again, and find that it spits out only part of your beautiful graphic...

No problem!

We'll take it from here. With our **JetRam™** line that supports the leading brands of laser printers and **PcRam™** line that upgrades your Notebook, Laptop or Desktop computers, Transcend can help solve your memory problems.

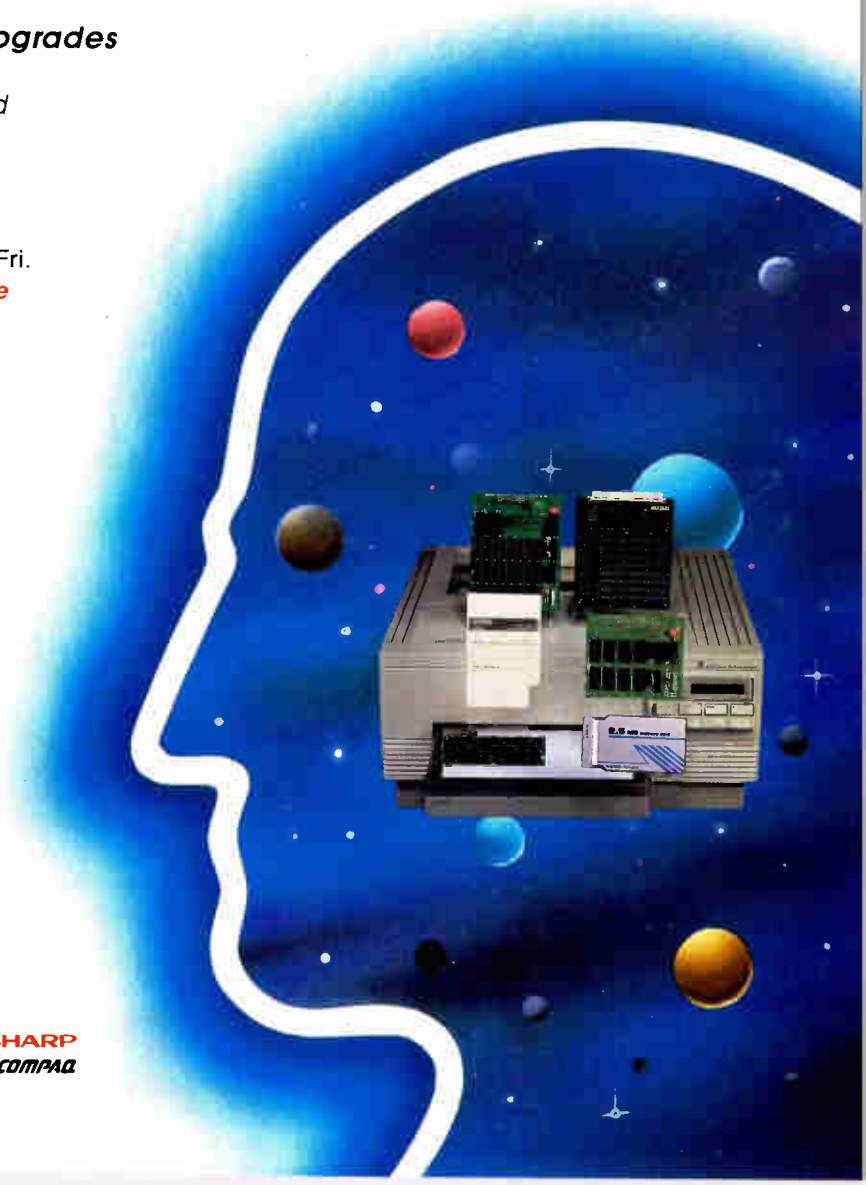
What you get from our memory upgrades

- *Life time warranty on all our products*
- *Full memory lines support a variety of brand names of laser printers and PCs*
- *High quality at a reasonable price*
- *Easy-to-install*

Office hours: 6:00 a.m. to 6:00 p.m. Mon. to Fri.

"You order in the morning, we will ship in the afternoon."

See us at CeBit Show '93
Booth no. Hall 6 Stand A59



HEWLETT PACKARD IBM EPSON Panasonic NEC SHARP
TOSHIBA OKIDATA star QMS COMPAQ
Apple KYOCERA brother TEXAS INSTRUMENTS

* All brand names are registered trademarks of their respective owners.

Transcend

Your Supplier, Your Partner, Your Friend.

Transcend Information Inc.

104 Exchange Place,
Pomona, CA 91768 U.S.A.
TEL: (909) 598-5500
FAX: (909) 598-5050, (909) 598-6050

3Fl., No. 465, Chung Hsiao East Road,
Sec. 6, Taipei, Taiwan, R.O.C.
TEL: (886) 2-7881000
FAX: (886) 2-7881919, 7889191

Circle 204 on Inquiry Card.

World Radio History

Speed that Excels

The power, reliability and price of Kaiyo computers make them stand out among other leading computer systems. Thanks to the Local Bus VGA design, Kaiyo offers you the best performance, especially in the CAD and windows environments.

Rated by Chip Magazine of Germany as its January "Tip of the Month", Kaiyo enhances video performance by more than ten-times that of normal VGA display. In utilizing a full 32-bit CPU bus. Kaiyo's local bus design lets VGAs operate at the processor's clock speed. This versatile series includes a comprehensive range of PCs guaranteed to meet the needs of all your customers. It features up to 66 MHz 80486DX2 EISA bus microprocessors so they'll never be at a loss for computer power. Incorporating the most advanced microprocessor technology, Kaiyo has among the smallest, yet most powerful compact desktop computers in the world.

But don't just take our word for it.

Over the years, our Group has established a strong base of over 190 active customers in 46 countries. We're particularly strong in Western Europe, especially Germany. And our sales in Eastern Europe have increased by over 74% over the last year.

Team up with us– long-term business partner that support you every step of the way.

Kaiyo

The Power In PCs

intel inside

"The Intel Logo is a trademark of Intel Corporation" (All brand names are registered trademarks of their respective owner.)

Ocean Office Automation Ltd.

Head Office: Ocean Office Automation Ltd.
4th & 5th Floor, Kader Industrial Building, 22 Kai Cheung Road, Kowloon Bay, Kowloon, Hong Kong.
Tel: (852) 3051800 Telex: 52289 OCCOM HX Fax: (852) 799 2398 (5 lines)

U.S.A. Office: Ocean Information Systems, Inc
12155 Mora Dr. Suite 6, Santa Fe Springs, CA 90670, U.S.A.
Tel: (213) 946 5888 Fax: (213) 946 0929
For US Enquiry—Call Toll Free: 1-800-32-KAIYO (52496)

Circle 207 on Inquiry Card (RESELLERS: 208).

World Radio History

Circle 203 on Inquiry Card.

You Can Rely on Ralin For all Your PC System Upgrades!

MODEM UPGRADES

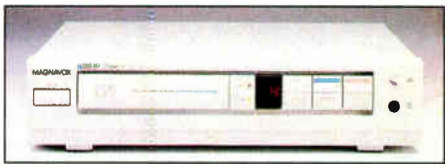
Zoom Telephonics

All Zoom modems are backed by a 7-year warranty and are made in the USA.

2400 bps w/ v.42bis and MNP 2-5	(AMC)	internal	$ 49.00
	(AMX)	external	$ 65.00
2400 bps w/ v.42bis and MNP 2-5 9600 send & 4800 receive Fax	(AFC)	internal	$ 49.95
	(AFX)	external	$ 69.95
9600 bps modem w/ v.32, v.42bis, MNP2-5	(VP-V32)	internal	$188.00
	(VX-V32)	external	$199.00
14,400 bps modem w/ v.32bis, v.32, v.42bis, MNP 2-5 and 9600 bps send/receive Fax	(VFP-V32bis*)	internal	$199.95
	(VFX-V32bis*)	external	$249.95
2400 bps modem w/.42 bis and MNP 2-5, 9600 bps send and 4800 bps receive Fax	PKT Pocket/Fax Modem		$ 89.95

*WINFAX software option available for $15 if purchased with VFP-V32bis or VFX-V32bis modem.

MPC UPGRADES



Philips CDD-462 BK $325.00

- External MPC CD-ROM and CD Audio player.
- Kodak Photo CD compatible
- 680 Meg.

- **Dealer Inquiries Welcome.**
- **Purchase Orders Accepted.**
- **International Orders Welcome.**

Call a corporate sales expert today and find out how Ralin can maximize your purchasing dollars by upgrading your existing computer equipment.
Ralin stocks: • Motherboards • SIMM Memory • Controllers • Printers • Monitors Hard Drives • MPC Products • Computer Cases • Keyboards and much more

CALL FOR A CATALOG TODAY

CALL 1-800-752-9512

Ralin

Ralin Policies

- Prices and availability subject to change.
- Purchase orders are accepted, subject to approval.
- We do not charge your card until order is processed.
- Incomplete returns are subject to a service charge.
- All returns other than exchanged items incur a 10% re-stocking fee.

To insure your shipment arrives when you need it, Ralin uses only the most reputable modes of transportation available:

DHL WORLDWIDE EXPRESS UPS

INTERNATIONAL ORDERS WELCOME

WE ACCEPT: MasterCard VISA

WHOLESALERS, INC.
P.O. Box 450, Orchard Park, NY 14127
Hours: 8:00 am to 6:00 pm Mon-Fri
Customer Service: 716-674-6267
Fax: 716-674-2108

The Most Ergonomic Input Interface TouchPLS® Touch Screen Monitors Make Your Application Systems More Competitive

9", 14", 15", 17" touch screen monitors available now. Contact us for more information.

We specialize in superior quality touch screen monitors, excluding full-set touch screens. Also available are touch screen panels to make assembling easier and more satisfying. OEM, special design requirements are welcome. Contact today.

Features include:

A. Monitor:

- Autoscan digital control color monitor
- Superb display quality
- Full microporcessor control
- Continuous display frequency
- Autoscan
- Elegant appearance
- User friendly operation
- "No screws" mechanism for easy maintenance

B. Touch Screen (Resistive type)

- Reolution: 1024×1024
- Position accuracy: Maximum error of 1%
- Durability: up to 3 million touches
- Operational temperature range: −15°C to 65°C
- Operational Humidity Range: 5% to 96% RH
- Operation system: MS-DOS
- Connector: RS-232
- Software utilities: Windows Mouse Drive/DOS Mouse Drive/ASCII Code Background Drive

Applications: Banking ATM System/Supermarket/Traffic Station/Hotel/ Medical System for hospitals or clinics/CAI/Games/ Real Estate/Multimedia/Design Testing/Postal Service/ Information Service, etc.

OEMs DISTRIBUTORS WELCOME!
CONTACT US YOU COULD WIN THE MARKET

TouchPLS®
The Professional Touch Screen Company
TouchPLS Technology Co., Ltd.
6F-1, No. 21, Sec. 2, An Ho Rd., Taipei, Taiwan, R.O.C. Tel: 886-2-325-3117 Fax: 886-2-704-5621

Circle 213 on Inquiry Card.

World Radio History

Serving you since 1979

JDR Microdevices®

2233 Samaritan Drive, San Jose, CA 95124

BUY WITH CONFIDENCE FROM JDR!
- 30-DAY MONEY BACK GUARANTEE
- 1 YEAR WARRANTY
- TOLL-FREE TECH SUPPORT

UPRIGHT CASE $99.95

- Mounts 3 floppy and 4 hard drives
- Accommodates std. & mini motherboards
- 2 digit LED display

CASE-100A		$99.95
CASE-200A	Super Deluxe Upright	$349.95
PS-250TW	250W p. supply	$129.95
PS-300TW	300W p. supply	$149.95
CASE-130	Mid-upright case	$99.95
CASE-120		$199.95

Mini-upright case w/200W power supply

POWER SUPPLIES

- UL approved
- 110/220VAC, 50/60Hz

PS-150	8088 150 watt	$69.95
PS-200X	8088 200 watt	$89.95
PS-200	286/386/486 200 watt	$89.95
PS-300	286/386/486 300 watt	$149.95

ENHANCED KEYBOARD $49.95

BTC-5339 101/102-key enhanced layout $49.95

NON-INTERLACED 1024 x 768 MONITOR

NEW LOWER PRICE!

VGA-MON-1024N .28 dot pitch $379.95

VGA-MON-17N	1024x768 17" NI, 0.26mm	$999.00
VGA-PKG-1024N	Non-interlaced Super VGA pkg	$469.95
VGA-PKG-1024+	1024x768 interlaced VGA pkg.	$449.95
VGA-PKG	640x480 .39mm dot pitch VGA pkg.	$299.95

2400 BAUD MODEM $49.95

VALUE!

- Internal data modem
- Hayes compatible
- Config. as COM1-COM2

MCT-24I $49.95

14,400 BPS INTERNAL FAX/MODEM

- 14,400/12,000/9600/7200/4800/2400/300
- Hayes AT set, V.42bis/V.42/V.32, Group III fax comp.

VIVA-144IF		$229.95
VIVA-144EF	14,400 baud external version	$299.95
VIVA-96E	9600 baud external modem only	$269.95

FAX/MODEM/PHONE SWITCH

- Save phone line charges!
- Supports fax, modem, phone and answering machine from 1 phone line

FAXM-SWITCH		$89.95
FAX-SWITCH	Without modem connection	$59.95

PORTABLE IC TESTER

- Tests the following 14 to 20-pin devices: 74 series TTL, 40 & 45 series CMOS & 41/44 series DRAM up to 1Mb
- Identifies unknown part numbers

MOD-MIC $149.95

WIRE-WRAP PROTOTYPE CARDS

JDR-PR2	8-bit with I/O decode layout	$29.95
JDR-PR10	16-bit with I/O decode layout	$34.95

SOLDERLESS PROTOTYPE CARDS

PDS-601	8-bit breadboard-on-a-card w/IO decode	$79.95
PDS-611	16-bit version	$89.95

MOTHERBOARDS

MODULAR CIRCUIT TECHNOLOGY

25MHZ 386SX $199.95

NEW LOWER PRICE!

- 25MHz Intel 80386SX CPU • Expandable to 16Mb on-board • Uses 256K, 1M or 4M x 9 80ns SIMMs (0K installed) • Six 16-bit and two 8-bit slots

MCT-M386SX-25		$199.95
MCT-M486-50E	50MHz EISA w/cache	$1195.00
MCT-M486-50	50MHz cache 486	$999.00
MCT-M486-33	33MHz cache 486	$799.00
MCT-M486SX-25	25MHz cache 486SX	$399.95
MCT-C386-40	40MHz cache 386	$379.95
MCT-C386-33	33MHz cache 386	$349.95
MCT-M286-16	16MHz 286	$149.95
MCT-M286-12	12MHz 286	$129.95

16-BIT VGA CARD $49.95

- 8/16-bit 8088 and 286/386/486 compatible
- 640 x 480 in 16 colors 320 x 200 in 256 colors
- 256Kb video RAM

MCT-VGA-1000	....	$49.95
MCT-VGA-4000	1024x768, 1Mb DRAM	$129.95
MCT-VGA-5000	Windows Accelerator	$149.95
SPEEDSTAR-24X	24-bit color, 1280x1024	$169.95
STEALTH-VRAM	Windows acceler., 1280x1024	$229.95

3-BUTTON MOUSE $14.95

VALUE!

- Accuracy 290 -1450 DPI
- Opto-mechanical design
- Windows 3.1 compatible

JDR-MOUSE-3	.....	$14.95
MOUSE-PAD	.....	$4.95

POST CODE DISPLAY CARD

- 286/386/486 compatible
- Displays power on self-test code
- Warns when software won't even boot

PCODE $49.95

EPROM PROGRAMMER $199.95

- Programs devices up to 512K bits, plus 27C100, 27C101, 27C301, 27C1000, 27C1001, 27C2001, 27C4001 and more
- Includes dedicated 8-bit 8088 and 286/386/486 PC compatible card
- ZIF socket accepts 0.6" W DIP IC's to 32 pins

MOD-MEP-1A		$199.95
MOD-MEP-4A	As above with 4 ZIF sockets	$269.95
MOD-EMUP	Universal programmer/tester	$699.00

EPROM ERASER $39.95

- Quickly and simultaneously erases up to 4 standard EPROMs

DATARASE II $39.95

CONNER 120Mb DRIVE PACKAGE $299

NEW LOWER PRICE!

- CP-30104 120Mb, 19ms IDE hard drive, 16-bit floppy/hard disk controller, cables and instructions

HDKIT120 ..... $299.00

IDE HARD DRIVES

PART #	BRAND	CAP.	SPD.	TYPE	PRICE
CP-3000	Conner	42Mb	28ms	3.5" IDE	$159
ST-351A	Seagate	42Mb	28ms	3.5" IDE	$169
CP-30084	Conner	84Mb	19ms	3.5" IDE	$239
ST-3096A	Seagate	88Mb	16ms	3.5" IDE	$259
CP-30104	Conner	120Mb	19ms	3.5" IDE	$279
ST-3144A	Seagate	131Mb	16ms	3.5" IDE	$319
CP-30204	Conner	212Mb	12ms	3.5" IDE	$429

FLOPPY DRIVES

FDD-1.44A	1.44Mb, 3.5", Beige	$79.95
FDD-1.44X	1.44Mb, 3.5", Black	$79.95
FDD-1.2	1.2Mb, 5.25", Beige	$89.95
FDD-360	360Kb, 5.25", Black	$89.95
FDD-2.88A	2.88Mb 3.5" drive, Beige	$149.95
FD-505	5.25" & 3.5" combo drive, Beige	$149.95

MULTI I/O CARD WITH IDE FLOPPY/HARD CONTROL $69.95

- 16-bit 286/386/486 compatible
- Supports 2 IDE hard drives & 2 floppy drives (360Kb-1.44Mb)
- 2 serial, 1 parallel & 1 game port

MCT-IDE1O		$69.95
MCT-IDE1O+	As above w/16550 capatability	$99.95
MCT-IDEFH	16-bit IDE hard/floppy controller	$29.95
MCT-CIDEFH	16-bit IDE CACHE controller	$169.95
MCT-IDE-8	8-bit IDE controller	$79.95
MCT-FDC-HD	1.44Mb floppy controller	$49.95
MCT-FDC-HD4	1.44Mb floppy controller (4 drives)	$59.95
MCT-FDC-ED	2.88Mb intelligent floppy controller	$79.95
MCT-AIO	Serial/parallel/game port card	$49.95
MCT-AIO+	Two NS16550 serial/par/game port	$89.95
GATEKEEPER	PC security card	$49.95
RAMPAT+	8/16-bit 16Mb RAM card (w/0Kb)	$139.95
SOUNDBLASTPRO	8-bit MIDI sound board	$199.95

DYNAMIC RAM

PART #	SIZE	SPEED	TYPE	PRICE
41256-80	256K x 1	80ns	DIP	1.69
414256-80	256K x 4	80ns	DIP	5.49
1M8-80	1M x 1	80ns	DIP	4.99
1M8-60	1M x 1	60ns	DIP	5.49
41256A9B-80	256K x 9	80ns	SIMM	14.95
41256A9B-60	256K x 9	60ns	SIMM	16.95
421000A9B-80	1M x 9	80ns	SIMM	39.95
421000A9B-60	1M x 9	60ns	SIMM	45.95
424000A9B-80	4M x 9	80ns	SIMM	149.95
424000A9B-60	4M x 9	60ns	SIMM	159.95

MATH CO-PROCESSORS intel

PART #	SPEED	PRICE	PART #	SPEED	PRICE
8087-2	8MHz	129.95	80387-SXP	≤ 25MHz	79.95
8087	5MHz	89.95	80387-DXP	≤ 33MHz	89.95
80287-XL	12MHz	89.95	80487-SX	≤ 25MHz	389.95

CALL FOR YOUR FREE JDR CATALOG TODAY!

FOR PC'S, SOFTWARE, MONITORS, DISK DRIVES, KEYBOARDS, MODEMS, CABLES, CONNECTORS, ICS, COMPONENTS, PROGRAMMERS, TEST EQUIPMENT, TOOLS & MORE!

NOW ORDER 24 HOURS A DAY!

800-538-5000

Toll-free Fax Ordering 800-538-5005

Local 408-559-1200

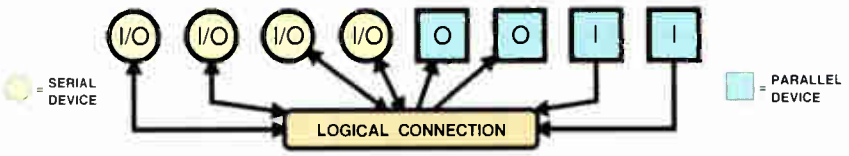
BBS 408-559-0253

TERMS: For shipping & handling include $5.00 for ground & $7.50 for air. Orders over 1 lb. and foreign orders may require additional shipping charges—contact our Sales Dept. for the amount. CA residents must include applicable sales tax. Prices subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturer. All merchandise subject to prior sales. A full copy of our terms is available upon request. Items pictured may only berrepresentative. JDR, the JDR logo, JDR Microdevices, and the MCT logo are registered trademarks of JDR Microdevices, Inc. Modular Circuit Technology is a trademark of JDR Microdevices, Inc. Copyright 1993 JDR MICRODEVICES.

KEY CODE 1040

World Radio History

LOCAL PRINTER SHARING



LCX-1000 1Mb **$495**
4 serial I/O, 57,600 bps
2 parallel in, 2 parallel out

LC-512Kb **$495**
4 serial I/O, 19,200 bps
2 parallel in, 2 parallel out
Many New Features!

LC Jr.-256Kb **$239**
Up to 115,200 bps
4 serial in, 1 parallel out

LC-41PAS **$90**
Smart-switch
4 in / 1 out, all parallel
Requires no power supply

SPPS **$60**
Up to 115,200 bps
Serial / Parallel Converter
Requires no power supply

PB-42PP-256Kb **$250**
4 in / 2 out, all parallel
Upgradable to 4Mb

Logical Connection, Inc.
4660 Portland Road NE #108
Salem, OR 97305-1697

Customer Support:
(503) 390-9375
FAX: (503) 390-9372

800-238-9415

AMT INTERNATIONAL
(COMPUTERS & PERIPHERALS)

3074 LANDESS AVENUE · SAN JOSE, CA 95132
TEL: (408) 942-9695 · FAX: (408) 942-5509

VISA
master charge

LOWEST PRICES
SAME DAY SHIPPING

COMPAQ MEMORY

DeskPro 286-E, 386-20/20E/25
1MB 113131-001 $75.00
4MB 113132-001 $169.00
DeskPro 286N, 386N and 386SX
2MB 118689-001 $135.00
4MB 118690-001 $230.00
DeskPro 386S
1MB 113646-001 $99.00
4MB 112534-001 $195.00
DeskPro 386-33, 486-33 & SystemPro
2MB 115144-001 $185.00

AST MEMORY

Bravo-286, Workstation
512K Kit 500510-010 $59.00
2MB Kit 500510-002 $150.00
Premium 386-16/20C
1MB Kit 500510-003 $75.00
4MB Kit 500510-004 $185.00
Premium 386-20
1MB Kit 500510-003 $75.00
4MB Kit 500510-004 $185.00
Bravo-386SX
4MB Kit 500510-008 $220.00
Premium 386-SX/25/33 & 486-25
1MB 500718-002 $60.00
4MB 500-780 $195.00

HEWLETT-PACKARD MEMORY

Vectra QS/16S
1MB $65.00
4MB $185.00
Vectra QS/20PC, RS/25PC and 20C
1MB D1640A $65.00
4MB D1642A $170.00
Vectra 486PC
1MB D2150A $75.00
4MB D2151A $165.00

IBM PS/2 MEMORY

Models 30-286, Exp. Board 1497259
512K Kit 30F5348 $54.00
2MB Kit 30F5360 $95.00
Models 70-E61/121, 55SX, 65SX
1MB 6450603 $59.00
Models 70-E61/121, 50Z, 55SX, 65SX
2MB 6450604 $99.00
Models 55SX, 65SX, 34F3077 & 34F3011
4MB 34F2933 $149.00
Models 70-A21
2MB 6450608 $99.00
Models 80-141
1MB 6450375 $75.00
Models 80-111/311
2MB 6450379 $99.00
All Models 70 and 80
2-14MB w/2M 34F3077 $290.00
4-16MB w/4M 34F3011 $350.00
Models 50, 50Z, 55SX & 60
2-8MB 1497259 $290.00

LASER PRINTER MEMORY

Hewlett-Packard Laser Jet IIP, III & IIID
1MB 334748 $70.00
2MB 33475B $99.00
4MB 33477B $185.00
Hewlett-Packard Laser Jet IIP & IID
1MB 33443B $75.00
2MB 33444B $110.00
4MB 33445B $175.00
IBM Laser 4019 and 4019e
1MB 1039137 $95.00
3.5MB 1038675 $195.00
Canson LBP-811, 811R, 811T
2MB S63-1880 $129.00

LAPTOP AND PORTABLE MEMORY

TOSHIBA MEMORY
1MB Model 1000SE/XE $110.00
2MB Model 1000SE/XE $99.00
2MB Model T1200XE $99.00
2MB Model T1600 $99.00
2MB Model T3100E $99.00
2MB Model T3100SX $99.00
4MB Model T3100SX $195.00
2MB Model T3200SX $99.00
4MB Model T3200SX $195.00
2MB Model 5100 $99.00
2MB Model T5200, T8500 $110.00
8MB Model T5200, T8500 $299.00

ZENITH MEMORY
1MB SuperSport 286 & 286E $135.00
2MB SuperSport 286 & 286E $140.00
2MB SuperSport SX/Alpha $140.00
2MB SuperSport SX/Beta $140.00

COMPAQ MEMORY
1MB Portable LTE 286 $125.00
2MB Portable LTE 286 $150.00
1MB SLT-286 $140.00
4MB SLT-286 $350.00

NEC MEMORY
1MB Prospeed 286 $170.00
2MB Prospeed 386 $240.00

ZENITH MEMORY

Zenith Z-386/20/25/33 & 33E
1MB ZA36/3800ME $90.00
2MB ZA3600MG $140.00
4MB ZA3800MK $205.00
Zenith Z-386 SX
2MB Z-605-1 $125.00

MATH COPROCESSORS

Overdrive Matheo ..... CALL

INTEL
8087-5 MHz $50.00
8087-2 8MHz $60.00
8087-1 10MHz $99.00
80287-6 6MHz $50.00
80287-8 8MHz $55.00
80287XL 8/10MHz $59.00
80287XL & SLT $89.00
80287-10 10MHz $59.00
80C287-12 12MHz $69.00
80387SX-16 $85.00
80387SX-20 $85.00
80387DX-20 $89.00
80387DX-25 $89.00
80387DX-33 $89.00
80487SX-20 $435.00

WEITEK
3167-20 20MHz $80.00
3167-25 25MHz $135.00
3167-33 33MHz $240.00
4167-25MHz $350.00
4167-33MHz $585.00

CYRIX
82S87XL $59.00
83D87-16 $59.00
83D87-20 $75.00
83D87-25 $75.00
83D87-33 $75.00
83D87-40 $89.00
83S87-16 } SX $65.00
83S87-20 } SX $65.00
83S87-25 } SX $65.00

IIT
2C87-8 $49.00
2C87-10 $59.00
2C87-12 $59.00
2C87-20 $59.00
3C87-20 $69.00
3C87-25 $69.00
3C87-33 $79.00
3C87-40 $89.00
3S87-16 } SX $65.00
3S87-20 } SX $69.00
3S87-25 } SX $69.00

ULSI
US83587SX25/33 ..... $59.00
USD8387-33-40 ..... $79.00

SIMM MODULES

IBM TYPE
ADD $2.00 FOR SIPPS
4Mx9-80 $138.00
4Mx9-70 $140.00
4Mx9-60 $143.00
1Mx9-10 $30.00
1Mx9-80 $35.00
1Mx9-70 $36.00
256x9-70 $10.00
256x9-10 $9.00
256x9-80 $10.00
256x9-60 $12.00

APPLE-MAC
1Mx8-70 $32.00
1Mx8-10 $30.00
1Mx8-80 $32.00
4Mx8-80 $118.00

DRAM

DRAM 1MGX1
1 MGX1-120NS $3.00
1 MGX1-100NX $3.50
1 MGX1-80NX $3.60
1 MGXI-70NX $3.65
1 MGXI-60NX $3.75

DRAM 64X1
4164-150 $0.85
4164-120 $0.95
4164-100 $1.50
4164-80 $2.00

DRAM 64X4
4464-15 $3.99
4464-12 $4.50
4464-10 $4.75

DRAM 256XI
256XI-150NS $1.25
256XI-120NS $1.50
256XI-100NS $1.60
256XI-80NS $1.75
256XI-70NS $4.75
256XI-60NS $3.85

DRAM 256X4
256X4-100NS $3.99
256X4-80NS $4.50
256X4-70/60NS $4.75

256XI-STATIC COL
51258P-10 $1.50
AAA 2800-08 $1.75
AAA 2800-07 $1.85
AAA 2800-60 $1.95
1X4-80 ZIPP $1[illegible].00
1X4-80STT ZIPP $1[illegible].00
1X4-70STT ZIPP $1[illegible].00

SYSTEM

486 DX-33 w/ 64k cache
- 4MB RAM • 1.2 & 1.44 • 130MB HD
- SVGA Monitor • 101 Key Board
- Mini-Tower Case • DOS 5.0
- IDE With I/O

$1369.00

MONITORS

VGA 0.41 14" $215.00
SVGA 0.28 14" $259.00
SVGA N-1 0.28 14" 310.00
VIEW SONIC ..... CALL
NEC ..... CALL

MOTHERBOARDS w/CPU

486 DX-50 w/256k cache $600.00
486DX-33 w/ 128k cache $450.00
386/486 DX-40 AMD (upgradable) $230.00
486 SX-25/20 ..... $279.00
386 DX-40/64k cache $169.00
386 SX-33 ..... $125.00
386 SX-25 ..... $110.00
486VL-50/33/256k cache $195.00

ADD ON CARDS

IDE with I/O $22.00
Tndent w/1MB $69.00
Orchid Pro IIS w/1MB $139.00
Diamond Stealth w/1MB $235.00
NESA IDE Controller $80.00

MEMORY BOARDS OK

Rampat AT $95.00
Rampat Plus XT, AT $119.00
Simmply Ram PS/2-16 ..... $149.00
IBM PS/2 50, 50Z, 55, 60, 65 or any MCA System
Simmply Ram PS/2-32 ..... $169.00
PS/2, 70, 80 & 90 32 Bit MCA System

HARD DRIVE

CP3000 44 MB $158.00
CP3000 89MB $215.00
CP3000 130MB $247.00
CP3000 210MB $360.00
CP3000 340MB $595.00
CP3000 520MB $890.00

FAX MODEM

Modem 2400 Bps $40.00
96/24 Bps Int... ..... $60.00
96/144v.32 Bps/v.42 Bps $220.00

World Radio History

Polaroid

Polaroid's 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 98% 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 617-446-4600

Circle 349 on Inquiry Card.

Experience the Power

Parallel Processing

For the professional, student or hobbyist who wants to come up to speed with parallel processing. All kits include one or more 20-MHz 32-bit transputer processors, each with 1MB of DRAM • Occam2, C, and assembler • examples and demos • complete set of manuals • schematics. Requires IBM-compatible PC.

4 Processors: $1,284 1 Processor: $396

The Transputer Education Kit is outstanding. You would be hard pressed to find as valuable and inexpensive a tool.
R. Eckhouse, IEEE Computer, Sept. 92, page 97

Computer System Architects

15 N.100 E., #100
Provo, Utah 84606

☎ 800-753-4CSA
or 801-374-2300
FAX 801-374-2306

VISA • MasterCard
American Express

Circle 331 on Inquiry Card.

ROMDISK™

Solid State Disk and Drive Emulators

- **Proven Performance!** For OEM/Military, Embedded Systems, Diskless/High Performance PC's, CAD/CAM, Industrial Control, Medical, POS, LAN's, etc.
- **High Capacity** Models (PCF/PCM)
- **Low Cost** Models (FERO,E/2-SR/Special OEM)
- **Dual Mode Emulation** Models (PCF, PCM/2, PCE/2)
- **Autoboot Capabilities,** all models
- MS DOS/DR DOS/E-Venix OS Support
- ***NEW!* PCMCIA models (PCM, PCM/2) and accessories**

CURTIS, INC.
Industry Leader in Disk and Drive Emulation Products

418 W. County Rd. D
St. Paul, MN 55112
612/631-9512
FAX 612/631-9508

DR DOS is a trademark of Digital Research; MS DOS is a trademark of Microsoft

Circle 333 on Inquiry Card.

SCSI • IDE • FLOPPY

HOST BUS ADAPTER/CONTROLLER

STANDARD FEATURES

- Drivers for Fixed, Optical and Removable Drives
- Internal and External SCSI Connectors
- SCSI and IDE Cables
- On-Board Diagnostics
- Complete Documentation
- Lifetime Warranty
- 30 Day Return Policy
- Made in the USA

$150.00
(16-Bit HBA/Cntl)

SUPPORTS

- Up to 7 SCSI Devices
- Up to 2 IDE Drives
- Up to 4 Floppy Drives
- 7 ROM Addresses
- 2 I/O Addresses

OPTIONS

- CD ROM & UNIX Drivers
- ASPI Manager
- 3rd & 4th Floppy Driver

$175.00
(16-Bit HBA/Cntl w/Option Pkg.)

CONTROL CONCEPTS INC.
(703) 876-6444 • (703) 876-6416 Fax

Government Educational and Corporate Discounts Available
Dealer Inquiries Welcome

Circle 381on Inquiry Card.

GLOBAL INDUSTRIAL PRODUCTS AND RESOURCES

- 10"/14" VGA Color Industrial Workstation
- 17" Rock Mount Monitor Enclosure with Touch Screen
- 286/386SX-33/386DX-40/486DX2 All-in-one Slot Board Computer
- All-in-one EISA bus CPU Card
- Dual Drive RAM/ROM/FLASH Disk
- 19" Rock-Mount Chassis with 14 Slots
- 6-Slots heavy-duty Node Chassis

MITAC Inc.
16TH FL., 51 SEC. 3,MING SHENG E. RD.,TAIPEI,TAIWAN,R.O.C.
TEL:886-2-504-5180 FAX:886-2-509-0979

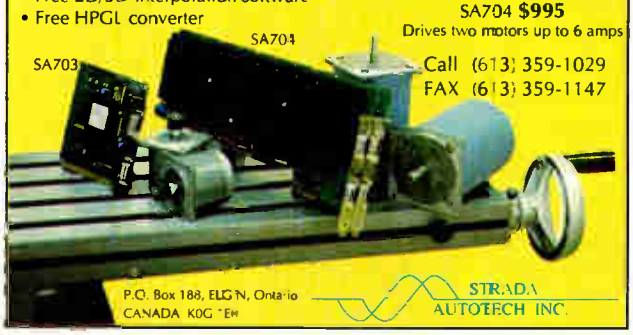
MITAC **RHINO** (U.S.A DISTRIBUTOR) 101 N. ALLOY DRIVE FENTON,MI 48430,U.S.A
TEL:1-800-448-2248 FAX:313-750-1836

Circle 374 on Inquiry Card.

Direct Stepper Drive from PC

- No external DC supply or translators required
- Free 2D/3D interpolation software
- Free HPGL converter

SA703 **$249**
Drives two 1/2 amp motors
SA704 **$995**
Drives two motors up to 6 amps



Call (613) 359-1029
FAX (613) 359-1147

P.O. Box 188, ELGIN, Ontario
CANADA K0G 1E0

STRADA AUTOTECH INC.

World Radio History

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 light weight allow you to take the wands wherever the work needs to be done. **Call Videx today for your free information kit: 503-758-0521.** Prices starting at:

Videx

TimeWand I $298
DuraWand $495
TimeWand II $698

1105 NE Circle Blvd., Corvallis, OR 97330-4285
503-758-0521 • FAX 503-752-5285

TimeWand, DuraWand, and Videx are registered trademarks of Videx, Inc. GCO355

Circle 359 on Inquiry Card.

Access your old PC's disks from your new PC

Introducing: InfiniStor!

InfiniStor™ from Infinicon™ makes your old PC's disk drives appear to be internal to your newer PC. What's more, those disks will perform almost as fast as if they were mounted inside. InfiniStor consists of a pair of half-size add-in cards (one for your old PC and one for your new one), a thin 12 ft. cable (which can be increased to 50 feet or more), and easy-to-use software which takes less than 10 minutes to install. And you'll get **Super PC-Kwik™** disk caching software (to speed things up even more) and **Stacker™** file compression software (to double the size of your old PC's hard disk), both bundled **FREE** with InfiniStor.

InfiniStor Add-In Cards and Cable

Only $129.95 (introductory offer)

Warning! InfiniStor is not a network product, and as such Infinicon cannot promise that you will encounter the typical network software installation difficulties. Furthermore, you won't have to deal with the usual cabling problems, and you won't have to become a master of complexity.

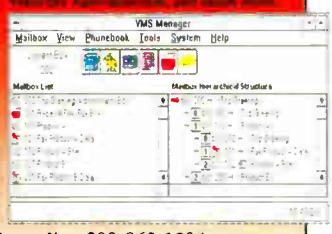
InfiniStor uses only 4K bytes of memory, appears transparent when in use, and is compatible with all your favorite software (including Microsoft Windows™ and computer networks). And if you're not totally satisfied, just return it within 30 days for a complete refund on the purchase price.

For info or to order, call toll-free: (800) 374-3880
VISA • MasterCard • AMEX
Or: (801) 374-8880
Fax: (801) 370-3880

INFINICON • 15 North 100 East, Suite 106 • Provo, UT 84606

Circle 378 on Inquiry Card.

New for Windows 3.1!
It's Voice Mail.
It's Fax-on-demand.
It's an Applications Generator.
It's $495 for board and software.
It's **PhoneOffice.**



Call our demo line 309-862-1804
to get more information by fax-on-demand.
eDENS technology corp. Tel: (309)862-1704 Fax: (309)862-1804
309 W. Beaufort, Suite 8, Normal, IL 61761
Dealers, call us about our specially discounted promotional units.

Circle 379 (RESELLERS 380) on Inquiry Card.

LET YOUR COMPUTER DO THE TALKING!

Integrated Voice/Fax Mail
integrates major voice/fax applications plus program control into one full-featured high performance software. PC-AT/386/486 based. Menu driven. Easy to use. Full support for Rhetorex, New Voice, Dialogic, TTI and Intel voice and fax hardware. Supports up to 24 voice lines and up to 8 fax lines.
Hardware + Software Kits
2 voice lines kit starts at **$650**
24 hours free info: 818-368-4566 or 818-368-8848

SigmaTech Software
Tel: (818) 368-6132 Fax: (818) 368-7859
10801 Bismarck Ave., Northridge, CA 91326 USA
(Resellers/Dealers/OEMs/Private labels are welcome)

- Auto-Attendant
- Unlimited Audiotex
- Voice Mail
- Call Processing
- Telemarketing
- Fax Mail
- Fax-on-Demand
- Fax Broadcasting
- Party/Chat lines
- Talking Yellow pages

Circle 371 (RESELLERS 372) on Inquiry Card.

Light-Speed Serial Communications

PCSS-8FX Intelligent Serial Coprocessor

Fast

- Better than 1Mbyte/second transfer rate.
- No load on Host Processor!
- I/O Mapped - No host memory used.
- NEW - Supports DMA transfer. Faster than Dual Ported Memory!
- Looks like IBM Uart with Huge QUEUE!
- 8 ports per card. RS-232, 422, 485.

ORDER TOLL-FREE 800-282-4835

GTEK INC.

GTEK, INC. • DEVELOPMENT HARDWARE & SOFTWARE • P.O. Box 2310
Bay St. Louis, MS 39521-2310 USA • Mississippi & Technical Support 601-467-8048
Fax: 601-467-0935 • OEM & Dealer Inquiries Welcomed!

Circle 338 on Inquiry Card.

Multi-Line Voice Mail Plus...
FAX ON DEMAND!

FAX ON DEMAND • VOICE MAIL
CALL PROCESSING • TELEMARKETING

VOICE PLUS gives you professional VOICE MAIL & AUTO TRANSFER while it pounds out Fax'd Hard Copy non-stop 24-hours a day. Give it to them - NOW! Complete Package with Hardware and FAX Software. 2 year warranty. Requires PC/AT/386/486.

VOICE PLUS ..... only **$695**
Basic Voice Mail ..... from **$295**

For Sales and Information Call:
1-800-685-4884
510-522-380•FAX: 510-522-5556

(Developer/OEM package specials)
(VISA-MC-AMEX-COD)

TALKING TECHNOLOGY, INC.
1125 Atlantic Ave., Alameda, CA 94501

Circle 354 on Inquiry Card.

World Radio History

Computer Systems

486 Computers

486-33 64K Cache $1649
Intel 486DX 33 MHz Processor
4Mb SIMM Memory
1.2Mb. and 1.44Mb Floppies
120Mb Hard Disk Drive @15ms
2 Serial, 1 Parallel, 1 Game Port
Tower Case with 230Watt PS
SVGA Card – Trident 8900 w/1Mb
1024 x 768 .28dp SVGA Monitor
Keytronics 101 Keyboard, Mouse
486-50DX2 256K Cache $1749
486-50DX 256K Cache $1949
486SX-33 8K Cache $1399
350 VA Upsonic UPS only $90 w/486 Purchase!

386 Computers

386DX 40 128K Cache.....$1199
Intel 386DX 40Mhz Processor
4Mb SIMM Memory
1.2Mb, and 1.44Mb Floppies
84Mb Hard Disk Drive @15ms
2 Serial, 1 Parallel, 1 Game Port
Tower Case with 230Watt PS
SVGA Card – Trident 9000 w/512Kb
1024 x 768 .28dp SVGA Monitor
Keytronics 101 Keyboard

386DX-33 128K Cache $1189
386SX-33.....$999
Free 3 Button Mouse w/386 Purchase

NoteBook Computers

386SX/25.....$1259
60Mb Hdd. 2Mb RAM. 64 Gray VGA
1 ser. 1 par. 1 PS/2 Mouse port
86 Key. 12 Function Kbd. 6 Lbs

486SLC/25.....$1599
80Mb Hdd. 4Mb RAM. 64 Gray VGA
1 ser. 1 par. 1 PS/2 Mouse port
86 key, 12 function Kbd. Case,
Universal Power Supp., 6 Lbs.

Components

1 Mb SIMMS @ 70ns.....$32
250 VA UPS.....$99
213 Mb Hdd.....$395
Internal FAX modem 96/24 .....$72
250 Mb Colorado Tape Back-up..$259
Internal CD ROM.....$259
Creative Labs Multi-Media Kit $549
3 Button Mouse $21
Monterrey Spill-Proof 101 Kbd $26

Call or Fax for More Great Prices

COD & Company POs accepted

G² Computers International

911 N. Edgefield
Dallas TX 75208

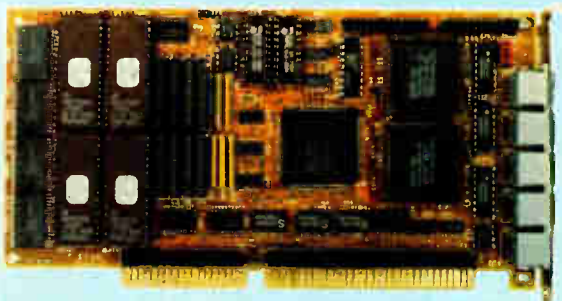
Ph. (214) 948-3155
FAX (214) 942-8360

Member: Dallas Chamber of Commerce, Dallas Better Business Bureau

Circle 388 on Inquiry Card.

Computer Systems • Data Acquisition

AT Systems in ROM



Run DOS in ROM

Develop code on a PC. Use 'C' and standard PC tools. Burn DOS and .exe code in ROM. Run disk-less on our battery-backed single board computers.

PC Compatible

Our CPU cards are PC compatible. They run all PC software and drive standard PC expansion cards (VGA, A/D, etc.) on a passive backplane.

CPU Card	KS-6	KS-3
Base price	$ 299	$ 224
CPU chip	V53	V40
Equivalent to	286	186
Runs PC code	yes	yes
Bus	AT	XT
Max DRAM	4M	512K
Max ROM	2M	512K
Max SRAM	512K	256K
Serial ports	5	3
Parallel ports	2	2
Real clock	yes	yes
Flop, Keybd.	no	yes
Size	4"x8"	4"x6"
Power 5v	400mA	250mA

We provide complete support to implement ROM based PC systems. Development kits with source code samples and DOS utility disk are available.

For Catalog Call **303-444-7737**
or fax 303-786-9983

KILA

655 Hawthorn Avenue, Boulder CO 80304 USA

Circle 343 on Inquiry Card.

ines
Messtechnik Datenverarbeitung

ines GmbH
Neuenhöfer Allee 45
D-5000 Köln 41 · Germany
Phone: +221/491621 · 492299
Fax: +221/4995605

IEEE-488

- Interfaces + Software
- Analyzer + Converter
- Extender + Cables
- DOS, Windows, OS/2, UNIX, SunOS

Circle 341 on Inquiry Card.

20-BIT A/D
For PC/XT/AT & Compatibles

Linearity .0005 percent of full scale

$300 software included

LAWSON LABS, INC.
74 4TH AVE. NW
KALISPELL, MT 59901
800 321-5355
406 257-5355

Circle 345 on Inquiry Card.

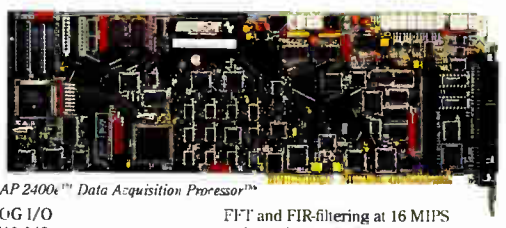
Rackmount Solutions

RACKMOUNT COMPONENTS – QTY 25 PRICING
Rackmount Chassis 19"x7"x17" $183
Rackmount VGA Monitors $531
Rackmount Monitor Shelf $113
Rackmount Keyboard Shelf $88
RACKMOUNT PLATFORMS – Qty 1 Pricing
RMS486-33EISA $1799 RMS386-40 $814
RMS486-33 $1443 RMS386SX-25 $693
System Platforms include 7" Rackmount Chassis, 200W Power Supply, Motherboard, 1.0MB Memory, IDE, FDC, 2-Ser, Par, 1.2MB or 1.44MB Floppy Disk Drive, 1 Year Warranty
RACKMOUNT CHASSIS – 15 Models up to 20 Board Slots
SLOT CPU BOARDS – 486, 386, 386SX
RACKMOUNT MONITORS – Super VGA and Monochrome
RACKMOUNT CABINET – Modular from 21" to 96" high

SEA VALLEY TECHNOLOGY INC.
2468 Armstrong Street, Livermore CA 94550
(510) 447-2030 FAX: (510) 447-4559

Circle 365 on Inquiry Card.

The Intelligent Solution For Data Acquisition



DAP 2400e™ Data Acquisition Processor™

ANALOG I/O
DIGITAL I/O
- Inputs to 312K samples per second
- Outputs to 312K samples per second
- Simultaneous fast input/output

CPU: i186 or i486

FFT and FIR-filtering at 16 MIPS
20 MHz CPU with DRAM to 1024K
32 MHz DSP with SRAM to 96K
DAP/L™ Operating System
- 100- standard commands
- Custom commands in C

MICROSTAR LABORATORIES
2265 116th Avenue NE
Bellevue, WA 98004
FAX (206) 453-3199

Send for FREE catalog and demo diskette.
Or call us at (206) 453-2345.

Circle 346 on Inquiry Card.

World Radio History

Disk & Optical Drives • Keyboards

PS/2 50 50z 55sx 60 70 80 P70

INTERNAL DRIVES - May be used as a high performance replacement or to co-exist with original IBM drive. Compatible with DOS 3.3, 4.01, 5.0, OS/2 2.0 and Novell. Includes IDE or SCSI-2 microchannel controller, hard drive, mounting kit, ribbon & power cable, manual, and hardware.

85mb, 17ms, Internal Western Digital IDE Drive Kit	$439
125mb, 15ms, Internal Maxtor IDE / SCSI Drive Kit	$494/$504
200mb, 15ms, Internal WD IDE/Maxtor SCSI Drive Kit	$623/$649
340mb, 13ms, Internal WD IDE/Maxtor SCSI Drive Kit	$837/$933
512mb, 12ms, Internal Fujitsu IDE / SCSI Drive Kit	$1,289/$1299
1.2gb, 12ms, Internal Toshiba SCSI Drive Kit	$1,794

PS/2 Model 25, 30, 30-286 42mb Seagate Hard Drive Kit $243; 85mb/125mb Hard Drive Kit $313/$368

External SCSI drives available from 125 mb to 1.7+ gb. Includes SCSI-2 controller, external case with drive installed and configured, 6' SCSI cable. Free drivers for CD-Rom drives or Novell 286 & 386.

General Technics — *1 Year Warranty - 10 Day Money Back Guarantee*

VISA · MasterCard · Discover · American Express · COD · Orders

1-800-GT-SALE-8
1-800-487-2538
Tel: (516) 981-9473
Fax: (516) 981-5038
38 Raynor Ave
Ronkonkoma
NY 11779
Open 9am to 6pm EST, Mon-Fri

Circle 375 on Inquiry Card.

MiniSCSI*plus*

High-Performance Parallel-to-SCSI Adapter

Transform Your Parallel Port

Connect up to 7 SCSI devices to your parallel port and still use your printer!

Up to twice as fast as our original **MiniSCSI**, the **MiniSCSI Plus** 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. Plus, an integrated cable makes it a snap to share SCSI devices with desktops and other notebooks.

- 100% Printer Passthrough
- Weighs Just 7.2 Ounces
- Fully Compatible With Bidirectional anc Unidirectional Parallel Ports
- Powered By The SCSI Bus
- Only $229.00

Call Today For Details!

800-872-6867 · 800-TRANTOR

TRANTOR

Trantor Systems, Ltd.
5415 Randall Place • Fremont, CA 94538-3151
TEL: (510) 770-1400 • FAX: (510) 770-9910

© 1993 Trantor Systems Ltd. MiniSCSI and MiniSCSI Plus are trademarks and Trantor is a registered trademark of Trantor Systems Ltd. All other product names are trademarks of their respective companies.

"This product... is darned near perfect."
–Jerry Pournelle, Byte Magazine March 1993

"This year, the company outdid itself. . . The MiniSCSI Plus is even more elegant than its predecessor and almost twice as fast."
–Jim Seymour, PC Magazine December 1992

Circle 364 on Inquiry Card.

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.

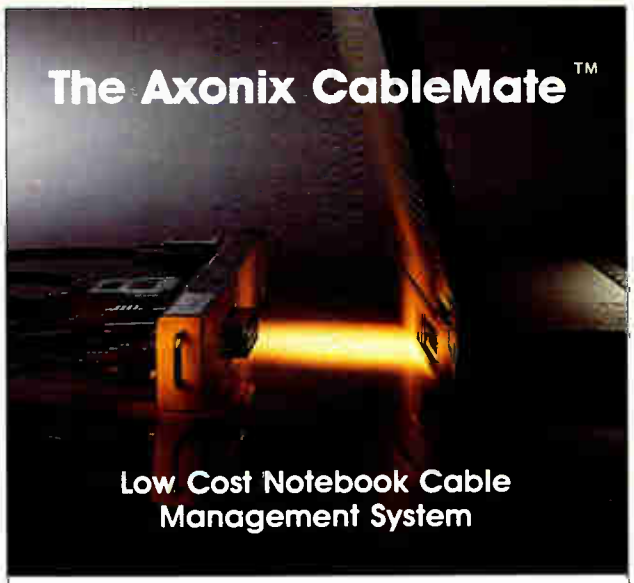
Call Toll Free To Order: 1-800-DATALUX

DATALUX
– VISA, MC, AmX –

155 Aviation Dr. • Winchester, VA 22602
Tel 1-703-662-1500 • FAX 1-703-662-1682
Auto-FAXed Specs FAX 1-703-662-1675

Circle 335 on Inquiry Card.

Laptops & Notebooks



Now you can connect your desktop peripherals in one easy step while reducing wear and tear on your interface ports. The CableMate Plus option provides bus expansion for low cost ISA compatible Lapstation expansion systems and both versions are available for Compaq LTE, Toshiba T2200-T6400 and other popular Notebook models. CableMate and Lapstation are available from Axonix direct, and from Authorized Axonix dealers worldwide.

Axonix
1214 Wilmington Avenue
Salt Lake City, Utah 84106
Tel: 801-466-9797 / Fax: 801-485-6204

Call Toll Free for Nearest Dealer 1-800-866-9797

Circle 330 on Inquiry Card.

FREE CATALOG

HP 95LX

Everything you can dream of for your HP 95LX! Flash and RAM memory cards, connectivity kits, printers, modems, and over 30 software programs are just some of the products you will find in this 72 page catalog — all at EduCALC's everyday discount prices! Call today for your FREE catalog.

EduCALC Mail Store
27953 Cabot Road
Laguna Niguel, CA 92677
(714) 582-2637

HEWLETT PACKARD

Circle 385 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

World Radio History

Universal Keypad for Portable Computers

Available in Ivory or Black

Boost data entry speed, accuracy and convenience with Genovation's Micropad,™ the innovative numeric keypad for portable computers.

TO COMPUTER

TO PRINTER

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.

(800) 822-4333
17741 Mitchell, North
Irvine, CA 92714 USA
TEL (714) 833-3355
FAX (714) 833-0322

GENOVATION INC

Circle 337 on Inquiry Card.

Memory Superstore . . . your direct source.

...For the absolute best prices on laptop, desktop and workstation memory, call now! 800•800•7056.

Standard SIMMS

4MB x 9-80-70★★★	$110.00
4MB x 9-60	$114.00
256K x 9-80-70	$11.00
1MB x 9-80-70 (9 chip)	$34.50
1MB x 9-80-70 (3 chip)	$31.00
1MB x 36-70*	$136.00
2MB x 36-70*	$262.00
4MB x 36-70* ★★★	$499.00

Call for best price on a 30-pin & 72-pin Modules, 2, 4, 8 & 16MB

*used in PS/2, Compaq, Dell & other high-end systems (386 & 486)
**4 piece minimum

Laser Printer Memory

Canon	1MB	$118.00
LBP 8II/8IIR/8IIT	4MB	$190.00
Epson Action Laser	2MB	$125.00
Action Laser II	2MB	$138.00
HP LaserJet IIP,IIPPlus,III,IIID,IIIP,II,IID,IIIsi		
	2MB $99.00	4MB $172.00
HP DeskJet	256K	$78.00
IBM 4029★★★	4MB	$140.00
Sharp JX9500PS	1MB	$75.00
OKI Laser CL400	2MB	$116.00
OL800/820	2MB	$135.00
	4MB	$210.00
Panasonic	2MB	$135.00
KXP4420, 4450		
KXP4455	2MB	$175.00
KXP4410	4MB	$215.00

IBM & Compaq Memory

PS/2; 35SX/LS,40SX,50Z,55SX/LS,57SX, 65SX/LS,70,70A21,B21,B61,90,95
2MB $89 4MB $136 8MB $268

DeskPro386/20,E,25,S/16,N,SX20,33M
2MB $89 4MB $136 8MB $268

Workstation Memory

Sun EPC/IPX★★★	16MB	$470
Dell 486	16MB	$495
IBM RS6000	16MB	$620
HP Apollo	16MB	$675
Silicon Graphics	16MB	$620
Next	16MB	$470

Specialists in workstation products. Contact us for current prices & new catalog.

Laptop/Credit Card/Flash Memory

Apple Power Book★	4MB	$230		
AST Premium Exec.	4MB	$160		
AT&T Safari	4MB	$345		
Bondwell B310	1MB	$136		
Compaq				
LTE386s/20	1MB	$82	4MB	$259
LTELite/20.5	2MB	$140	4MB	$240
	8MB	$578		
LTE/286	1MB	$88	2MB	$138
SLT/286	1MB	$88	4MB	$240
Goldstar GS520	4MB	$330		
HP 95LX, Poget PC, Grid Pad				
SRAM Card	256K	$122		
	512K	$149		
Flash Memory	1ME	$238		
	2MB	$309		
Packard Bell, Magnavox, Mitsuba★★★				
	2MB	$150	4MB	$290
Toshiba - T1000SE/LE/XE,T2000SX, T1000LE, T2200-SX, T2000SXE				
	1MB	$80	2MB	$109
	4MB	$230	8MB	$430
Toshiba - TI200XE	2MB	$88		
Toshiba -T4400 SX/SXC, T3300, T6400				
	2MB	$182	4MB	$329
	6MB	$469	8MB★	$670
Zenith Masters SL	2MB	$122		

Memory Superstore (800) 800-7056 OR (805) 339-0305 FAX (805) 339-0353

COD Prices subject to change. POs welcome. OAC Volume Discounts for Corporations,VARs, Government and Universities. Shipping worldwide Fed Ex and UPS.

20% Restocking Fee on refunds within 30 days. No refunds or exchanges after 30 days. WARRANTY REPLACEMENT ONLY. ALL PRICES FINAL. PRICES SUBJECT TO CHANGE.

Circle 367 on Inquiry Card.

ROM BIOS UPGRADES

LARGEST BIOS DISTRIBUTOR!!
AMI-MR. BIOS-PHOENIX
AS LOW AS $29.95

ROM BIOS UPGRADES FROM ACER TO ZEOS, SET-UP IN ROM, FULL SUPPORT FOR WINDOWS, IDE, SCSI, UP TO 2.88MB FLOPPY, VIRUS AND PASSWORD PROTECTION, 47 DRIVE TYPE INCL. 2 USER DEFINABLE, ENHANCED KEYBOARD, VGA, AUTO DETECTION, ETC.
DON'T BE FOOLED BY THE REST, BUY FROM THE BEST!!!

MEMORY LASER MEMORY: HP IV-4MB $175.00 HP III 2MB $98.00
PANASONIC 4410/30 2MB $105.00 PANASONIC 4410/30 4MB $165.00
HP-PANASONIC-OKIDATA-IBM-NEC-TEXAS INSTRUMENTS-APPLE-AND MORE!!!
MEMORY ALSO AVAILABLE FOR PC'S AND LAPTOPS. *CALL NOW!!!!!*

TTI MOTHERBOARDS UPGRADEABLE 386'S, 2 YEAR WARRANTY,
268-386-486 STARTING AT $85.00. VESA LB MB'S,VL BUS IDE & VIDEO CARDS

TTI Technologies
2432-A Palma Drive
Ventura, Ca. 93003
(805)650-2030/FAX (805)650-6515

1-800-541-1943
VISA MC AMEX DISC. COD
GOVT, UNIV. & HOSP. PO'S WELCOME
FREE CHIP PULLER, CATALOG, MANUALS.
OTHER ITEMS ALSO AVAILABLE,CALL US NOW!

Circle 387 on Inquiry Card.

STAND-ALONE LCD MONITOR

New Touch Screen Option Available

$795 This 10" black on white monitor is easy-to-read, yet compact. Resolution is 640x480 for sharp, flicker-free image. Fast response, high refresh rate twisted nematic technology with backlighting provides a bright low radiation screen with a wide viewing angle. The adjustable monitor base is only 29x14 cm. It lets you mount the LCD monitor on vertical surfaces or fold for transport. Comes with 1.5 m cable and controller card. No external power required. IBM AT compatible.

$1,295 New Touch Screen Version. Capacitive technology from MicroTouch™. Provides high resolution, fast response, all glass scratch proof optically clear touch sensor. Complete with controller and software. DOS, Windows compatible.

To Order Call Toll-Free: 1-800-DATALUX

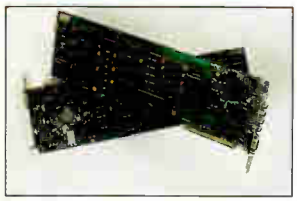
DATALUX
155 Aviation Drive • Winchester, VA 22602

Tel: 1-703-662-1500
FAX: 1-703-662-1682
AutoFAXed Specs: 1-703-662-1675

Circle 334 on Inquiry Card.

IMAGING CARDS

MODEL 1-800-292-1160



Video Framegrabbers for the XT/AT/386

- Real time grab/display
- Complete with software
- 60 & 50 Hz. Video
- Quality since 1987!
- Money back guarantee

-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 ***$795***

-02 256x240x8 Workhorse 8 bit grayscale. 2 inputs, 24 bit RGB out, cursor ***$495***

-03 256x240x6 Economy 6 bit version of -02 above ***$395***

MC/VISA/COD

Control Vision
Box 596 Pittsburg, KS 66762
316-231-6647 Fax: 231-5816

Circle 332 on Inquiry Card.

World Radio History

Multimedia • Printers/Plotters • Programmable Hardware

Desktop Video

Motion Capture

- Real-time & motion video capture
- 8, 16, 24-bit color
- DOS & Windows support
- S-VHS & Composite input
- Free development kit
- Sound Blaster compatible

US$ 299

VGA-TV Converter

- Sharp & Flicker-free
- TV & Monitor display simultaneously
- S-VHS & Composite output
- Windows support
- MRVP/NTSC also for Mac
- Hor. Over/Under-scan switch

US$ 149 (MR VV Plus)
US$ 349 (MR VP)

DISPLAY RESEARCH LABORATORY

VISA

Capital Automation Inc.
Tel.: 1-800-CAPITAL
Fax: 704-596-9595

International inquiry:
Int'l Tel.: (852) 420 1165
Int'l Fax: (852) 415 2739

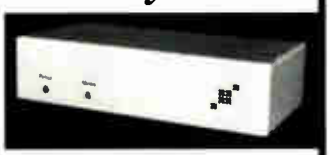
Circle 382 on Inquiry Card (RESELLERS: 383).

SMART PRINTER BUFFER

for automatic sharing of printer(s) by several computers.

- Simultaneous input on all ports
- Compatible with all printers, Lasers and CAD plotters
- Pop-up Menus
- Free Technical Support
- 30 day money-back guarantee & full-year limited warranty
- Full *Windows*® Support

Nobody waits!



STANDARD 1 MB memory • memory sizes thru 8 MB
• Fast - data rates to 75 KB/S • multiple copies • multiple outputs

NEW

1 MB 6-Port Parallel
$199.95

9-Port Parallel	$259.95
15-Port Parallel	$379.95
4-Serial + 5-Parallel	$269.95
16-Serial + 3-Parallel	$399.95

Single User Parallel
$99.95

512 KBytes - unit is expandable to 4 MB

Serial or Converting buffers available

Other Models also available - Call! | Extra Memory: $50 per Megabyte

Technologic SYSTEMS

MasterCard VISA

513-644-2230 • FAX 644-2232 Made in USA

204 EAST FOURTH STREET, MARYSVILLE, OHIO 43040

Receive FAX Info On-Demand: (805) 650-3299 - Item # 700

Circle 355 on Inquiry Card (RESELLERS: 356).

LOW COST COMPACT PLC

PICOLOG

ONE OF THE CHEAPEST P.L.C.'s IN THE WORLD!

HARDWARE: •16 opto-isolated digital inputs, •8 relay outputs @125 VAC, •I/O status indicator LED's, •Watch-dog and power failure circuits, •standard RS232 interface, •single 5/12/24 VAC/VDC power supply (under 3W), •24 Kb battery back-up SRAM, •110x170 mm. PROGRAMMABLE with any compatible PC thru RS232 in ladder logic using our powerful remoTER program. •Real time variables debug, •C, BASIC compilers and assemblers available. SOFTWARE DRIVERS enable your PC applications to remote control PICOLOG I/O thru RS232. EXTENSION MODULES AVAILABLE.

Elsist s.r.l. • ITALY

Phone 39 142 451987
Fax 39 142 451988
BBS 39 142 453165

Circle 373 on Inquiry Card.

Programmable Hardware

IEEE 488.2 for Notebook PCs

- Attaches to the PC's parallel printer port
- Controls up to 14 IEEE instruments
- Transfers data at up to 170 Kbytes/sec
- Includes DOS or Windows software drivers
- Graphics & analysis software available
- Allows parallel & IEEE devices to be connected simultaneously

Call or fax for more information:
Tel (216)-439-4091
Fax (216)-439-4093

IOtech *the smart approach to instrumentation*

IOtech, Inc. • 25971 Cannon Road • Cleveland, Ohio 44146

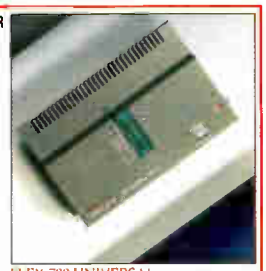
Circle 342 on Inquiry Card.

UNIVERSAL PROGRAMMER, EMULATOR, & TESTER

TUP-400 $745.00 *NEW*
TUP-300 $575.00

- New Improved hardware and software.
- The most complete PC-based Universal Programmer, Programs PLD (PAL, GAL, FPL, EPLD, PEEL, MAX, MACH...), E(E)PROM, (up to 16Mbit), Flash EPROM, BPROM, Special PROM, MPU (87XX, 68XX, Z8, PSD3XX, PIC16XX, TMS320EXX, UPD75PXXX, HD637XXX...).
- Covers DIP, PLCC, QFP, SOP, and PGA with 8 to 84 pins Gang Progamming adapters available also.
- EPROM EMULATION capability.
- Tests digital ICs and DRAMs (SIMM/SIP adapter available).
- Free software updates and new device added upon request.
- IC Manufacturers' approval.
- 1-year warranty, 30-day money-back guarantee.

CALL TODAY FOR MORE INFORMATION.
Distributors are welcome!



FLEX-700 UNIVERSAL PROGRAMMER SYSTEM NOW AVAILABLE. CONNECTS TO ANY PC XT/AT/386/486/LAPTOP THRU THE PARALLEL PRINTER PORT

Tribal

Tribal Microsystems Inc.
44388 S. GRIMMER BLVD., FREMONT, CA 94538
Tel (510) 623-8859
FAX (510) 623-9925

Circle 357 on Inquiry Card (RESELLERS: 358).

SUPERPRO® $549
Universal Programmer

Over 2,000 devices, desktop programmer for your IBM PC with high speed & reliability

- Easy to use menu driven Software.
- Universal programming for E(E)PROM, Flash E(E)PROM, Bipolar PROM, PAL, FPL, PEEL, GAL, E(E)PLD, & Microcontroller, etc.
- Test TTL/CMOS logic ICs, & memory (DRAM/SRAM).
- Life time free Software updates on BBS & technical support.
- 1 year Hardware warranty & 30 day money back guarantee.
- Developed & made in U.S.A.
- Call for demo disk.

Distributors are welcome!!

E(E)PROM programmer to 4-Mbit
- ROM MASTER: $149

E(E)PROM programmer 4 gang version
- ROM MASTER/4: $239

757 N. Pastoria Avenue, Sunnyvale, CA 94086
(408) 524-1929
FAX (408) 245-7084 BBS (408) 245-7082

XELTEK

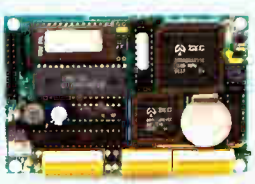
Circle 362 on Inquiry Card.

NEW!

Little PLC™ $195!

Program It In C

New **Little PLC**™ measures only 4.33 x 2.85 inches and costs $195! This miniature controller includes 8 optically isolated inputs, 8 relay driver outputs, two RS-485 serial ports, battery backed memory and time/date clock, programmable timers, and watchdog. Low cost expansion cards increase digital and analog I/O. With easy to use **Dynamic C**™ $195 development system, you can write programs in an hour or develop major applications with 20,000 lines of C language.



Z-World Engineering (916) 757-3737

1724 Picasso Ave., Davis, CA 95616 • FAX: (916) 753-5141
24 hr. Data Sheet Retrieval from YOUR fax: (916) 753-0618

Circle 363 on Inquiry Card.

World Radio History

COMPUTER SECURITY PRODUCTS

COMPLETE LINE OF PROVEN AND EASY TO INSTALL COMPUTER SECURITY PRODUCTS FOR COMPUTERS.

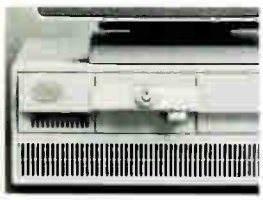
PREVENT COMPUTER THEFT!

KABLIT™ SECURITY SYSTEM

This system allows you to secure all your computer components: CPU, monitor, keyboard, printer. **Internal component security:** Kablit fasteners secure the rear panel of CPU protecting internal boards and hard drives. Fasteners available for all applications. Prices **$34.95** to **$49.95** depending on system.

DISK DRIVE LOCK™

IBM PS-2 DLK-270 SERIES



Now you can lock a diskette into your disk drive and force the computer to boot from the diskette. Disk Drive Lock models available for PS/2 - 30, 55SX, 50, 70 and 90. Protect your data from viruses or from being copied. Other drive locks to fit most non IBM PS/2 and Macintosh disk drives. List price **$24.95**

Order your free catalog of these and many other security products. Purchase orders accepted. Quantity pricing available. Shipping not included. MC/VISA accepted. Dealer inquiries invited.

Secure-It, Inc. 1-800-451-7592

18 Maple Court East Longmeadow, MA 01028

Circle 352 on Inquiry Card (RESELLERS: 353).

Desktop 9-Track Tape Subsystem

#1-selling 9-track system on desktop.

Qualstar's low cost 1/2-inch 9-track Streaming tape systems bring full ANSI data interchange to IBM AT, PS/2 or Macintosh, giving your micro the freedom to exchange data files with nearly any mainframe or minicomputer in the world.

Systems include DOS or Xenix compatible software, coupler card and cables. High reliability 1600 or 6250 BPI capability may be used for disk backup as well as data interchange.

QUALSTAR®

Call us today! **For details and to order: Fax (818) 882-4081 Phone (818) 882-5822**

9621 Irondale Ave., Chatsworth CA 91311

©1989 Qualstar Corp.
All product and company names and trademarks are the exclusive property of their respective owners.

Circle 350 on Inquiry Card.

SAVE ON

9 TRACK MAGNETIC TAPE SYSTEM

FOR IBM PC/X T 286/386/486

- Mainframe to PC Data Xfer to 24MB/min
- Complete Software Packages
- Ready to Operate Systems
- Service and Support, Easy Installation
- No. 1 In Customer Satisfaction
- SCSI Buss Interface, UNIX Compatible
- 3480, Cartridge, Tape Duplication Systems
- Data Conversion /Duplication Services
- New/Unused, Reconditioned, Used MTUs

call **(919) 763-8400** or write to:
4304 Market St., Wilmington, NC 28403

WILTEC

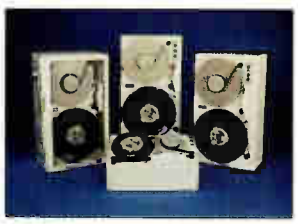
Circle 384 on Inquiry Card.

9 Track/3480 Tape Subsystems
1/4" DAT 8mm Optical
New Windows Software Available

- Best Quality
- Lowest Prices

800/1600/3200/6250 BPI

CALL 1-800-938-TAPE



Laguna Data Systems

3740 Smoke Ranch Road, Suite C, Las Vegas, NV 98128
Tel: (702) 254-2648 • Fax: (702) 254-0901

Circle 344 on Inquiry Card.

9-Track for PCs

Mainframe to PC data interchange

Rock solid solutions, rock bottom prices.
Direct from the manufacturer. 1600 & 6250 bpi.
Subsystems include drives and software.

800-729-8725

OVERLAND DATA®
Since 1980

3480 Now with IDRC!

Tel: 619-571-5555 · FAX: 619-571-0982
Europe: Tel: (+49) 6172-35027 · FAX: (+49) 6172-35028

Ask about 3480 tape drives too

Circle 348 on Inquiry Card.

Let your "true colors shine through" when you advertise your computer products in BYTE's

HARDWARE/SOFTWARE SHOWCASE

our newest, affordable, 4-color advertising section!

Call for more details:
(603) 924-2695
or (603) 924-2598

World Radio History

Business • CAD/CAM • Engineering/Scientific

Electronic archiving/ retrieval software!

- Stores scanned images & existing files
- Designed for multiuser networks
- Supports desktop and E-size scanners
- Safe, secure, protected
- Multiple optical drives (either 5.25" or 12")

V.O.I.C.E. outperforms the competition in cost & features!

V.O.I.C.E. was designed specifically for multiuser networks like Novell and Lantastic. Use V.O.I.C.E. with any IBM compatible PC with a VGA or EGA monitor. V.O.I.C.E. archives and retrieves scanned images, drawings, *Word Perfect*, *AutoCad*, and *Lotus 1-2-3* electronic files, and has *multiple levels of security.*

indus
Tools for the micro information age
340 South Oak Street
West Salem, WI 54669 USA

Place an order by calling:
1-800-843-9377

All company and product names are trademarks of their respective owners

Circle 339 on Inquiry Card (RESELLERS: 340).

Program Your Business For Success

MicroBiz
AUTOMATE YOUR BUSINESS

COMPUTERIZE YOUR BUSINESS & WATCH YOUR PROFITS GROW!

- Increase Control
- Increase Profits & Sales
- Work smarter, not harder
- Lower Costs & Reduce Inventory

We Provide Software That Is:

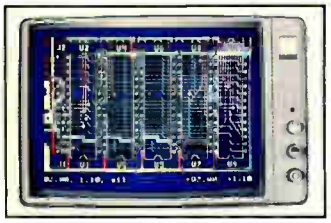
- ✔ Affordable & Functional
- ✔ Easy to use
- ✔ Tested & Stable
- ✔ Unparalleled In Technical Support

800-637-8268

Main Phone:	(914) 425-9500
Fax:	(914) 425-4598
BBS:	(914) 425-6440
Fax on demand:	(914) 426-6064
Dealers Welcome:	800-SELL-POS

CALL TODAY FOR A FREE CATALOG

Circle 376 on Inquiry Card (RESELLERS: 377).



smARTWORK® PCB Software

WINTEK

Wintek Corporation
1801 South Street
Lafayette, IN 47904

(800) 742-6809

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 361 on Inquiry Card.

CoVis - Animated Scientific Graphs

Nine types of animated graphs let you quickly visualize large data sets. Ideal for researchers working with mathematical models, data acquisition boards, chaotic systems, and other sources of large or dynamic data sets.

Also try our other MS-DOS software for technical drawings, statistics, and non-animated graphs. (This ad was created with CoVis and CoDraw.)

Circle 368 on Inquiry Card (RESELLERS: 369).

Engineering/Scientific • Data Acquisition

FINALLY, SERIOUS PC HARDWARE DIAGNOSTICS!

V-ATE PLUS
Now Supports XT, AT & EISA

30 Day Money-Back Guarantee

If you've been disappointed with traditional diagnostics and "Passive Post Cards," or are looking for an alternative to high cost ATE Systems - Put V-ATE plus to the test! We're certain you'll find V-ATE the best investment you've made in years.

- Find Failures in 100% DEAD Systems
- Find Intermittent Faults
- Test for PC Compatibility and reject Sub-standard or Faulty hardware
- US prices from $995

Call (800) 875-8459 Today!

VISTA MICROSYSTEMS, Inc.
6 Whipple St., No. Attleboro, MA 02760
Tel. 508-695-8459 • FAX 508-695-8688

Circle 360 on Inquiry Card.

Free Data Acquisition Software Tool

DAQ Designer is a free software tool that helps determine which hardware and software combinations are best for your PC-based data acquisition system. DAQ Designer will (1) ask questions about your application, (2) analyze your answers to determine your system needs, and (3) describe what hardware and software you need to develop your data acquisition system.

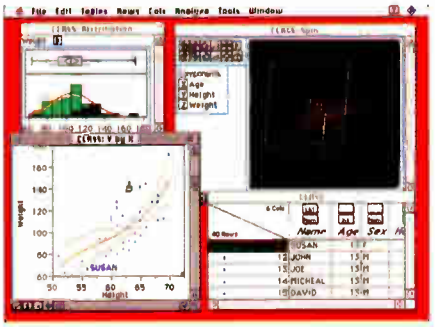
National Instruments
6504 Bridge Point Parkway
Austin, TX 78730
(512) 794-0100 • (800) 433-3488

Circle 347 on Inquiry Card.

World Radio History

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."



MACWORLD

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

Circle 351 on Inquiry Card.

PC Diagnostics and System Information

QAPlus™ Over 3 Million users

- New Version 4.7 now includes Reachout™ Host remote control software and Novi™ Scan virus detection software
- Both novices and expert PC users can quickly solve common computer problems
- Reports hardware configuration, interrupts, performance benchmarks and more
- Includes LAN features for networked PC support and management

For More information call:

1-800-DIAGSOFT

Also from DiagSoft: *QAPlus/WIN*™ for tuning and troubleshooting Windows™ and *QAPlus/FE*™ for power-users and service/support professionals.

Available from Egghead Discount Software, Comp USA, Biz Mart, Fry's Electronics and other fine resellers.

DiagSoft, Inc., 5615 Scotts Valley Drive, Suite 140, Scotts Valley, California 95066 · 1-408-438-8247 · FAX 1-408-438-7113
Suggested Retail: $159.95

Circle 336 on Inquiry Card.

APL

Complete APL system $60.

J 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

Iverson Software Inc.

33 Major St., Toronto, Ontario, Canada M5S 2K9
Phone (416) 925-6096 Fax (416) 488-7559

Circle 370 on Inquiry Card.

FingerCheck Fingerprint verifier

Application Area:
- Computer access or transaction control.
- Computer database security control.
- Physical access control by connecting FingerCheck fingerprint verifier with control circuitry to activate door locks (stand-alone system). The Stand-alone system can be connected to a computer network to perform other functions such as event recording and communications for management (network type system).
- For law enforcement applications the FingerCheck fingerprint verifier can work with card systems, such as smart cards and optical cards to perform identity verification. It provides social welfare security by using cards such as ID card, drivers license, passport, credit card and so on.

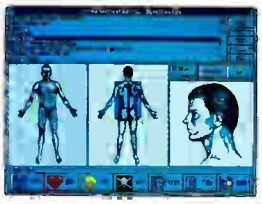
Distributors, OEM & ODM are welcome!

STARTEK ENG, INC.
3F, 54 Park Ave II Science-Based Industrial Park Hsinchu, Taiwan 300 R.O.C.
Tel. 886-35-785168 Fax 886-35-787089

Circle 386 on Inquiry Card.

IS THERE A DOCTOR IN THE HOUSE?

Nominee Compute Choice Award
Best Adult Discovery Software
WINDOWS VERSION



- **Dr. Schueler's Home Medical Advisor** gives updated info on diseases, injuries, medical tests, drugs, poisons, nutrition, diets, fitness, and health/travel tips.
- Q/A format analyzes your symptoms, shows you anatomical displays, and makes over 400 diagnoses.
- Hypertext and SCAN features make finding any topic FAST.
- Low cost updates to all registered users.
- Developed by over 40 physician specialists.

Available in WINDOWS or DOS versions $99.95 Retail
WINDOWS Special: **$69.95**
DOS Special: **$59.95**

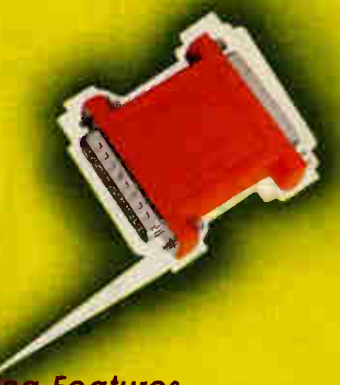
To order, Call: **1-800-788-2099, Dept. B**
or see your software dealer

PIXEL PERFECT INC.
10460 S. Tropical Tr.
Merritt Island, FL 32952

Circle 366 on Inquiry Card.

World Radio History

KeyPro ...
A Legend in Software Protection



Just as the legendary Chinese warrior god **Zhong-Kui** had the reputation of a fearsome warrior who easily fended 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 Dectection***
  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

Your Supplier, Your Partner, Your Friend.

Transcend Information Inc.

U.S.A.
104 Exchange Place,
Pomona, CA 91768
TEL: (909) 598-5500
FAX: (909) 598-5050
(909) 598-6050

Taiwan
3Fl., No. 465, Chung Hsiao E. Rd.,
Sec. 6, Taipei, Taiwan
TEL: (886) 2-7881000
FAX: (886) 2-7881919
(886) 2-7889191

Germany
Transcend Information Trading GmbH
Lademannbogen 45a,
2000 Hamburg 63
TEL: (49) 40/538 81 37
FAX: (49) 40/538 17 81

Circle 205 on Inquiry Card.

World Radio History

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"x1⅛"** ads can include headline (23 characters maximum), descriptive text (300 characters is the maximum recommended) plus company name, address, telephone and fax number. **2"x2⅝"** 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.

RATES (Jan. 1993)

	3-5 issues	6-11 issues	12 issues	13 issues
2"x1⅛"				
1 ad	$663	$636	$557	$530
2 ads/issue	–	–	530	504
3 ads/issue	–	–	504	477
2"x2⅝"				
1 ad	$1,326	$1,272	$1,114	$1,060
2 ads/issue	–	–	1,060	1,008
3 ads/issue	–	–	1,008	954

ACCESSORIES

RADIOACTIVE?

Plot it on your PC with The RM-60 RADIATION MONITOR
Serial or printer port. Detects: ALPHA • BETA • GAMMA • X-RAY.
MicroR 1000 times the resolution of standard geiger counters.
Excellent for tracking RADON GAS. Find sources. New: Version 2.9 + WINDOWS. Plot: • Background • Cosmic Rays • Clouds • Foods
Call/Write for PC MAGAZINE review. • TSR • GM Tube
VISA/MC/EURO Phone orders. Not satisfied? Full refund.

800-729-5397 or Tel/Fax: (302) 655-3800
Aware Electronics Corp.
P.O.Box 4299, Wilmington, DE 19807 $149.50

KEYBOARD, VIDEO, MOUSE, AUDIO

Extend signals from PC with **EXTENDER**
Split signals with **COMPANION/PC 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
2800H Bob Wallace Ave., Huntsville, AL 35805
Phone: 205-534-0011 Fax: 205-534-0010

Inquiry 701.

CUSTOM KEYBOARDS AND TERMINALS

Engineering, Development and Production

• Point-of-Sale • Special purpose • Harsh environment • Access control • Data collection • Operator input • Unique • Industrial • Any interface, key style or size • No minimum quantity required

GENOVATION, Inc.
17741 Mitchell North, Irvine, CA 92714
(800) 822-4333 (714) 833-3355 FAX (714) 833-0322

Inquiry 702.

YOUR SALES MESSAGE

about the special computer product or service that you provide belongs in print

THE BUYER'S MART
can help you reach computer professionals and produce valuable inquiries for your company!

Call **Margot Gnade** for more information
603-924-2656
or
Fax: 603-924-2656

Inquiry 703.

ADD-ON MAILING TOOLS

MAIL FOR LESS!

BAR_LITE – INSTANT BAR CODES on labels, invoices, envelopes, letters, etc. Just load BAR_LITE and run your print job!

DB_Mailer – Full 1st and 3rd Class presorts, barcoding, reports, etc. for XBASE files.

ZIP+4, OTHER BARCODES AND PRODUCTS.
POSTAL CERTIFICATIONS. RESELLER PROGRAM.

POSTSAVER SYSTEMS
(800) 879-6820 FAX (313) 299-5052

Inquiry 704.

ARCHIVAL UTILITIES

RawCopy PC™

The Best Archival Utility, Removes all the things you HATE to look up & plug in

CALL US TODAY
$79.95
FREE SHIPPING
Micro Systems International™
1-800-944-3410

Inquiry 705.

BAR CODE

Portable Reader

Simple, Powerful, Easy-to-use

- AA Battery Operated, with backup coin battery
- 2 x 16 Supertwist 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 2of5, UPC/EAN, 128, Code 39, etc.
- Uploads with furnished Programs or Xmodem
- 64K Complete with Steel Wand – $799

Worthington Data Solutions

Swiss Office
Rütistrasse 6
CH 9050, Appenzell Switzerland
071 87 51 17 FAX
071 87 51 15 Phone

3004 Mission Street
Santa Cruz, CA 95060
408-458-9938
800-345-4220

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', AIAG, KMart, Sears, MIL-STD, Pennys, 2of5, 128, UPC/EAN, Code 39. File Input & Scanned PCX graphics – $279. Other programs from $129.

Worthington Data Solutions
(408) 458-9938 800-345-4220

BAR CODE

Bar Code Readers

For PC, XT, AT, PS/2, Macintosh and Serial Terminals

- Attaches as 2nd Keyboard or to any ADB port
- Reads 2of5, 128, UPC/EAN, Code 39, etc.
- External or internal attachment on PC
- Wand, CCD, Slot Badge, Magstripe or Laser
- Two Scanners per Reader
- 100+ Configurable Options
- 2 Year Warranty, 30 Day $ Back Guarantee
- Direct From Manufacturer
- Top Rated by Independent Review
- Complete with Laser Scanner – $1399
- Complete with Stainless Steel Wand – $399

Worthington Data Solutions

Swiss Office
Rütistrasse 6
CH 9050, Appenzell Switzerland
071 87 51 17 FAX
071 87 51 15 Phone

3004 Mission Street
Santa Cruz, CA 95060
408-458-9938
800-345-4220

CREATE BAR CODE SYSTEMS

Data Harvester Developer's Version can put hand-held portable bar code data collection in your application. Generate system to scan, validate entries (lengths, types, etc.) and communicate data to PC. Format data for your software. Easy to use. No programming. Supports many portable terminals. DOS & UNIX.

AccuScan, Inc.
PO Box 80037, Conyers, GA 30208
(404) 922-1220

Inquiry 706.

Portable Bar Code Reader

- Use as a PORTABLE, WEDGE, or SERIAL
- 9V Battery Operation with Lithium Backup
- 2x16 Supertwist LCD Display
- 54 Key Keyboard with Separate Numeric Keys
- Real-time Clock Supports Date & Time Stamps
- Reads all Popular Bar Codes (16 types)
- Wand, CCD, Laser, or Serial Input Devices
- Built-In Program Generator
- Create Your Own Custom Programs
- 6 Built-In Inventory Programs
- Up to 250 Programs Can Reside in Memory
- Create up to 250 Data Files per Program
- Up to 250 Look-Up Files in Memory
- Built-In Calculator
- Supports HAYES Compatible Modems
- 64K Memory with Data Compression
- 30-day $$ Back Guarantee – 1 Year Warranty
- Complete Unit with WAND Scanner – $795

AMERICAN MICROSYSTEMS
2190 Regal Parkway, Euless, TX 76040
(800) 648-4452 (817) 571-9015 FAX (817) 685-6232

World Radio History

THE BUYER'S MART

BAR CODE

BAR CODE READERS
For PC, XT, AT, PS/2, & Serial Terminals

- Emulates Keyboard: Works With Any Software
- Data Appears as Keyboard Input
- Uses Enhanced Decoding Algorithms
- Accepts Wand, Slot/Badge, CCD, Laser, Magnetic Stripe Reader, & RS232 Serial Input
- Reads All Popular Bar Codes (16 types)
- Reads HIGH, MEDIUM, & LOW density codes
- Auto-Discriminates Between Bar Code Types
- Easily Programmed with a Bar Code Menu
- Over 140 User Configurable Options
- Daisy Chain Up to 96 Readers
- Supports NOVELL Networks
- Supports US & INTERNATIONAL Keyboards
- Direct From Manufacturer
- 30-day $$ Back Guarantee, 1 Year Warranty
- Complete Unit with LASER Scanner – $1095
- Complete Unit with WAND Scanner – $395

AMERICAN MICROSYSTEMS
2190 Regal Parkway, Euless, TX 76040
(800) 648-4452 (817) 571-9015 FAX (817) 685-6232

Bar Code Printing Software
LabelWorks for Windows

- Prints all Popular Bar Code Types (19 Types)
- Desktop Publishing Features: WYSIWYG, Scalable Fonts, Rulers, Guides, Lines, Shapes, Page Zooms (25%-400%), Templates
- Rotates Text, Bar Codes, and Graphics
- Supports Windows Compatible Fonts
- Choose From Over One Hundred Popular Label Formats or Design Your Own
- Rich Text Support: Mix Styles, Types, & Sizes
- Automatically Prints Serial Numbers
- Imports & Exports Graphic Files: TIFF, GIFF, BMP, PCX, WPG, WMF, TARGA
- Supports Virtually all Windows Compatible Printers (PostScript, Laser, & Dot Matrix)
- 30-day Money-Back Guarantee, $295

CALL FOR FREE DEMO SOFTWARE

AMERICAN MICROSYSTEMS
2190 Regal Parkway, Euless, TX 76040
(800) 648-4452 (817) 571-9015 FAX (817) 685-6232

BAR CODE "SPECIALS"

- Wedges/Portables/Multi On-Line readers with HP wands
- Spectra-Physics lasers $899. PSC & Symbol in stock
- 3" CCDs $468. Mag stripe encoders/readers $1485
- Software: print bar codes $99 & read bar codes $159
- P.O.S. – cash drawers $199/receipt printers $399...
- 30-day $$ Back / 1 Year Warranty *Spanish Dept. available
- OEM/VAR/Dealer discounts

BARCODE INTERNATIONAL SYSTEMS
9190 Palm Canyon Drive, Corona, CA 91719
(714) 277-1917 • (800) 653-4252 • FAX: (714) 277-1005

Inquiry 707.

800-821-9362
Scan Characters/Bar Codes

- CCD Scanner, Integral decoder $399, Wand & decoder $199
- Character scanning, OCR 'A' etc, turnkey service hardware, software, on site training and installation from $4200

Keypads/ Specialty Keyboards

- Keypads 18-35 keys, mini keyboards from $64.99
- Keyboards with-trackball/mag stripe/telephone and system
- 24 programmable keys full size keyboard $99

30 day money back, 12 month warranty

ELECTRONE INC. FAX 303-758-3088
1685 S. Colorado Blvd, Suite 353, Denver CO 80222

BAR CODE

ONE STOP SOURCE FOR BAR CODE SOLUTIONS
Quality * Performance * Value

We carry a full line of READERS•PRINTERS•PORTABLES• SOFTWARE•READERS•SELF-CONTAINED READERS•WANDS• MAGNETIC SWIPE READERS. Our readers plug and play with your existing system without software. 30 DAY GUARANTEE • LIFETIME TECHNICAL SUPPORT • NEXT DAY DELIVERY • VARIETY OF PAYMENT OPTIONS•OEM/VAR DISCOUNTS. CALL US

INTERNATIONAL TECHNOLOGIES & SYSTEMS
Richmond, VA — Eastern USA (800) 228-9487
Brea, CA — Western USA (800) 826-1688

Inquiry 709.

PC BAR CODE SPECIALISTS
Bar code readers designed for fast, reliable, cost-effective data entry. They emulate your keyboard, so data looks just like it was typed in! Choose from stainless steel wand, laser gun, CCD, and magnetic stripe scanners. Also, powerful label printing software. Great warranty. Generous reseller discounts. 30-DAY MONEY-BACK GUARANTEE.

Seagull Scientific Systems
15127 N.E. 24th, Suite 333, Redmond, WA 98052
1-800-758-2001 206-451-8966

DATA INPUT DEVICES
Bar Code, Magnetic Stripe Readers & SmartCard Encoder/ Reader for microcomputers & terminals, including IBM PS/2 & others, DEC, Macintosh, AT&T, CT, Wyse, Wang. All readers connect on the keyboard cable & are transparent to all software. UPC & 39 print programs, magnetic encoders, & portable readers are also available.

TPS Electronics
4047 Transport, Palo Alto, CA 94303
415-856-6833 Telex 371-9097 TPS PLA
1-800-526-5920 FAX: 415-856-3843

Inquiry 710.

VARIANT MICROSYSTEMS
BAR CODE READERS DELIVER
WAND/LASER/MAGNETIC CARD CONNECTIVITY

- Keyboard wedges (Internal/External) for IBM PC/XT/AT, PS/2, and portables
- RS232 wedges for WYSE, Link, Kimtron terminals
- Bar code and label printing software
- Full two-year warranty
- **30-Day Money-Back Guarantee**
- **Extensive VAR/Dealer Discounts**

46560 Freemont Blvd., Suite 206 / Freemont, CA 94538 / (510) 440-2870
800-666-4BAR FAX: (510) 440-2873

Inquiry 711.

CAD

TERMINATOR
is fiendishly relentless
in routing your board to completion
Super high density router
(Complete with **schematic** & **PCB** Editor)

Design Computation's totally integrated CAD software offers *unquestionably* superior functionality at *undeniably* competitive prices. Request a FREE DEMO & see for yourself. All **DC/CAD** packages include:

- Rip up and retry router w/via minimization
- No copy protection available
- ASCII file format w/automatic procedure recording
- All user-definable option
- WINDOWS compatible as Dos task
- Autoplacer and autopanning
- Two-way Gerber and DXF
- Complete w/schematic, SMT and dolly libraries
- Optional Automatic Copper plane w/cross hatching
- Optional simulation capability & enhanced mode for 386 users

Price from **$195** *Call for current promotional offer
EXPEDITED PCB LAYOUT SERVICE AT LOW COST
LEASE PROGRAM, PAYMENT PLAN & SITE LICENSE AVAILABLE

Design Computation, Inc.
1771 Highway 34, Farmingdale, NJ 07727
Phone: (908)681-7700 Fax: (908)681-8733
DC/CAD - The performance value leader for the demanding entrepreneur

Inquiry 712.

CAD

ELECTRONICS CAD
Schematic Capture & PCB CAD
Analogue Simulation, Digital Simulation, etc.
Prices from $195. Credit cards welcome.
For brochure use Inquiry # or contact us at:

NUMBER ONE SYSTEMS
Harding Way, ST. IVES, Cambs, UK, PE17 4WR
Tel: 011-44-480-461778 Fax: 011-44-480-494042

Inquiry 713.

ECAL UNIVERSAL ASSEMBLER

- 170 + processors supported.
- User control of syntax and instructions.
- Integrated linker/loader.
- Trace and I/O windows.
- Monitor and RS-232 windows.
- Single micro versions available.
- Demo version available.

VAIL SILICON TOOLS (305) 570-5580

Inquiry 714.

CAD/CAM

CONTOURING MOTION CONTROL
FROM A PRINTER PORT!
Indexer LPT™ software **$249**
NEW **VERSION 3** VISA/MC

- Controls up to six step motors simultaneously.
- Linear and Circular Interpolation.
- New features to accommodate machine control.
- Easy-to-use DOS device driver. Super Manual.
- CAD-CAM interface available.

Ability Systems Corporation, 1422 Arnold Ave. Roslyn, PA 19001 (215) 657-4338 FAX: (215) 657-7815

Inquiry 715.

CAT-SCANNERS

INPUT SLIDES & NEGATIVES
with FOTOVIX III-S
New high-resolution S-video version of Tamron's popular 35mm film to video converter. Perfect for input of film to any computer equipped with a video capture board. Crop 35mm images with 3x zoom. Color balance and exposure correction controls. List price $929.00

Tamron Industries Inc.
99 Seaview Blvd., Port Washington, NY 11050
1-800-827-8880

Inquiry 716.

CD-ROM

OPTI-CD*cache*™
Improve CD-ROM workstation performance!
Only $89!
OPTI-CD*cache*™ takes advantage of Extended Memory (XMS) to cache CD-ROM data. Retrieve data from a high speed cache instead of directly from the CD-ROM drive and significantly improve your CD-ROM workstation performance!
Ask for our free catalog of exciting CD-ROM products including the market leading OPTI-NET™ CD-ROM networking software!

ONLINE COMPUTER SYSTEMS, INC.
A member of the Reed Elsevier group
800-922-9201 or 301-428-3700
FAX us at 301-428-3709.

Inquiry 717.

NEW *NEW* *NEW*
Rocket "93" HQ CD ROM
600 megs of High Q. Shareware $39.95+
Latest Shareware on floppies $1.98 ea.+
Lowest Prices – Highest Quality
Catalog Available

ROCKET SHAREWARE
1-612-934-4775

Inquiry 718.

World Radio History

CD-ROM

Simtel MSDOS Shareware CDROM, 640 Meg, Dec. 92 ..$24.95
CICA MS Windows Shareware CDROM, Nov. 92.....$24.95
OS/2 Shareware CDROM, Nov. 92.....$24.95
Source Code CDROM, 600 Meg, Mar. 92.....$39.95
INFO-MAC Macintosh SW, 4000+ files, Aug. 92.....$39.95
CDROM Caddies.....$4.95

WALNUT CREEK CDROM
1547 Palos Verdes Mall, Ste 260, Walnut Creek, CA 94596
(800) 786 9907 (510) 947 5996 FAX: (510) 947 1644

Inquiry 719.

COMMUNICATIONS

X.25, HDLC, SDLC, BSC
SDLA card and software provides "plug-in" synchronous link support for PCs which is inexpensive, easy to use and robust. Coprocessor architecture ensures reliable communications under any operating system at line speeds to 180kbps. Packages include protocol analyser, test and development software. OEM enquiries welcome.
Full function SNA emulation packages also available.
Sangoma Technologies Inc.
(416) 474-1990 1-800-388-2475

Inquiry 720.

COMPUTER BOOKS

Going From C to C++
Robert J. Traister
The author draws on the reader's knowledge of C as the new tools of C++ are introduced, making the transition between these object-oriented programs a smooth and logical process.
April 1993, c. 224 pp., $34.95 (tentative)
ISBN: 0-12-697412-8
System requirements: 5¼" disk for 286 or higher IBM PC or compatible.
ACADEMIC PRESS
HBJ Order Fulfillment Dept. DM17915, Orlando, FL 32887
CALL TOLL FREE 1-800-321-5068 or FAX 1-800-336-7377

Inquiry 721.

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. MC/VISA/AMEX. CompuServe 70007,1333. GO CBK Windows, C++, O/S 2 2.0, UNIX, Mac, OOP
CompuBooks
Rt. 1, Box 271-D 512-321-9652
Cedar Creek, TX 78612 Fax 512-321-4525
800-880-6818

Inquiry 722.

COMPUTER INSURANCE

INSURES YOUR COMPUTER
SAFEWARE 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
SAFEWARE, The Insurance Agency Inc.
PO Box 02211, 2929 N. High St., Columbus, OH 43202

Inquiry 723.

COMPUTER SYSTEMS

LOW-LOW-LOW
Computer Systems/Notebooks/Network Solutions
IBM-Apple-Compaq-AST-ALR-Everex-&others
SURAH 386/486 ISA/EISA–AMI/Mylex Motherboards • CD ROMS • Tape Backup • Pocket FAX Modem LAN Cards • Hard Drives/Floppy Drives • Memory/upgrades • DRAMS, SIMM Modules • Laser Printers/Scanners • Plotters & Digitizers • Software
SURAH inc. 44912 Osgood Road, Fremont CA 94539 *USA*
Phone: (510) 651-5101 Fax: (510) 651-5241
1-800-543-1001 Nationwide Orders

Inquiry 724.

CROSS ASSEMBLERS

PC BASED DEVELOPMENT TOOLS
We offer low-cost efficient **CROSS ASSEMBLERS** and a superb line of **SIMULATOR-DEBUGGERS** with full built-in **DISASSEMBLERS** for Intel's **MCS-48, 51, 85** and **96**, and for the **Z80** families of embedded controllers. Our new simulators for the **80C196KB** and **80C196KC** are unique in the market, and have been received with rave reviews. The price of our software includes unlimited free upgrade privileges!
Lear Com Company
2440 Kipling St., Ste. 206, Lakewood, CO 80215
(303) 232-2226 FAX (303) 232-8721

Inquiry 725.

Cross Assemblers $50
Simulators $100
Disassemblers $100
PseudoCorp
716 Thimble Shoals Blvd. Newport News, VA 23606
(804) 873-1947 Fax (804) 873-2154

Inquiry 726.

DATA ANALYSIS

ADVANCED DATA ANALYSIS... at a click!
CLICK-X™ software, the most user friendly data analysis – ever! • Edit Graph/Data • Analyze • Advanced Math / Regression / Engineering / Statistics • Import/Export. FREE demo disk. Custom software available.
SoloSoft
P.O. Box 2548, Stamford, CT 06906-0548
Phone: (203) 977-8161 Fax: (203) 977-8237

Inquiry 727.

DATA CONVERSION

TAPE CONVERSION & DUPLICATION
- DC2000
- TEAC
- 8mm EXABYTE
- 1/2" Tape
- 1/4" Cartridge (AS/400)
- 4mm DAT
- DEC TKxx media
- 3480 & 3490

Mainframe, Mini or Micro – popular or obscure.
Fixed price quote by return. Standard turnaround 24 Hours.
In U.S.A. TEL 1 800-392-5373 FAX: 405-321-2741
TEL 44+ (0) 734-890042 FAX: 44+ (0) 734-890040
Vogon Enterprises Ltd.
Unit 5, Forrest Court, Oaklands Park, Fishponds Road, Wokingham, Berks., RG11 2FD, England

Inquiry 728.

DATA RECOVERY

Ontrack
DATA RECOVERY
• Professional service recommended by major hard drive manufacturers • Expertise in virtually every operating system & media storage device • 24-hour support with weekend, priority, & on-site service available • For fast, successful results, call:
CA: 1-800-752-7557 • MN:1-800-872-2599
2400 Main Street, Suite 200, Irvine CA 92714
6321 Bury Drive, Eden Prairie MN 55346

Inquiry 729.

Now we're Ontrack in London, too.
ONTRACK DATA RECOVERY EUROPE, LTD.
0800-24-39-96 • 44-81-974 5522
Surrey House, 34 Eden St., Kingston upon Thames, Surrey KT1 1ER U.K.

Inquiry 730.

DATA RECOVERY

Dr. Solomons Data Recovery Service
NO FIX-NO FEE
Unique Technical Expertise High Success Rate
Free Diagnosis Fast Turnaround
S & S International
Berkley Court, Mill Street
Berkhamsted, Hertfordshire HP4 2HB UK
Tel +44 (0)442 877877 Fax +44 (0)442 877882

Inquiry 731.

TAPE DATA RECOVERY
- DC2000
- TEAC
- 8mm EXABYTE
- 1/2" Tape
- 1/4" Cartridge (AS/400)
- 4mm DAT
- DEC TKxx media
- 3480 & 3490

Whatever the Hardware, Software & Problem... if there is data on a tape we will recover it.
In U.S.A. TEL 1 800-392-5373 FAX: 405-321-2741
TEL 44+ (0) 734-890042 FAX: 44+ (0) 734-890040
Vogon Enterprises Ltd.
Unit 5, Forrest Court, Oaklands Park, Fishponds Road, Wokingham, Berks., RG11 2FD, England

Inquiry 732.

DATA/DISK CONVERSION

CONVERTING YOUR DISKETTES? ENTRUST THEM TO US!
2500 Word Processor & Computer formats, 3½", 5¼", 8" Disks, Mag Tapes, Mag Cards, Cartridges, Cassettes & 8 MM Custom Conversions, Programming & Applications Development
DISK DUPLICATION
OCR SCANNING SERVICES
Call us for Quality, Best Prices and Quickest Turnaround Time.
COMPANY COMPENDIA, INC., 55 E. Washington St.,#237
Chicago, IL 60602 TEL: 1-800-374-DISK FAX: 312-419-1390

Inquiry 733.

THE #1 CHOICE
in disk & tape conversion
for many leading corporations, government agencies, law firms, and companies in every industry worldwide.
Free test • Satisfaction guaranteed
Graphics Unlimited Inc.
3000 Second St. North, Minneapolis, MN 55411
(612) 588-7571 FAX: (612) 588-8783
1-800-745-7571

Inquiry 734.

CONVERSION SERVICES
Convert any 9-track magnetic tape to or from over 5000 formats including 3½", 5¼", 8" disk formats & word processors. Disk-to-disk conversions also available. Introducing CD-ROM conversions. Call for more info.
Pivar Computing Services, Inc.
165 Arlington Hgts. Rd., Dept. #B
Buffalo Grove, IL 60089 **(800) Convert**

DATABASE

dBASE, Fox & Clipper from Visual Basic
Get complete database management power and dBASE, FoxPro and Clipper file compatibility from VB Win and VB DOS. Get CodeBasic! Fully multi-user and only $195. Comes with a 90 day money-back guarantee. FREE demo available.
Sequiter Software
#209, 9644-54 Ave., Edmonton, AB, Canada T6E 5V1
Tel (403) 437-2410 Fax (403) 436-2999

Inquiry 735.

World Radio History

THE BUYER'S MART

DATABASE

Which Windows database is the best?
The *best?*
We recommend **SUPERBASE 2**
We build vertical applications with it, train end-users and developers on it, and make it available to others who want the best Windows relational database
Superbase 2 for $189 (list $795)
Superbase 2 Developers Edition $650.
Superbase 2 Developer class, 4 days for $995.
Consulting and on-site training available.
THE NERD SHOP
800-448-NERD

Inquiry 736.

DIAGNOSTIC

"..PINPOINT ANY PC FAILURE."
John C. Dvorak, PC Magazine 6/30/92
Top-rated PocketPOST Power On Self-Test card with diagnostic software for ISA/EISA/Micro-Channel. 180-page book. Hones your trouble shooting skills. CALL NOW.
DATA DEPOT, Inc.
1710 Drew Street #5, Clearwater, FL 34615
1-800-275-1913
813-446-3402 FAX 813-443-4377

Inquiry 737.

FREE NEWSLETTER OFFER
THE PC TROUBLESHOOTER
Learn all the latest PC troubleshooting tips and tricks from the pros. Covers PCs, networks, Windows and more. CALL NOW for a FREE sample issue.
USA: (800) 683-6696
Int'l: (813) 443-1331, FAX: (813) 443-6603
Landmark Research Int'l Corp.
703 Grand Central Street
Clearwater, FL 34616

Inquiry 738.

DISK DRIVES

21MB 3.5" Floptical Disk Drive for $399!
EchoDrive SCSI Floptical disk drive not only reads and writes to 21MB 3.5" Floptical diskettes but also:
- reads and writes to 720K and 1.44MB floppy diskettes
- runs under DOS, Windows, or on the Macintosh
- is available as an external or internal drive
- ***provides amazing floppy speed! WOW!***
- It's GREAT for backup, file archival, and transporting files.

Second Wave, Inc. • 9430 Research Blvd. II-260
Austin, TX 78759 • (512) 343-9661 • FAX: (512) 343-9663

Inquiry 739.

EDUCATION

B.S. & M.S. In COMPUTER SCIENCE
The American Institute for Computer Sciences offers an in-depth correspondence program to earn your Bachelor of Science and Master of Science degrees in Computer Science at home. B.S. subjects covered are: MS/DOS, BASIC, PASCAL, C, Data File Processing, Data Structures & Operating systems. M.S. program includes subjects in Software Engineering and Artificial Intelligence.
AMERICAN INST. for COMPUTER SCIENCES
2101-BY Magnolia Ave. South, Ste. 200, Birmingham, AL 35205
800-767-2427 205-323-6191

FINANCIAL SOFTWARE

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. 12,000 sold. PC or Mac.
Still only $195!
Free Flyer: 800/284-8112, 916/477-7481
California Scientific Software

Inquiry 740.

FLOWCHARTS

FLOW CHARTING 3
FRIENDLY → FAST → FLEXIBLE
- High resolution print outs... dot matrix or laser
- Multi-page charts... portrait or landscape
- Import/export capabilities
- 35 shapes, 10 fonts, 4 line styles

ONLY $250
Call for free demo disk!
PATTON & PATTON 800-525-0082 ext. 1317
Software Corporation 485 Cochrane Cr., Morgan Hill, CA 95037
See our ad on page 172

Inquiry 741.

WINDOWS FLOWCHARTER $129
RFFlow 2.0 is a professional drawing tool for flowcharts & org. charts. Requires Microsoft Windows. 100 shapes auto adjust in size. Diagonal lines and curves. Auto line routing and re-routing. Click on a shape to bring up a sub-chart. Move charts to other apps. via the Clipboard. Call for free trial disk.
RFF ELECTRONICS
1053 Banyan Court, Loveland, CO 80538
Phone: (303) 663-5767 FAX: (303) 669-4889

FRAMEWORK/FRED

***THE* FRAMEWORK MAGAZINE**
Framework enhancement programs
12 issues **$29.90**
Unlimited Framework and FRED support. Access undocumented powers of Framework & FRED.
fBase for Framework $190.90
The fastest disk database access in existence. dBase file Index optimization and compression.
Selections & Functions, Inc.
(617) 826-1553
25 Washington Street, Hanover, MA 02339

G.I.S.

Digital Quad Maps
Local Street Maps, State Maps, and World Maps in DXF, PCX, PICT, PIC or TIF Formats. Gigabytes of Map data available.
Micro Map & CAD™
(303) 988-4940

Inquiry 742.

GRAPHICS DATA CONVERTER

OPTICAL GRAPH RECOGNITION (OGR) SOFTWARE
SCAN-X™ software imports, converts and manipulates data from scanned plots, pictures, graphs on paper, or captured screens into data files for comparing/analyzing/plotting/exporting. FREE demo disk. **Service available.**
SoloSoft
P.O. Box 2548, Stamford, CT 06906-0548
Phone: (203) 977-8161 Fax: (203) 977-8237

Inquiry 743.

HARDWARE

Let US Meet Your Hardware Needs
- Complete Systems-Starting @ $895 w/SVGA monitor
- For 486 DX50 from $895-$1795
- Motherboards, Memory
- Software

Call for information or catalog. MC & VISA accepted
Kings Computer Technologies
311 North Gray
Killeen, TX 76541 **817-554-5464**

Inquiry 744.

Pre-Owned Electronics, Inc™
THE Independent Provider, serving the Dealer, Professional, Corporate, Government, and Educational Buyer since 1985
APPLE II® & MACINTOSH®
SYSTEMS • PARTS • EXCHANGE REPAIRS
*Call for a Catalog...***800-274-5343**
INT'L: 617-275-4600 • FAX: 617-275-4848
205 BURLINGTON ROAD • BEDFORD, MA 01730

Inquiry 745.

HEWLETT PACKARD
Buy – Sell – Trade
LaserJet, DeskJet, RuggedWriter, Electrostatic Plotters
ColorPro, DraftPro, DraftMaster
• Monochrome and Color
HP 9000 Workstations and Vectras also available.
T. E. Dasher & Associates
4117 Second Ave., S. Birmingham, AL 35222
Phone: (205) 591-4747 Fax: (205) 591-1108
(800) 638-4833

Inquiry 746.

HARDWARE/COMPUTERS

SC/FOX™ EMBEDDED COMPUTERS
PC Parallel Coprocessor Plug-in Boards: 15 MIPS avg 50 MIPS burst, using the SC32 32-bit CPU or the 16-bit Harris RTX 2000™.
VME Master/Slave System Controller SBC: 18 MIPS avg 70 MIPS burst, uses RTX 2000 cpu. SCSI, 2 ser, 1 ptr ports, to 640K bytes.
Stand-Alone Single Board Computers: 18 MIPS avg 60 MIPS burst, 3U or 100x100mm Eurocard-size using either SC32 or RTX 2000.
Ideal for embedded real-time control, data acquisition, robotics, and signal processing. OEM software development system included.
SILICON COMPOSERS INC (415) 322-8763
208 California Avenue, Palo Alto, CA 94306

Inquiry 747.

World Radio History

INDUSTRIAL COMPUTING

Complete RealTime Operating System
For your 386/486 PC only
$995!

- POSIX Compliant
- Full Networking
- X Windows
- Realtime Tasks
- Development Tools
- Source Available

RTMX-UniFLEX **Call: 1-919-493-1451**

800 Eastowne Dr., Ste 111 • Chapel Hill, NC 27514

Inquiry 748.

JAPAN MARKET

Seek Software Developers

We are looking for companies developing competitive software products for PCs and aggressively wishing to enter Japan market. Enormous Japanese PC software market attracts worldwide attention. Do not worry about even though you are unfamiliar with Japan market or do not have well organized sales network in Japan. Our technical engineer is pleased to help you by modifications for Japanese PCs. If your company deserves our considering, please feel free to fax us today for details. Product catalogs and company profile are highly welcome.

Giken Shoji Co., Ltd.
Fax: 81-052-972-6577 Phone: 81-052-972-6544
6F Soar Bldg. 2-3, 1-chome Izumi, Higashi-ku, Nagoya 461, Japan

Inquiry 749.

LANS

The $25 Network
Try the 1st truly low-cost LAN

- Connect 2 or 3 XTs, ATs,386s, 486s
- Uses serial ports and null modem cable
- Runs at 115K baud - approx 8500 bytes/sec
- Runs in background, totally transparent
- Share disks and printers, etc.
- Needs only 15K of RAM

Little Big LAN
The most flexible network

- Peer to Peer LAN to 250 nodes
- $75 total software cost, not per node!
- Link via serial, parallel, or Arcnet
- Link via Ethernet or Modems soon
- Mixed mode routing
- Typically only 35K of RAM

Skeptical? We make believers!

Information Modes
P.O. Drawer F, Denton, TX 76202
Tech 817-387-3339 **Orders 800-628-7992**
Hours 1-5 Mon/Wed, 9-5 Tue/Thu/Fri CST

Inquiry 750.

LAPTOP COMPUTERS

USED COMPUTERS
MAJOR BRANDS - WIDE SELECTION
IBM - COMPAQ & OTHERS
Computers from $99 Color Printers $199
Mono Monitors from $25 CGA Color Monitors $129
IBM 5140 LAPTOP $349
IBM PCjr & CONVERTIBLE PARTS & ACCESSORIES
HARD-TO-FIND ITEMS FOR OLDER PCS
FREE CATALOG
COMPUTER RESET
P.O. Box 461782, Garland, TX 75046
Phone (214) 276-8072 & FAX BBS (214) 272-7920

Inquiry 751.

LAPTOP PERIPHERALS

Auto Power Adapters

- 12V battery systems
- Small package with high efficiency
- Plugs between computer and lighter receptacle
- $99 to $129
- Designed and made in USA!!

In stock for Apple PowerBook (10-30V input), Canon BJ printer, Compaq Contura, Everex Tempo LX, IBM, Kodak Diconix printer, Sanyo, Sharp, Toshiba, Zeos. Custom adapters designed for OEMs. Serial interface cards for Toshiba and Sanyo.

Empire Engineering
California USA
tel 805/543-2816 fax 805/543-2820

Inquiry 752.

MEDICAL SOFTWARE

INTELLIGENT MEDICAL SYSTEM
Distributors required for English, French, German & Spanish Market

Horizon Integrated Intelligent Medical System for International use in multilingual environment (HIMS) is a "state of the art" system for Doctors & Hospitals. Developed in conjunction with World Health Organization (WHO) standards.

HORIZON SOFTWARE LTD.
27 East Street, Leicester, LE1 6NB, U.K
TEL: (44) 533-556550 FAX: (44) 533-470942

Inquiry 753.

PROGRAMMERS TOOLS

INCORPORATE SOUND BLASTER & ADLIB INTO YOUR SOFTWARE

The WORX programmers toolkit will allow you to easily incorporate sound and music into your software without having to struggle with low level code and compatibility problems. Plays back standard MIDI files and VOC sample files fully in the background. This toolkit is a linkable library which takes less than 32K of code, and requires no driver or TSR. Autodetects Sound Blaster configuration. No royalties, and updates are always free. WORX 1.6 for Turbo C, Pascal and Microsoft C: $49 Resource manager for WORX (C only): $29

MYSTIC SOFTWARE
1504 Encinal Avenue, Ste D, Alameda, CA 94501
Voice: (510) 865-9189 Demos/BBS: (510) 865-3856

Inquiry 754.

DON'T
DEVELOP NETWORK APPLICATIONS
without NPPC, a powerful library subroutine package that handles all the details of IPX or NetBIOS programming! NPPC supports high-level program communication at the message level. If you are using C or Assembler, NPPC allows you to write a single application that runs on BOTH IPX AND NetBIOS without any modifications. Supports both client/server and peer-to-peer models. 30 day money back guarantee.

NPPC for IPX or NetBIOS
$195 w/source $395
SOFTWAREHOUSE CORPORATION
326 State Street, Los Altos, CA 94022
(415) 949-0203 FAX: (415) 949-0208

Inquiry 755.

Boost Your BASIC with ProBas!

- ProBas5 adds 938 new commands to QB/PDS
- Written in assembly for speed
- Gives your programs a professional look
- Easy to use, money back guarantee, $195
- Other add-ons for BASIC, C & Visual Basic avail.

FREE DEMO Disk AND BOOKLET
TeraTech **(800) 447-9120 x1043**
Dept 1043, 100 Park Ave., Suite 360, Rockville, MD 20850
Int'l +1(301) 424-3903 Fax (301) 762-8185 BBS (301) 762-8184

Inquiry 756.

Structograms
Software Documentation made quick and easy with PANORAMA

- **Structograms** (Nassi-Shneidermann) automatically from the source code in a flash
- **Hierarchie-trees** of modules, procedures
- **Headers** of modules, procedures
- **Software-Metrics:** McCabe complexity, LOC and more

Available for: Turbo Pascal, C, Modula-2, Fortran-77, PL/M, dBase
PANORAMA Standard (Pascal, C, Modula-2): $495
PANORAMA Lite: $295 **Wuest Informatik AG**
Schuetzenstrasse 11; CH-8245 Feuerthalen; Switzerland
Int'l (+41 53) 29 31 32 FAX: (+41 53) 29 31 43
Call or Fax for information and free demo.

Inquiry 757.

PROJECT BILLING

CLIENT PROJECT

A Time and Billing System that accounts for charges to over 100,000 projects *(or matters)*. Regular price $299, current price with limited time discount $159; demo available for $10.

MICRO BILLING SYSTEMS, INC.
117 W. Harrison, Ste# 624M, Chicago IL 60605
Tel: (312) 939-1869 Fax: (312) 939-1351

Inquiry 758.

SECURITY

FIGHT PIRACY!
★ EVERLOCK 3.0 ★
SOFTWARE COPY PROTECTION
New Option Board Safe-New Remote Registration
New CPU LOCK-CD ROM LOCK and more
★ EVERKEY HARDWARE LOCKS ★

Az-Tech Software, Inc.
Call for a FREE Demo **(800) 227-0644**
201 East Franklin, Richmond, MO 64085
(816) 776-2700
FAX (816) 776-8398

Inquiry 759.

THE ULTIMATE SOFTWARE SECURITY

- STOPCOPY family – UNCOPIABLE copy protection
- STOPVIEW software encryption
- NETLIMIT network license metering
- DOS, Windows, Macintosh, OS/2, support
- No source code changes required - for ANY of our products in ANY environment
- Our products destroy ALL of our competition
- Call for FREE demo disk, or to discuss our products' MANYoptions

BBI Computer Systems, Inc.
14105 Heritage Lane, Silver Spring, MD 20906
800/TRY-ABBI • 800/879-2224 • 301/871-1094 • FAX:301/460-7545

Inquiry 760.

Cop's CopyLock II

The professional software protection with TRUE Machine Install. Option Board safe. **OS/2, Networks, Windows,** and **Trace 1020.**

LINK Computer
Int'l: + 45 31232350 Fax: + 45 31238448
US/CAN: 800-344-2545 FAX: 408-923-7061

KEY-LOK™ SECURITY

Piracy survival over 10 years proves effectiveness of powerful multilayered security. Algorithmic response. Programmable memory. Very economical. Device transparent to PARALLEL/SERIAL port, Counters/Real-Time-Clock. Multi-product/feature licensing. DOS/UNIX/VMS/etc. Also, access control system and diskette drive locks.

MICROCOMPUTER APPLICATIONS
3167 E. Otero Circle, Littleton, CO 80122
(303) 770-1917

Inquiry 761.

SHAREWARE

FREE SOFTWARE FOR IBM®/CLONES

Try us! Get 5/5.25" or 3/3.5" disks full of the latest software – FREE! Choose from General Interest, Games, Windows®, Kid's, Clip Art or Fonts. Pay only a small service charge of $2.95 per package. Credit Cards only. CALL TODAY!

SOFTWARE OF THE MONTH CLUB
(619) 931-8111, EXT. 511

Inquiry 762.

World Radio History

THE BUYER'S MART

SOFTWARE WANTED

Publish Your Program!

Young, enthusiastic and successful software publishing company looking for PC productivity and utility software to acquire or publish. For a confidential review of your software product, send information to **Software Adv., 2210 Wilshire Blvd., #836, Santa Monica, CA 90403** or circle our number on the Direct Link Card in the back of this issue. We will contact you promptly.

Inquiry 763.

SOFTWARE/ACCOUNTING

dBASE BUSINESS TOOLS

- GENERAL LEDGER
- ORDER ENTRY
- JOB COSTING
- BILL OF MATLS
- PAYROLL
- PURCH ORD/INVNTORY
- ACCOUNTS RECVABLE
- JOB ESTIMATING
- SALES ANALYSIS
- ACCOUNTS PAYABLE

$99/$198 ea. + S&H

dATAMAR SYSTEMS Cred. Card-Check-COD

6969-D Corte Santa Fe, San Diego, CA 92121

(619) 452-0044 **(800) 223-9963**

Inquiry 764.

SOFTWARE/ENGINEERING

Mixed Mode Simulation

Electrical Engineers!

Now you can run Analog/Digital SPICE Simulations on your PC or Macintosh with the affordable and powerful

ISSPICE3

Also Available

- **Integrated Schematic Entry**
- **Extensive SPICE Model Libraries**
- **Waveform Graphics and Analysis**
- **Filter Synthesis and Design**

Full SPICE programs starting at $95. Complete systems with schematic, ISSPICE3 simulation, models, and waveform graphics only $1575.

Call or Fax for your Free Demo and information kit.

P.O. Box 710 San Pedro, CA 90733-0710

Tel (310)833-0710

FAX (310)833-9658

intusoft

Inquiry 765.

SAUNA: 3D THERMAL ANALYSIS

• Models: PCBs, plates, heatsinks, enclosures, multiboard enclosures. • All heat transfer modes: convection, radiation, conduction • Interactive menu-driven • Thermal parameters library • Fast "what if" dimension, mat'l, finish, analyses • Easy to learn & use • IBM PC & Macintosh II

Call for free evaluation program

Tatum Labs, Inc.

1287 N. Silo Ridge Drive, Ann Arbor, MI 48108

313-663-8810

Inquiry 766.

SOFTWARE/GRAPHICS

TIFF, PCX, TARGA, GIF, DIB, BMP, DCX, EPS, WMF, WPG, PICT, JPEG

AccuSoft Image Format Library 3.0

"The most comprehensive raster support library on the market"

Import, export, convert, display, and print all above formats! DOS & Windows versions included in one package. No royalties. Includes several sample programs with source code. Supports all languages. **Format compatibility guaranteed!** G3, G4, TIFF-F, multi-page images etc. Rotate, scale, color reduction, sharpen etc. 30 day satisfaction guarantee. $495

AccuSoft Corporation

160 E. Main St., P.O. Box 1261, Westboro, MA 01581

(800) 525-3577 (508) 898-2770 FAX (508) 898-9662

Inquiry 767.

SOFTWARE/GRAPHICS

SCIENTIFIC VISUALIZATION

Graphics library for VGA and ET4000 Super VGA. Up to 1024x768 resolution. Supports HiColor and 24-bit true color. 2-D & 3-D w/perspective. Gouraud shaded polygons. Z-buffer hidden surface removal. Animation. Mouse & joystick support. Scale and rotate text. Store/retrieve in PCX format. Available for MS FORTRAN, MS C, Borland C, Turbo C. $250. Call for free demo disk.

AEROSOFT CORPORATION

5562 Bells Ferry Rd., Suite 233, Acworth, GA 30102

Ph. 800-949-1812 **Tel/Fax 404-917-1309**

"The Ultimate CAD/CAM/CAE Programming Engine"

Slash your development time, with your CAD programming companion, **TG-Professional v.4.0,** the most complete C/C++ toolbox of 2D & 3D geometric routines available today! Over 800 routines including NURBS, DXF, Graphics, Surfacing, Hidden Line, Transforms, Perspectives, Polygon (Int/Union/Diff), Clipping, Tangents and more. Routines for drawing using BGI or MSC Graphics. Full source & 30 day guarantee. USA $500.00. Use MSC, Borland C/C++, WATCOM C/386 or Metaware High C/C++. Call 1-800-635-7760 or Fax/Phone 214-423-7288 for free 30 page technical paper.

Disk Software Inc.

109 S. Murphy Rd., Plano, TX USA 75094

Inquiry 768.

Sirlin's CAD ++ ENGINE

- Read and Write AutoCAD DWG and DXF files.
- Object oriented, modular, database-like access to CAD data.
- View, Print (rasterize), Plot (vectorize), and Pick (interact) modules.
- Available for C/C++ for DOS, Extended DOS, Windows, Sun and other Unix systems.

Sirlin Computer Corporation

25 Orchard View Dr., Ste 14, Londonderry, NH 03053

Phone: (603) 437-0727 • Fax: (603) 437-0737

Inquiry 769.

MARKET TO EUROPE!

The BYTE EURODECK offers you a unique opportunity to sell your computer products to BYTE's 50,000 European Subscribers!

Call Jim for more info!

(603) 924-2533

Inquiry 782.

SOFTWARE/GUI

GUI TOOLKIT ONLY $249

Full source code included

TEGL Windows Toolkit lets you create DOS based GUI apps that are completely standalone. Over 500 functions. Menus, mouse & keyboard support, dialogues, and more. Includes TEGL graphics interface which has drivers for most popular video modes. Supports most C and Pascal compilers. Protected mode version is only $499. No royalties.

TEGL Systems Corporation

P.O. Box 580, Stn. A, Vancouver B.C. V6C 2N2

(604) 669-2577 FAX (604) 688-9530

Inquiry 770.

SOFTWARE/PACKAGING

FREE SOFTWARE PACKAGING CATALOG

Everything you will need to Package, Distribute, and Ship Your Software!! From manuals and binders to mailers and shippers

LABELS • LABELS • LABELS

For your diskettes, plain or custom printed dot matrix or laser printer... free samples

•••FREE CATALOG•••

Hice & Associates

8586 Monticello Dr., West Chester, OH 45069

Phone/Fax: 513-777-8586

Inquiry 771.

SOFTWARE/PACKAGING

STOCK PACKAGING

to help you

market your software

ask for catalog 92 S

Call 708 390-7744

or fax 708 390-9886

PolyQuick Co.

1243 Rand Road, Des Plaines, IL 60016

Inquiry 772.

SOFTWARE/SCIENTIFIC

Weather Monitor & Weatherlink!

The ultimate in weather monitoring systems! A state-of-the-art weather station and a PC link allow you to view, record, summarize, and graph weather information. The perfect marriage of computer and weather technology.

DAVIS INSTRUMENTS

3465 Diablo Avenue, Hayward, CA 94545

1-800-678-3669 FAX 1-510-670-0589 BY28

Inquiry 773.

Volume Visualization

VoxelBox is a volume renderer for Windows. Volume rendering is the most direct method of visualizing 3D data. VoxelBox is fast, powerful and easy to use. It features raytracing, color/alpha mapping, lighting, keyframe animation support and much more. Price $495

Jaguar Software, Inc.

573 Main St. Suite 9B, Winchester, MA 01890

(617) 729-3659

Inquiry 774.

VTEX Scientific Desktop Publishing

• Equations • Tables • Graphics • Scalable Fonts • Supports most printers • WYSIWYG previewer • Foreign Languages • Special Symbols • Font Effects • Indices • Only $299

"TEX of Tomorrow"–Notices of AMS, March 1991.

Call now for a ***FREE DEMO DISK***

MicroPress, Inc.

68-30 Harrow Street, Forest Hills, NY

Tel (718) 575-1816 **Fax (718) 575-8038**

Inquiry 775.

SOFTWARE/VOICE/FAX

MULTI-VOICE® TOOLS

Multi-Voice Tools is a complete development Toolkit for Pascal or "C" to access all the features for most speech processing boards available today. It helps you write MULTI-LINE VOICE APPLICATION systems in minutes. A number of programming examples are provided. All programs and libraries are delivered with source code.

Dialogic, Rhetorex, Pika, VBX: $599. Watson (Single Line): $99. ALSO AVAILABLE: Fax Programmer's Toolkit ($199). Based on CAS specifications. Visa/MC accepted

ITI Logiciel

4263 Cristophe-Colomb, Montreal, Quebec, Can. H2J 3G2

TEL (514) 597-1692 **FAX (514) 526-2362**

STATISTICS

The AIM Estimator™

Outperforms Neural Nets & Regression!

AIM combines the best of neural nets & regression to automatically learn polynomial networks that ESTIMATE or PREDICT any numeric value, such as: prices, probabilities, fuzzy values, inventories, sensor readings, control settings, and costs. ANYONE can learn AIM within 30 minutes and quickly achieve more accurate results.

Order $20 Demo Package Today!

AbTech Corporation

508 Dale Ave. Tel:804-977-0686

Charlottesville, VA 22903 Fax: 804-977-9615

Inquiry 776.

World Radio History

STATISTICS

NCSS 5.x Series – $125
Easy-to-use menus & spread sheet. Multiple regression. T-tests. ANOVA (up to 10 factors, rep. measures, covariance). Forecasting. Factor, cluster, & discriminant analysis. Nonparametrics. Cross 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 777.

PsychStat MAX 2.2 - $59.95
Frequency • descriptives • chi-square • Fisher's exact test • ttests • multiple regression • weighted & unweighted ANOVAs • correlation • repeated measures • intraclass corr • ANCOVA • right-wrong & Likert item analysis • Cronbach's Alpha • point-biserial • corrected item-total • coprocessor support • ASCII • 25500 variables • satisfaction or money back.

PsychStat
1003 Justin Lane 2118
Austin, TX 78757 512-451-8152

Inquiry 778.

UTILITIES

***FastTrax* THE BEST DISK OPTIMIZER**
- Defragments any size DOS disk incl. >1 Gb
- No limits on directories, files or clusters
- Unique in-cylinder method reduces seeks
- ***MakeTrax*** (incl.) for custom file placement
- Batch operation, power failure protection
- $70, or $40 for competitive upgrade, + S&H

FastTrax International
880 Ensenada Avenue, Berkeley CA 94707
24-hr Sales and Tech support (510) 525-3510

Inquiry 779.

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/Chk/MO.

FPLOT Corporation
24-16 Steinway St., Suite 605, Astoria, NY 11103
718-545-3505

Inquiry 780.

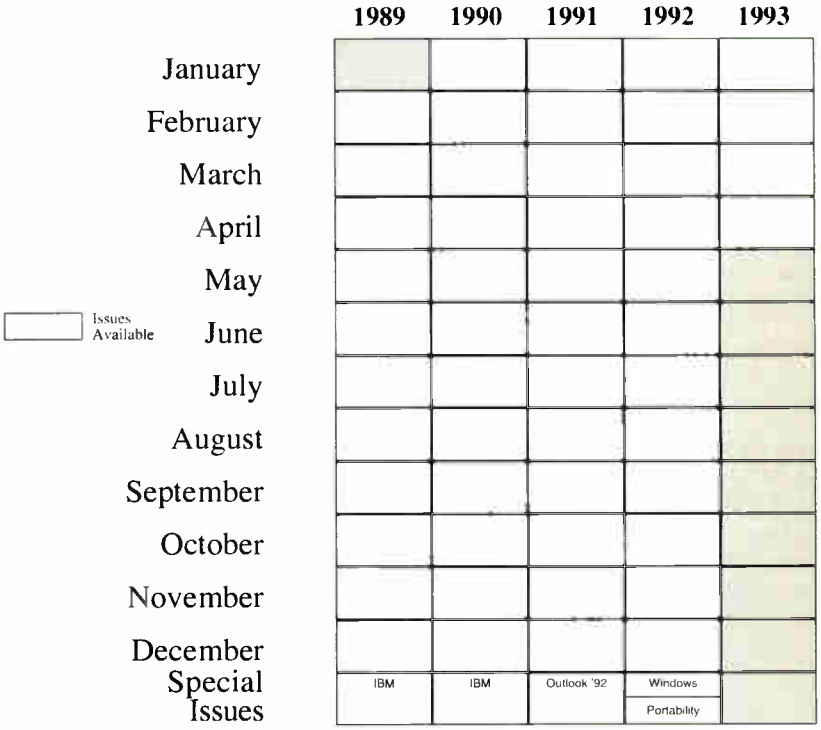
WINDOWS

***Hyper* Photo_db**
the HyperImage Spreadsheet/ Document manager/Desktop image authoring system for Windows
Display and manipulate up to 62K stampviews on main image matrix, or create families of images and documents–an image spreadsheet! Associate text info, other images, or imported files with any image or any pixel inside an image. Use Hyperlinking to navigate from image to image through successive levels of detail. Search 500K images in seconds. Design graphic information templates for relational database, report writing, tree search, or finding a point inside an image.
Use HyperPhoto_db to dynamically manage image collections and text. HyperLink your images to navigate images and retrieve data. Use your scanner and HyperPhoto_db to create simple desktop authoring for training, QA/QC, customer support, sales applications. Coming–compatible upgrade to *Hyper*-Video_db.
Work with PCX, BMP, TIF, GIF, Postscript file formats in true color or with color matching. Network version available.

Imaging power for $225!
Friendly Information Systems, Inc.
552 Massachusetts Avenue, Cambridge, MA 02139
CALL 800-55HYPER FAX (617) 492-8525

Inquiry 781.

BYTE BACK ISSUES FOR SALE



Windows – Portability U.S. Delivery $3.00, Foreign Delivery $4.00
1988 thru 1989 U.S. Delivery $3.00, Foreign Delivery $4.00
1990 thru 1992 U.S. Delivery $6.00, Foreign Delivery $8.00, Canada & Mexico $6.50

European customers please refer to Back Issue form in International Advertising section of book.

Please indicate which issues you would like by checking (√) the boxes. Send requests with payment to:

BYTE Back Issues,
One Phoenix Mill Lane
Peterborough, N.H. 03458
(603) 924-9281

☐ Check enclosed Charge: ☐ VISA ☐ MasterCard

Card# _____

Exp. Date _____

Signature _____

Name _____

Address _____

City _____

State _____ Zip _____

All orders must be prepaid. Please allow four weeks delivery.

World Radio History

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!***

Inquiry No.		Page No.	Phone No.
	A		
170-171	A T & T PARADYNE (N.A.)	181	800-554-4996 ext. 9604
61-62	ABACUS SOFTWARE	119	800-451-4319
178-179	ABC COMPUTER	224	310-325-6369
154	ADDA	118	+886-2-248-4276**
180-181	ADVANCED COMPUTER PROD	222	714-558-8813
63-64	AETECH	147	619-431-7714
165-166	ALLMICRO	103	800-653-4933
66	AMERICAN POWER CONV	110	800-800-4APC DPT.A2
182	AMT INTERNATIONAL	240	408-942-9695
568	APPRO INT'L INC	228PC-7	408-732-6091
67	ATI TECHNOLOGIES INC	167	416-756-0718
330	AXONIX CORP	244	801-466-9797
	B		
183-184	BAY TECHNICAL ASSOC	230	800-523-2702
450	BIX	206	800-695-4775
159-160	BLINK INC	109	804-355-4444
401-402	BOCA RESEARCH INC (INT'L)	80IS-3	407-997-6227
68-69	BORLAND INTERNATIONAL	13	800-336-6464 ext. 5074
185	BUFFALO PRODUCTS	223	800-345-2356
*	BYTE SUB MESSAGE	202	
	C		
*	C++	172IDRC1-2	212-274-0640
552	C.E.T.R.A.	228MW-3	+886-2-725-1314**
557	C.E.T.R.A.	228NE-4	+886-2-725-1314**
564	C.E.T.R.A.	228PC-6	+886-2-725-1314**
571	C.E.T.R.A.	228SO-2	+886-2-725-1314**
161	CASTELLE CORP	212	800-359-7654
73	CENTRAL POINT S/W	38-39	800-967-9251
403	CHERRY MIKROSCHALTER GMBH (INT'L)	206-207	+49-964-318-262**
436-437	CHICONY	56IS-4	+886-3-323-5743**
200	CITITRONICS	231	818-855-5688
368-369	COHORT SOFTWARE INC	248	510-524-9878
74-75	COLORADO MEMORY SYS	25	800-346-9881
76	COMMODORE	79	800-66-AMIGA
404-405	COMPEX INC	56IS-3	714-630-7302
406	COMPUSAVE INT'L (INT'L)	CIII	602-437-8208
79	COMPUTER ASSOCIATES	37	800-CALL-CAI
216	COMPUTER ASSOCIATES	136	800-CALL-CAI
*	COMPUTER PROFESSIONAL'S BOOK SOCIETY	148A-B	717-794-2191
*	COMPUTER PROFESSIONAL'S BOOK SOCIETY	149	717-794-2191
407	COMPUTER QUICK (INT'L)	57	415-861-8330
331	COMPUTER SYS ARCHITECT	241	800-753-4CSA
186	COMPUTERLANE UNLTD	72IS-4	800-526-3482
381	CONTROL CONCEPTS	241	703-876-6444
332	CONTROL VISION	245	316-231-6647
80	COREL SOFTWARE	48	800-836-SCSI
176-177	COVOX INC	205	503-342-1271
157-158	CREATIVE LABS INC	33	800-998-LABS
333	CURTIS INC	241	612-631-9512
187-188	CYBEX CORP	226	205-534-0010**
408-409	CYBEX CORP (INT'L)	CIV	205-534-0010**
	D		
172	DALLAS SEMICONDUCTOR	24	800-258-5061
335	DATALUX CORP (N.A.)	244	800-DATALUX
335	DATALUX CORP (INT'L)	244	+44-306-876718
334	DATALUX CORP (N.A.)	245	800-DATALUX
334	DATALUX CORP (INT'L)	245	+44-306-876718
410	DATAPRO INT'L	96IS-3	+44-0628-773628**
411-412	DATATRONICS TECH (INT'L)	97	+886-2-782-0305**
*	DELL COMPUTER CORP (N.A.)	CIII	800-626-8260
*	DELL COMPUTER CORP (N.A.)	CIV	800-626-8260
433	DEXDYNE (INT'L)	57	+44-285-655644**
553	DEXPO / MILLER FREEMAN, INC	228MW-5	800-87-DEXPO
559	DEXPO / MILLER FREEMAN, INC	228NE-7	800-87-DEXPO
567	DEXPO / MILLER FREEMAN, INC	228PC-5	800-87-DEXPO
572	DEXPO / MILLER FREEMAN, INC	228SO-5	800-87-DEXPO
336	DIAGSOFT INC	249	800-DIAGSOFT
173	DIGISPEECH INC	196	916-621-1787
382-383	DISPLAY RESEARCH LAB	246	+852-877-8810**
189-190	DISTRIBUTED PROCESSING TECH	234	407-830-5522
	E		
379-380	EDEN'S TECHNOLOGY CORP	242	309-862-1704
385	EDUCALC	244	714-582-2637
81	ELIASHIM MICROCOMPUTERS	147	+972-4-528613**
*	ELONEX (INT'L)	52-53	+44-81-452-6422**
373	ELSIST	246	+39 142 451988**
211-212	EMBARC / MOTOROLA	228	800-EMBARC4 ext. 350
413	EUTRON (INT'L)	97	+39-35-692-229**
558	EVOLUTION COMPUTING	228NE-3	800-874-4028
566	EVOLUTION COMPUTING	228PC-1	800-874-4028
	F		
82	FARALLON (N.A.)	73	800-998-7760 4
414	FAST ELECTRONIC GMBH (INT'L)	73	+49-89-533-401**
425-426	FIRST INT'L COMP	56IS-2	+886-2-717-4500**
191-192	FIRST SOURCE INT'L	232	714-588-9866
415-416	FUTURESOFT ENGINEERING	80IS-2	713-496-9400
	G		
*	GATEWAY 2000	CII,1	800-846-2000
*	GATEWAY 2000	40A-H	800-846-2000
375	GENERAL TECHNICS	244	800-487-2538
337	GENOVATION, INC	245	800-822-4333
417	GFK HAMBURG	72IS-3	+49-40-231-789**
83-84	GLENCO ENGINEERING	163	800-562-2543
77-78	GREENVIEW DATA	139	800-458-3348
418	GREY MATTER LTD	96IS-4	+44-0364-53071**
388	GSQUARED COMPUTERS	243	214-948-3155
338	GTEK INC	242	800-282-4835
	H		
440	HONEYWELL KEYBOARD DIV	72IS-1	914-544-5511
214	HUMMINGBIRD COMMNTNS	192	416-470-1207
	I		
*	IBM - DIRECT (N.A.)	51	800-IBM-2-YOU ext. 413BYTE
86	IBM - DIRECT (N.A.)	52-53	800-IBM-2-YOU ext. 413BYTE
85	IBM - DIRECT (N.A.)	54	800-IBM-2-YOU ext. 413BYTE
87	IBM PERSONAL S/W PROD	14-15	4070982-6408
339-340	INDUS	248	800-843-9377
341	INES GMBH	243	+49-221-491621
378	INFINICON	242	800-374-3880
88	INTEGRAND RESEARCH	46	209-651-1203
90	INTEL CORP	10-11	800-538-3373
89	INTEL CORP	22-23	800-538-3373
174-175	INTELLIGENT SECURITY SYS	202	800-237-4774
91	INTERFACE GROUP	70-71	
342	IO TECH	246	216-439-4091
155-156	ITERATED SYSTEMS	118	404-840-0633
370	IVERSON SOFTWARE, INC	249	416-925-6096
	J		
92	JAMECO ELECTRONICS	157	800-831-4242
*	JDR MICRODEVICES	239	800-538-5000
427	JEN ELECTRONICA (INT'L)	54	+39-73-3224035**
	K		
93	KEA SYSTEMS LTD	88	800-663-8702
*	KEDWELL SOFTWARE	80IS-1	603-433-4777
561	KENOSHA COMP CTR	228NE-8	800-255-2989
554	KENOSHA COMP CTR	228MW-1	800-255-2989
569	KENOSHA COMP CTR	228PC-3	800-255-2989
575	KENOSHA COMP CTR	228SO-6	800-255-2989
343	KILA	243	303-444-7737
94-95	KINGSTON TECHNOLOGY	42-43	714-435-2600
	L		
344	LAGUNA DATA SYSTEMS	247	800-859-8856
96	LAHEY COMPUTER SYSTEMS	50	800-548-4778
134-135	LANDMARK RESCH INT'L CORP	113	800-683-6696
345	LAWSON LABS INC	243	800-321-5355
206	LOGICAL CONNECTION	240	800-238-9415
97-98	LOGITECH INC	125	800-732-3021
	M		
*	MANCHESTER EQUIP CO	228NE-A-B	516-435-1199
577	MANCHESTER EQUIP CO	228NE-1	516-435-1199
435	MANNESMANN TALLY (INT'L)	51	+44-0628-527782**
*	MARK WILLIAMS CO	91	800-627-5967
101	MATHSOFT INC	146	800-628-4223
100	MATHSOFT INC	190	800-628-4223
*	MCGRAW HILL BOOKSTORE	92	212-512-4100
*	MCGRAW HILL NRI (N.A.)	80A-B	
102	MEDIA CYBERNETICS	128	800-992-HALO
419	MEGADATA	96IS-2	516-589-6858**
367	MEMORY SUPERSTORE	245	800-800-7056
104-105	MICRO SOLUTIONS COMP PROD	84	815-756-3411
201-202	MICRO-INTERNATIONAL, INC	229	800-967-5667
376-377	MICROBIZ	248	800-637-8268
103	MICROPOLIS CORP	159	800-395-3748
*	MICROSOFT CORP	21	800-426-9400
*	MICROSOFT CORP	56A-B	800-882-2000 ext. J49
*	MICROSOFT CORP (N.A.)	57	800-882-2000 ext. J49
*	MICROSOFT CORP	83	800-426-9400 ext. JK8
*	MICROSOFT CORP	85	800-426-9400 ext. JK8
*	MICROSOFT CORP	87	800-426-9400 ext. JK8
*	MICROSOFT CORP	107	800-426-9400
346	MICROSTAR LABORATORIES	243	206-453-2345
573-574	MICROTECH COMPUTER	228SO-3	800-342-6508
106	MICROWAY	142	508-746-7341
424	MINICOM LTD	80IS-2	+972-2-637576**
421	MINOLTA GMBH	96IS-1	+49-511-779089**
114	MINUTEMAN	89	214-446-7363
374	MITAC	241	+886-2-509-0979**
420	MKS / MORTICE KERN SYS	80IS-4	519-884-2251
107	MYLEX CORP	26-27	510-796-6100
	N		
209-210	NAGA SYSTEMS CORP	218	800-568-6242
108-109	NANAO USA CORP (N.A.)	97	310-325-5202
347	NATIONAL INSTRUMENTS	248	800-433-3488
*	NATIONAL INSTRU	172IDRC1-2	512-794-0100
110	NEC - PRINTERS	115	800-NEC-INFO
112	NEC - ENTRY SYSTEMS	30-31	800-NEC-INFO
111	NEC - LAPTOPS	17	800-NEC-INFO
193	NEVADA COMPUTER	227	800-654-7762
113	NSTL	235	215-941-9600
	O		
207-208	OCEAN OFFICE AUTOMATION LTD	237	+852-305-1800
428	ON TIME MKT / KARSTEN PETERSEN	96IS-2	+49-40-435-196**
348	OVERLAND DATA INC	247	800-729-8725
	P		
*	PACIFIC DATA PRODUCTS	131	619-625-3608
115	PATTON & PATTON	172	800-525-0082 ext. 112
551	PC EXPO	228MW-4	800-829-3976
556	PC EXPO	228NE-2	800-829-3976
563	PC EXPO	228PC-2	800-829-3976
570	PC EXPO	228SO-4	800-829-3976
116-117	PC POWER & COOLING	69	800-722-6555
118	PERSOFT INC	161	800-368-5283
555	PERSONAL SOLU COMP	228MW-2	800-685-3981
562	PERSONAL SOLU COMP	228NE-5	800-685-3981
576	PERSONAL SOLU COMP	228SO-1	800-685-3981
119	PHAR LAP SOFTWARE INC	82	617-661-1510
120-121	PINNACLE MICRO	6-7	714-727-3300
366	PIXEL PERFECT / MEDICAL ADVISOR	249	800-788-2099
122	PKWARE INC	160	414-354-8699
349	POLAROID CORP	241	800-225-2770
560	POLYWELL COMP, INC	228NE-6	800-999-1278
123	POPKIN S/W & SYSTEMS INC	175	212-571-3434
*	PROGRAMMER'S PARADISE	59	800-445-7899
99	PROGRAMMER'S PARADISE	60-61	800-445-7899

World Radio History

YOUR DIRECT LINK

ADVERTISER CONTACT INFORMATION

Inquiry No.		Page No.	Phone No.
*	PROGRAMMER'S SHOP (N.A.)	76-77	800-421-8006
	Q		
125	QUA TECH INC	216	800-553-1170
350	QUALSTAR CORP	247	818-882-5822
431-432	QUANTUM CORP (INT'L)	180	+41-38-337722
429-430	QUANTUM CORP (INT'L)	181	+41-38-337722
124	QUARTERDECK OFFICE SYS	187	310-392-9851
	R		
*	RAIMA CORP	75	800-327-2462
126-127	RAINBOW TECHNOLOGIES	65	800-852-8569
203	RALIN WHOLESALERS	238	800-752-9512
197-198	RECORTEC INC	219	800-729-7654
128	ROSE ELECTRONICS	8	800-333-9343
	S		
130	S'N'W COMPUTERS & ELECTRONICS	92	800-874-1235
194	SAFEWARE	225	800-848-3469
438-439	SAMTRON (INT'L)	76	+82-2-774-6659**
351	SAS INSTITUTE INC	249	919-677-8000
352-353	SECURE IT INC	247	800-451-7592
129	SEQUITER SOFTWARE INC	188	403-437-2410
371-372	SIGMA TECH SOFTWARE	242	818-368-6132
441	SOFTLINE CORP	56IS-1	718-438-6057
131-132	SOFTWARE SECURITY INC	203	203-329-8870
195	STARTECH INT'L	233	619-278-2600
386	STARTEK	249	+886-35-787089**
133	STATSOFT	209	918-583-4149
217	STORAGE DIMENSIONS	58	800-344-4323
*	STRADA AUTOTECH, INC	241	613-359-1029 ext. (ORIS)
162	SUNSOFT	2-3	800-227-9227
136-137	SYSTAT INC	93	708-864-5670
422	SZKI RECOGNITA CORP (INT'L)	77	+361-201-7607**
	T		
354	TALKING TECHNOLOGY INC	242	800-685-4884
355-356	TECHNOLOGIC SYSTEMS	246	513-644-2230
423	TECHPOWER COMPANY LTD	80IS-2	+886-2-753-1940**
138	TEKTRONIX	47	800-835-6100
139	TEXAS INSTRUMENTS	86	800-527-3500
141	TEXAS MICROSYSTEMS	116A-B	800-627-8700
140	TEXAS MICROSYSTEMS	117	800-627-8700
565	THE COMP MUSEUM	228PC-4	
142	TOSHIBA AMERICA INC	34-35	800-457-7777
196	TOTE-A-LAP	221	800-9-LAPTOP
213	TOUCHPLS	238	+886-2-325-3117
143-144	TOUCHSTONE SOFTWARE	90	714-969-7746
204	TRANSCEND INFO INC	236	909-598-5500
205	TRANSCEND INFO INC	250	909-598-5500
364	TRANTOR SYSTEMS LTD	244	800-872-6867
365	TRI VALLEY TECHNOLOGY INC	243	510-447-2030
357-358	TRIBAL MICROSYSTEMS	246	510-623-8859
145-146	TRIPP LITE	94	312-329-1777
387	TTI TECHNOLOGIES	245	800-541-1943
	U		
*	UNIXWORLD	184	800-257-9402
*	UNIXWORLD	184A-B	800-257-9402
	V		
147	VALITEK INC	178	800 VALITEK
148	VERBATIM CORP	123	
*	VERMONT CREATIVE S/W	9	802-848-3502**
167	VIDEO MAKER / VITEC	169	+33-146-29-03-04**
359	VIDEX, INC	242	503-758-0521
149-150	VIEWSONIC	18-19	714-869-7976
360	VISTA MICROSYSTEMS	248	800-875-8459
215	VORTEX COMPUTERS	263	800-548-7839
	W		
151	WATCOM PRODUCTS INC	29	800-265-4555
384	WILTEC, INC	247	919-763-8400
361	WINTEK CORP	248	800-742-6809
199	WORLDWIDE TECHNOLOGIES	220	800-457-6937
	X		
362	XELTEK	246	408-524-1929
163-164	XLI CORP	134-135	617-932-9199
	Z		
363	Z-WORLD ENGINEERING	246	916-757-3737
152	ZEOS INTERNATIONAL	171	800-423-5891
153	ZYLAB / DIVISION OF IDI	95	800-544-6339
168-169	ZYXEL USA	140-141	714-693-0808

** Correspond directly with company.*
*** Indicates FAX Number*

BYTE ADVERTISING SALES STAFF

Liz Coyman, Inside Advertising Sales Director, One Phoenix Mill Lane, Peterborough, NH 03458, Tel. (603) 924-2518

NEW ENGLAND
ME, NH, VT, MA, RI, CT, ONTARIO CANADA & EASTERN CANADA
David Richardson (617) 860-6344
Patricia Payne (603) 924-2654
McGraw-Hill Publications
24 Hartwell Avenue
Lexington, MA 02173
FAX: (617) 860-6899

EAST COAST
NY, NYC, NJ, DE, PA
Kim Norris (212) 512-2645
Jonathan Sawyer (603) 924-2665
McGraw-Hill Publications
1221 Avenue of Americas—28th Floor
New York, NY 10020
FAX: (212) 512-2075

SOUTHEAST
NC, SC, GA, FL, AL, TN, MS, AR, LA, KY, DC, MD, VA, WV
MaryAnn Goulding (404) 843-4782
Barry Echavarria (603) 924-2574
McGraw-Hill Publications
4170 Ashford-Dunwoody Rd., Suite 520
Atlanta, GA 30319
FAX: (404) 252-4056

MIDWEST
IL, MO, KS, IA, ND, SD, MN, WI, NE, IN, MI, OH
Kurt Kelley (312) 616-3328
Ed Ware (603) 924-2664
McGraw-Hill Publications
Two Prudential Plaza
180 North Stetson Ave.
Chicago, IL 60601
FAX: (312) 616-3370

SOUTHWEST, ROCKY MOUNTAIN
CO, OK, TX
Jennifer Walker (214) 701-8496
Larry Levine (603) 924-2637
McGraw-Hill Publications
14850 Quorum Dr., Suite 380
Dallas, TX 75240
FAX: (214) 991-6208

SOUTH PACIFIC: Los Angeles, CA
LOS ANGELES COUNTY, AZ, NM,
Alan El Faye (213) 480-5243
Larry Levine (603) 924-2637
McGraw-Hill Publications
3333 Wilshire Boulevard #407
Los Angeles, CA 90010
FAX: (213) 480-5249

NORTH PACIFIC
NORTHERN CA, OR, ID, MT, WY, UT
Roy J. Kops (415) 513-6861
Joseph Mabe (603) 924-2662
SILICON VALLEY, HI, WA, AK, W. CANADA
Bill McAfee (415) 513-6862
Jonathan Sawyer (603) 924-2665
SILICON VALLEY, NV
Barbara Holmes (415) 513-6945
Barry Echavarria (603) 924-2574
McGraw-Hill Publications
1900 O'Farrell Street, #200
San Mateo, CA 94403
FAX: (415) 513-6867

SOUTH PACIFIC: Irvine, CA
ORANGE COUNTY
SAN DIEGO COUNTY
Beth Dudas (714) 753-8140
Joseph Mabe (603) 924-2662
McGraw-Hill Publications
15635 Alton Pkwy., Suite 290
Irvine, CA 92718
FAX: (714) 753-8147

Peterborough, NH Office: Inside Sales FAX: **603-924-2683** Advertising FAX: **603-924-7507**

Hardware/Software Showcase
Mark Stone (603) 924-2695
Ellen Perham (603) 924-2598
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

The Buyer's Mart/Classifieds
Margot Gnade (603) 924-2656
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

BYTE Deck
Brad Dixon (603) 924-2596
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

EURO-DECK
James Bail (603) 924-2533
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Regional & Buyer's Guide
Brian Higgins (603) 924-2651
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

BYTE International Direct Response Postcards
Ellen Perham (603) 924-2598
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

INTERNATIONAL ADVERTISING SALES STAFF

GERMANY, SWITZERLAND, AUSTRIA
Jürgen Heise
McGraw-Hill Publishing Co.
Liebigstrasse 19
D-6000 Frankfurt
Germany
Tel: +49 69 71407 140
FAX: +49 69 71407 147

SCANDINAVIAN COUNTRIES
Zena Coupé
A-Z International Sales Ltd.
70 Chalk Farm Road
London NW1 8AN
England
Tel: +44 71 2843171
FAX: +44 71 2843174

FRANCE, UNITED KINGDOM, BENELUX
Gary Lucas (+44 81 545 6268)
McGraw-Hill Publishing Co.
Wimbledon Bridge House
One Hartfield Road
Wimbledon, London SW19 3RU
England
FAX: +44 81 5456294
TELEX: 892191

ITALY
Zena Coupé, Amanda Blaskett
A-Z International Sales Ltd.
70 Chalk Farm Road
London NW1 8AN
England
Tel: +44 71 2843171
FAX: +44 71 2843174

ISRAEL
Dan Ehrlich
Ehrlich Communication Int'l.
P.O. Box 99
Herzliya 46101, Israel
Tel: +972 52 586245
Tel: +972 52 586246
FAX: +972 52 585685

AUSTRALIA
Rod Tremain
Rod Tremain Media
Suite 4, 1st Floor,
13-14 Myrtle Street,
Crows Nest, NSW
Australia 2065
Tel: +61 2 955 3545
FAX: +61 2 955 3646

JAPAN
Masaki Mori
Transworld Media Inc.
4th Floor, 1-26-6 Kamimeguro
Meguro-ku, Tokyo 153, Japan
Tel: +81 3 57210761
FAX: +81 3 57210762

KOREA
Young-Seoh Chinn
JES MEDIA INT'L.
5th Floor, Banpo Bldg.
40-7, Chamwon-Dong, Seocho-Gu
Seoul 137-030, Korea
Tel: +82 2 5458001
Tel: +82 2 5458002
FAX: +82 2 5498861

SINGAPORE
Derek Ng
Stephen Tay
Third Wave Publishing Corp.
1123 Serangoon Road, #03-01
Singapore 1232
Tel: +65 296 6166
FAX: +65 298 7551

HONG KONG
Candice Lo
Third Wave Publishing Corp.
Unit 2, 6F Hing Wah Center
82-84 To Kwa Wan Road
Kowloon, Hong Kong
Tel: +852 764 3830
FAX: +852 764 3857

MAYAYSIA
Servex (Malaysia) Sdn. Bhd.
H.K. Lin
5th Floor, Bena Tower
160, Jalan Ampang
50450 Kuala Lumpur, Malaysia
Tel: +60 3 2624592
FAX: +60 3 2624591

THAILAND
Jack Hu
Sahaviriya OA Group
28/1 Prapawit Bldg., Surasak Rd.
Silom, Bangkok 10500
Thailand
Tel: +66 2 2360295
FAX: +66 2 2365960

TAIWAN
Liwen Lee
Third Wave Publishing Corp.
2nd Fl., No. 19-1, Lane 231
Fu Hsing North Road
Taipei 10445, Taiwan
R.O.C.
Tel: +886 2 7136959
FAX: +886 2 7151950

INDIA, INDONESIA, PAKISTAN, PHILIPPINES, OTHER ASIAN AND PACIFIC COUNTRIES
K.T. Wu
Third Wave Publishing Corp.
2nd Fl., No. 19-1, Lane 231
Fu Hsing North Road
Taipei 10445, Taiwan
R.O.C.
Tel: +886 2 7136959
FAX: +886 2 7151950

Subscription Customer Service
U.S. 1-800-232-2983
Outside U.S. +1-609-426-7676

For a New Subscription
U.S. 1-800-257-9402
Outside U.S. +1-609-426-5526

World Radio History

YOUR DIRECT LINK

PRODUCT CATEGORY INDEX

For FREE product information from individual advertisers, circle the corresponding inquiry numbers on Your Direct Link Card!

To receive information for an entire product category, circle the category number on Your Direct Link Card!

Category No. / Inquiry No. — Page No.

HARDWARE

1 ACCESSORIES/SUPPLIES

85	IBM - DIRECT (N.A.)	54
435	MANNESMANN TALLY (INT'L)	51
349	POLAROID CORP	241

2 ADD-IN BOARDS

67	ATI TECHNOLOGIES INC	167
401-402	BOCA RESEARCH INC. (INT'L)	80IS-3
404-405	COMPEX INC	56IS-3
331	COMPUTER SYSTEM ARCHITECT	241
381	CONTROL CONCEPTS	241
333	CURTIS INC	241
433	DEXDYNE (INT'L)	57
189-190	DISTRIBUTED PROCESSING TECH	234
379-380	EDEN'S TECHNOLOGY CORP	242
417	GFK HAMBURG	72IS-3
92	JAMECO ELECTRONICS	157
427	JEN ELECTRONICA (INT'L)	54
374	MITAC	241
107	MYLEX CORP	26-27
125	QUA TECH INC	216
•	STRADA AUTOTECH, INC	241
354	TALKING TECHNOLOGY INC	242

3 BAR CODING

435	MANNESMANN TALLY (INT'L)	51
359	VIDEX, INC	242

4 COMMUNICATIONS/NETWORKING

183-184	BAY TECHNICAL ASSOC	230
379-380	EDEN'S TECHNOLOGY CORP	242
•	ELONEX (INT'L)	52-53
211-212	EMBARC / MOTOROLA	228
338	GTEK INC	242
378	INFINICON	242
419	MEGADATA	96IS-2
573-574	MICROTECH COMPUTER	228SO-3
424	MINICOM LTD	80IS-2
128	ROSE ELECTRONICS	8
371-372	SIGMA TECH SOFTWARE	242
354	TALKING TECHNOLOGY INC	242
355-356	TECHNOLOGIC SYSTEMS	246

5 COMPUTER SYSTEMS

568	APPRO INTERNATIONAL INC	228PC-7
76	COMMODORE	79
•	DELL COMPUTER CORP (N.A.)	CIII
•	DELL COMPUTER CORP (N.A.)	CIV
•	ELONEX (INT'L)	52-53
•	GATEWAY 2000	CII,1
•	GATEWAY 2000	40A-H
388	GSQUARED COMPUTERS	243
•	IBM - DIRECT (N.A.)	51
341	INES GMBH	243
343	KILA	243
•	MANCHESTER EQUIPMENT CO	228NE-A-B
577	MANCHESTER EQUIPMENT CO	228NE-1
201-202	MICRO-INTERNATIONAL, INC	229
573-574	MICROTECH COMPUTER	228SO-3
209-210	NAGA SYSTEMS CORP	218
112	NEC - ENTRY SYSTEMS	30-31
113	NSTL	235
207-208	OCEAN OFFICE AUTOMATION LTD	237
116-117	PC POWER & COOLING	69
555	PERSONAL SOLUTION COMPUTERS	228MW-2
562	PERSONAL SOLUTION COMPUTERS	228NE-5
576	PERSONAL SOLUTION COMPUTERS	228SO-1
197-198	RECORTEC INC	219
423	TECHPOWER COMPANY LTD	80IS-2
141	TEXAS MICROSYSTEMS	116A-B
140	TEXAS MICROSYSTEMS	117
365	TRI VALLEY TECHNOLOGY INC	243
152	ZEOS INTERNATIONAL	171

6 DATA ACQUISITION

345	LAWSON LABS INC	243
346	MICROSTAR LABORATORIES	243
•	NATIONAL INSTRUMENTS	172IDRC1-2
125	QUA TECH INC	216

7 DISK & OPTICAL DRIVES

375	GENERAL TECHNICS	244
104-105	MICRO SOLUTIONS COMP PROD	84
103	MICROPOLIS CORP	159
120-121	PINNACLE MICRO	6-7
431-432	QUANTUM CORP (INT'L)	180
429-430	QUANTUM CORP (INT'L)	181
195	STARTECH INTERNATIONAL	233
364	TRANTOR SYSTEMS LTD	244

8 DISKETTES/DUPLICATORS

148	VERBATIM CORP	123

10 GRAPHICS TABLETS/MICE/PEN INPUT

440	HONEYWELL KEYBOARD DIVISION	72IS-1

11 KEYBOARDS

403	CHERRY MIKROSCHALTER GMBH (INT'L)	206-207
335	DATALUX CORP (INT'L)	244
335	DATALUX CORP (N.A.)	244

12 LAN HARDWARE

183-184	BAY TECHNICAL ASSOC	230
187-188	CYBEX CORP	226
408-409	CYBEX CORP (INT'L)	CIV
206	LOGICAL CONNECTION	240
424	MINICOM LTD	80IS-2
116-117	PC POWER & COOLING	69
203	RALIN WHOLESALERS	238

13 LAPTOPS & NOTEBOOKS

178-179	ABC COMPUTER	224
330	AXONIX CORP	244
436-437	CHICONY	56IS-4
385	EDUCALC	244
425-426	FIRST INTERNATIONAL COMPUTER	56IS-2
337	GENOVATION, INC	245
86	IBM - DIRECT (N.A.)	52-53
201-202	MICRO-INTERNATIONAL, INC	229
111	NEC - LAPTOPS	17
560	POLYWELL COMPUTERS, INC	228NE-6
130	S'N'W COMPUTERS & ELECTRONICS	92
139	TEXAS INSTRUMENTS	86
142	TOSHIBA AMERICA INC	34-35
196	TOTE-A-LAP	221
215	VORTEX COMPUTERS	263
152	ZEOS INTERNATIONAL	171

14 MAIL ORDER

180-181	ADVANCED COMPUTER PROD	222
182	AMT INTERNATIONAL	240
200	CITITRONICS	231
186	COMPUTERLANE UNLTD	72IS-4
86	IBM - DIRECT (N.A.)	52-53
85	IBM - DIRECT (N.A.)	54
92	JAMECO ELECTRONICS	157
•	JDR MICRODEVICES	239
554	KENOSHA COMPUTER CENTER	228MW-1
561	KENOSHA COMPUTER CENTER	228NE-8
569	KENOSHA COMPUTER CENTER	228PC-3
575	KENOSHA COMPUTER CENTER	228SO-6
193	NEVADA COMPUTER	227
555	PERSONAL SOLUTION COMPUTERS	228MW-2
562	PERSONAL SOLUTION COMPUTERS	228NE-5
576	PERSONAL SOLUTION COMPUTERS	228SO-1
130	S'N'W COMPUTERS & ELECTRONICS	92
195	STARTECH INTERNATIONAL	233

15 MEMORY/CHIPS/UPGRADES

200	CITITRONICS	231
191-192	FIRST SOURCE INT'L	232
417	GFK HAMBURG	72IS-3
90	INTEL CORP	10-11
89	INTEL CORP	22-23
92	JAMECO ELECTRONICS	157
94-95	KINGSTON TECHNOLOGY	42-43
367	MEMORY SUPERSTORE	245
204	TRANSCEND INFORMATION INC	236
205	TRANSCEND INFORMATION INC	250
387	TTI TECHNOLOGIES	245
199	WORLDWIDE TECHNOLOGIES	220

16 MISCELLANEOUS HARDWARE

88	INTEGRAND RESEARCH	46
97-98	LOGITECH INC	125
126-127	RAINBOW TECHNOLOGIES	65
195	STARTECH INTERNATIONAL	233

17 MODEMS/MUILTIPLEXORS

170-171	A T & T PARADYNE (N.A.)	181
411-412	DATATRONICS TECHNOLOGY	97
•	JDR MICRODEVICES	239
168-169	ZYXEL USA	140-141

18 MONITORS & TERMINALS

334	DATALUX CORP (INT'L)	245
334	DATALUX CORP (N.A.)	245
•	ELONEX (INT'L)	52-53
108-109	NANAO USA CORP (N.A.)	97
438-439	SAMTRON (INT'L)	76
213	TOUCHPLS	238
149-150	VIEWSONIC	18-19

19 MULTIMEDIA

154	ADDA	118
332	CONTROL VISION	245
176-177	COVOX INC	205
157-158	CREATIVE LABS INC	33
173	DIGISPEECH INC	196
382-383	DISPLAY RESEARCH LAB	246
96	LAHEY COMPUTER SYSTEMS	50
97-98	LOGITECH INC	125
•	MICROSOFT CORP	83
•	MICROSOFT CORP	85
•	MICROSOFT CORP	87
138	TEKTRONIX	47
167	VIDEO MAKER / VITEC	169

20 PRINTERS/PLOTTERS

183-184	BAY TECHNICAL ASSOC	230
185	BUFFALO PRODUCTS	223
206	LOGICAL CONNECTION	240
577	MANCHESTER EQUIPMENT CO	228NE-1
435	MANNESMANN TALLY (INT'L)	51
421	MINOLTA GMBH	96IS-1
110	NEC - PRINTERS	115
•	PACIFIC DATA PRODUCTS	131
130	S'N'W COMPUTERS & ELECTRONICS	92
355-356	TECHNOLOGIC SYSTEMS	246
138	TEKTRONIX	47
163-164	XLI CORP	134-135

21 PROGRAMMABLE HARDWARE

81	ELIASHIM MICROCOMPUTERS	147

World Radio History

YOUR DIRECT LINK

PRODUCT CATEGORY INDEX

For FREE product information from individual advertisers, circle the corresponding inquiry numbers on your Direct Link Card!

To receive information for an entire product category, circle the category number on your Direct Link Card!

Inquiry No.		Page No.
373	ELSIST	246
414	FAST ELECTRONIC GMBH (INT'L)	73
342	IO TECH	246
•	JDR MICRODEVICES	239
357-358	TRIBAL MICROSYSTEMS	246
362	XELTEK	246
363	Z-WORLD ENGINEERING	246

22 SCANNERS/OCR/DIGITIZERS

81	ELIASHIM MICROCOMPUTERS	147
573-574	MICROTECH COMPUTER	228SO-3

52 SECURITY

352-353	SECURE IT INC	247

23 TAPE DRIVES

74-75	COLORADO MEMORY SYSTEMS	25
344	LAGUNA DATA SYSTEMS	247
348	OVERLAND DATA INC	247
350	QUALSTAR CORP	247
147	VALITEK INC	178
384	WILTEC, INC	247

24 UPS

66	AMERICAN POWER CONVERSION	110
114	MINUTEMAN	89
116-117	PC POWER & COOLING	69
145-146	TRIPP LITE	94

SOFTWARE

25 BUSINESS

79	COMPUTER ASSOCIATES	37
339-340	INDUS	248
102	MEDIA CYBERNETICS	128
376-377	MICROBIZ	248
115	PATTON & PATTON	172
556	PC EXPO	228NE-2
551	PC EXPO	228MW-4
563	PC EXPO	228PC-2
570	PC EXPO	228SO-4
422	SZKI RECOGNITA CORP (INT'L)	77

26 CAD/CAM

558	EVOLUTION COMPUTING	228NE-3
566	EVOLUTION COMPUTING	228PC-1
361	WINTEK CORP	248

27 COMMUNICATIONS/NETWORKING

161	CASTELLE CORP	212
211-212	EMBARC / MOTOROLA	228
82	FARALLON (N.A.)	73
415-416	FUTURESOFT ENGINEERING	80IS-2
424	MINICOM LTD	80IS-2
118	PERSOFT INC	161

28 DATA ACQUISITION

341	INES GMBH	243
347	NATIONAL INSTRUMENTS	248

29 DATABASE

68-69	BORLAND INTERNATIONAL	13
79	COMPUTER ASSOCIATES	37
216	COMPUTER ASSOCIATES	136
•	MICROSOFT CORP	56A-B
•	MICROSOFT CORP (N.A.)	57
•	RAIMA CORP	75
129	SEQUITER SOFTWARE INC	188

30 EDUCATIONAL

61-62	ABACUS SOFTWARE	119
63-64	AETECH	147
91	INTERFACE GROUP	70-71
•	MCGRAW HILL NRI (N.A.)	80A-B

31 ENGINEERING/SCIENTIFIC

165-166	ALLMICRO	103
368-369	COHORT SOFTWARE INC	248
155-156	ITERATED SYSTEMS	118
134-135	LANDMARK RESEARCH INT'L CORP	113
101	MATHSOFT INC	146
100	MATHSOFT INC	190
428	ON TIME MKT / KARSTEN PETERSEN	96IS-2
360	VISTA MICROSYSTEMS	248

33 GRAPHICS

368-369	COHORT SOFTWARE INC	248
80	COREL SOFTWARE	48
108-109	NANAO USA CORP (N.A.)	97
138	TEKTRONIX	47
•	VERMONT CREATIVE SOFTWARE	9

35 MAIL ORDER

406	COMPUSAVE INTERNATIONAL (INT'L)	CIII
407	COMPUTER QUICK (INT'L)	57
418	GREY MATTER LTD	96IS-4
•	PROGRAMMER'S PARADISE	59
99	PROGRAMMER'S PARADISE	60-61
•	PROGRAMMER'S SHOP (N.A.)	76-77
441	SOFTLINE CORP	56IS-1

36 MATHEMATICAL/STATISTICAL

351	SAS INSTITUTE INC	249
133	STATSOFT	209
136-137	SYSTAT INC	93

37 MISCELLANEOUS SOFTWARE

428	ON TIME MKT / KARSTEN PETERSEN	96IS-2

38 ON-LINE SERVICES

450	BIX	206

39 OPERATING SYSTEMS

87	IBM PERSONAL SOFTWARE PROD	14-15
•	MARK WILLIAMS CO	91
124	QUARTERDECK OFFICE SYSTEMS	187

40 PROGRAMMING LANGUAGES/TOOLS

159-160	BLINK INC	109
77-78	GREENVIEW DATA	139
418	GREY MATTER LTD	96IS-4
370	IVERSON SOFTWARE, INC	249
•	KEDWELL SOFTWARE	80IS-1
106	MICROWAY	142
428	ON TIME MKT / KARSTEN PETERSEN	96IS-2
119	PHAR LAP SOFTWARE INC	82
123	POPKIN S/W & SYSTEMS INC	175
•	PROGRAMMER'S SHOP (N.A.)	76-77
126-127	RAINBOW TECHNOLOGIES	65
151	WATCOM PRODUCTS INC	29

41 SECURITY

165-166	ALLMICRO	103
403	CHERRY MIKROSCHALTER GMBH (INT'L)	206-207
172	DALLAS SEMICONDUCTOR	24
81	ELIASHIM MICROCOMPUTERS	147
413	EUTRON (INT'L)	97
414	FAST ELECTRONIC GMBH (INT'L)	73
83-84	GLENCO ENGINEERING	163
174-175	INTELLIGENT SECURITY SYSTEMS	202
126-127	RAINBOW TECHNOLOGIES	65
131-132	SOFTWARE SECURITY INC	203
386	STARTEK	249

45 UNIX

77-78	GREENVIEW DATA	139
214	HUMMINGBIRD COMMUNICATIONS	192
•	MARK WILLIAMS CO	91
420	MKS / MORTICE KERN SYSTEMS	80IS-4
162	SUNSOFT	2-3

46 UTILITIES

165-166	ALLMICRO	103
336	DIAGSOFT INC	249
134-135	LANDMARK RESEARCH INT'L CORP	113
122	PKWARE INC	160
217	STORAGE DIMENSIONS	58
143-144	TOUCHSTONE SOFTWARE	90

47 WINDOWS

61-62	ABACUS SOFTWARE	119
73	CENTRAL POINT SOFTWARE	38-39
418	GREY MATTER LTD	96IS-4
214	HUMMINGBIRD COMMUNICATIONS	192
93	KEA SYSTEMS LTD	88
•	MICROSOFT CORP	107
108-109	NANAO USA CORP (N.A.)	97
118	PERSOFT INC	161
366	PIXEL PERFECT / MEDICAL ADVISOR	249
153	ZYLAB / DIVISION OF IDI	95

48 WORD PROCESSING/DTP

•	MICROSOFT CORP	21
422	SZKI RECOGNITA CORP (INT'L)	77
153	ZYLAB / DIVISION OF IDI	95

GENERAL

49 BOOKS/PUBLICATIONS

61-62	ABACUS SOFTWARE	119
•	COMPUTER PROFESSIONAL'S BOOK SOCIETY	148A-B
•	COMPUTER PROFESSIONAL'S BOOK SOCIETY	149
•	C++	172IDRC1-2
410	DATAPRO INTERNATIONAL	96IS-3
•	MCGRAW HILL BOOKSTORE	92
•	UNIXWORLD	184A-B
•	UNIXWORLD	184

51 MISCELLANEOUS

•	BYTE SUB MESSAGE	202
552	C.E.T.R.A.	228MW-3
557	C.E.T.R.A.	228NE-4
564	C.E.T.R.A.	228PC-6
571	C.E.T.R.A.	228SO-2
553	DEXPO / MILLER FREEMAN, INC	228MW-5
559	DEXPO / MILLER FREEMAN, INC	228NE-7
567	DEXPO / MILLER FREEMAN, INC	228PC-5
572	DEXPO / MILLER FREEMAN, INC	228SO-5
194	SAFEWARE	225
565	THE COMPUTER MUSEUM	228PC-4

World Radio History

EDITORIAL INDEX

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.

Inquiry No.		Page No.
	A	
1288	Aatrix Software	78
976	Abacus Software	150
1135	ABC Computer	62
1178	Accolade	81
1138	Adambyte	63
977	AddStor	150
1182	Adobe Systems	49, 98
1296	Advanced Graphics Software	80
	Advanced Telecommunications Research Institute International	40
1146	Advanced Visual Systems	120, 129, 143, 148
978	Aladdin Systems	150
1224	Aldus	98, 183
	Always Technology	215
979	Alysis Software	150
1225	American Megatrends	179
	America-On-Line	28
1160	Amtec Engineering	120, 148
	Apple Computer	28, 32, 40, 98, 194, 201
1075	Applied Engineering	173
	Aptronix	111
	Art Plus Publishing	41
1077	Asanté Technologies	173
1294	ASD Software	80
	AT&T	40
1136	Atto Technology	63
	B	
1152	Boeing	148
1278	Bogen Communications	72
	C	
	Canon	36
	Carnegie Mellon University	40
	Casio Computer	28
	Central Point Software	44
	City University Business School	40
1147	CoHort Software	120, 148
1163	Commodore Business Machines	81
	Computer Associates	32
1164	Corel Systems	81, 98, 215
1169	Creative Labs	81
1285	Curran Software	74
	D	
1271	Data Depot	68
1149	Data Description	120, 148
	Dataquest	36
1131	Dauphin Technology	62
	David Sarnoff Research Center	120
1076	Dayna Communications	173
1133	DEC	32, 62, 98, 129
1232	Dell Computer	164
1226	Diamond Computer Systems	179
1148	DSP Development	148
	E	
1078	E-Machines	173
1137	Envisio	63
	EO	40
1083	Epson America	55
1293	Et Cetera	80
1141	Expert Graphics	64
	F	
1080, 1230	Farallon Computing	173, 185
980	Fifth Generation Systems	150
1144	50/50 Micro Electronics	64
	Freeport Data	215
	FuziWare	111
	G	
1167, 1233	Gateway 2000	12, 81, 164
	General Magic	40
	Georgia Institute of Technology	120, 129
	GeoWorks	28
1081	Global Village Communication	173
1158	Golden Technologies	148
981	Golden Triangle Computers	150
	H	
1234	Hewlett-Packard	111, 164
	Hiroshima Institute of Technology	111
	Hitachi	36, 111
	Hughes Aircraft	98
	Huntington Group	111
	HyperLogic	111
	I	
1161, 1222	IBM	36, 98, 120, 129, 137, 148, 177
	InfoCorp	98
1273	Innova Electronics	68
1134	Insight Distribution Network	62
982	Integrated Information Technology	150
1171	Intel	32, 36, 81
	International AVS Center	129
	Intuit	28
	J	
1162	Jaguar Software	120, 148
	Japanese Fuzzy Logic Systems Institute	111
	K	
	Kaleida Labs	32
	Kendall Square Research	129
1279	Klos Technologies	72
	Kumamoto National College of Technology	111
1166	Kyocera Electronics	81
	L	
	The Laboratory for International Fuzzy Engineering Research	111
1086	Logitech	58
	Lotus Development	98
	M	
1272	M & S Computer	68
1283	Macintosh Business Systems	74
1292	Manugistics	80
1155	MapInfo	148
	Market Intelligence	111
1156	The Math Works	148
	Matsushita Electric Industrial	40, 111
1227	Maxtor	179
1168	MCI	81
1142	Memorex Computer Supplies	64
	Metus Systems Group	111
1132	Micro Electronics	62
1228	Micronics Computer	179
1177	MicroProse Software	81
1084, 1174, 1179, 1181	Microsoft	12, 28, 32, 44, 55, 81, 98, 211
	Mitre	143
1221	Mortice Kern Systems	191
	Motorola	28, 40, 111
	N	
	National Center for Supercomputing Applications	120, 137
	National Institute of Standards and Technology	143
	National Institutes of Health	137
	The National Research Council	120
	National Semiconductor	111
1175	NCR	81
	Neuralogix	111
	Next Computer	40
	Norton	44
	Novell	210
	O	
1159	Oberon Software	148
	OKI Electric Industry	111
1235	Olivetti	164
	Omron	111
	Oracle	129
1143	Orange Micro	64
	P	
	Palm Computing	28
	Paragon Imaging	143
1274	Para Systems	68
1287	Pathtrace Systems	78
1165	PC Power & Cooling	81
1176	Phase III Computing	81
	Philips	40
	Pinnacle Publishing	98
1231	Pioneer Communications America	193
1275	Power Alarm	68
	Precision Visuals	120, 129
1139	Procom Technology	63
1295	Programmed Logic	80
1079	PSI Integration	173
1236	Psion	164
	Q	
1145	Quanta	64
	Quark	98
	Quarterdeck Office Systems	40
	R	
1153	Research Systems	129, 148
	Ross Systems	40
	Ryan	111
	S	
	Sandia National Laboratories	120
	San Diego Supercomputer Center	143
	SBT Accounting Systems	98
1140	Seiko Instruments	63
1172	Seikosha America	81
1284	Select Software Tools	74
1237	Sharp Electronics	164
	Siemens Nixdorf	36, 40
1297	Sigma Designs	64
1154	Signal Analytics	148
	Silicon Graphics	120, 129, 137
1281	Software Emancipation Technology	74
	Software Publisher's Association	98
1277	Sonix Communications	72
	Sony	40
1151	Spyglass	137, 148
983	Stac Electronics	28, 150
	Statsoft	120
	Sun Microsystems	129
1223	SunPro	189
1082, 1173	Supra	81, 173
	Sybase	129
1290	Sybiz Solutions	78
1289	Symantec	78
1282	Synopsis Software	74
1180	Systat	81, 120
	T	
1276	Telecraft Industries	72
	Teradata	143
1085	Texas Instruments	36, 56
	Togai Infralogic	111
	Tools & Techniques	98
	Toshiba	36
	Trantor Systems	215
1170	Turtle Beach Systems	81
	U	
1229	UltraStor	179
	University of California	143
	University of Karlsruhe	40
	University of Lowell	129
	University of New Mexico	129
	University of Pennsylvania	143
	V	
1157	Visual Numerics	148
	Vodafone	36
	W	
1150	Wavefront Technologies	129, 148
	Wolfram Research	120
	X	
	X Business Group	36
	Xerox	129
	Z	
1238	Zeos International	164

World Radio History

ACTIVE COLOR 486-33, SHIPPING NOW!

Winner of " BEST COLOR DISPLAY " at COMDEX '92

Simultaneous LCD & External SVGA!

486 SLC/e - 33 MHz Color Spectrum

- Built-in Math Co-processor
- Landmark speed 105 Mhz
- 9" Color LCD, 10" Mono
- 2 hour battery life
- 4 -10 MB RAM, expandable by SIMMS
- 85 MB (120, 200, 250,) Hard Drive
- 3.5" 1.44 MB floppy
- Ports: 1 or 2 Serial, 1 Parallel, 1 Docking station, SVGA, Key pad
- DOS 5.0 / Windows 3.1, games

ACTIVE MATRIX $3695

PASSIVE MATRIX $2495

MONO-CHROME $1795

VORTEX is committed to suppling top quality notebook computers. Our customers include NASA, Hewlett Packard, NCR, Texas Instruments, Cyrix, AT&T, Lockheed and the U.S. Navy to name a few. These discriminating customers depend on VORTEX, because we provide:

- Personal attention to your order
- **30 day** money-back guarantee
- burn-in every notebook for **60 hours** before shipping
- only the **highest quality** components
- true desktop performance
- **1 year** parts and labor warranty
- toll-free **technical support**
- complete **upgradeability**
- **48 hours** on any service, guaranteed

OPTIONS

Value Package 1
130 MB Hard Disk, Trackball, extra Battery $350

Value Package 2
210 MB Hard Disk, 10 MB RAM, Trackball Fax/Modem, extra Battery..... $975

Docking Station $385
Extra Battery ..... $ 85

INTERNATIONAL DISTRIBUTORS

GERMANY:
Ektotrade GMBH
Egglkofen
(049) 8639-5089

Logos Information Systeme
Gehenbühl
(049) 7156-2 5500

ENGLAND:
Microtek,
London
(44) 71-587-3535

CANADA:
Varcom Technologies Inc.
Downsview
(416) 638-4605

PORTUGAL:
Minitel
Lisbon
(351) (1) 65429

MEXICO:
Data Flux
52-83-19-06-11

IBC
805-650-4387

VENEZUELA:
RAI
58-2-951-76-44

SLOVENIA:
Mentek d.o.o.
(038) 61-44-89-88

CARIBBEAN:
Bermuda Microsystems
Hamilton
(809) 295-2624

SASI N.V.
St. Maarten
05795-42776

PHILIPPINES:
Communications Solutions
(63) 816-2643

VORTEX

VORTEX COMPUTERS

2930C Turnpike Drive, Hatboro,PA 19040
(215) 957-6584 • FAX (215) 957-6585

Call Today! *Dealer inquiries welcome*

800-548-7839 Or FAX Your Order: (215) 957-6585

Int'l. Orders Call: (215) 957-6584

Circle 215 on Inquiry Card.

World Radio History

STOP BIT

PATRICIA SEYBOLD

THE LEARNING ORGANIZATION

Organizational productivity constitutes the missing return on investment without which our computer industry, our organizations, and our global economy have become mired in finger-pointing gridlock. New information technologies cannot solve these problems because the source is organizational in nature. Organizations still can't assimilate the technology that corporate information technologists are trying to implant today.

No technological innovation can succeed without simultaneous organizational change

The rejection of technology is rife in most organizations. New technology comes in and is jettisoned back out or remains largely unabsorbed and unused. Why? Because people are reluctant to alter their work habits. Major changes are needed in organizational practices, behavior, and culture.

If we are going to make companies more responsive, more flexible, and more viable in the global information economy, we have to teach our organizations to learn. For better or worse, that responsibility is falling squarely on the shoulders of the information technologist.

These de facto change agents are saddled with both designing new distributed computing applications and changing entrenched organizational behaviors that threaten to subvert their best efforts. To avoid disaster, they should follow the basic principles of organizational learning and build them into each design effort.

One key is to make things tangible and visible. The most common complaints I hear from all types of workers in information-intensive organizations are, "I didn't know," "No one told me," "How was I supposed to know that?" and "I know we must have that information somewhere, but I don't know how to get it." Despite our efforts to deploy information technology, we haven't managed to communicate relevant information.

Suppose your assignment is to design a document management system to track and maintain changes in manufacturing standards. Your company produces 50 different products in 11 worldwide manufacturing facilities. The application needs to leverage the PCs and LANs deployed throughout the company. The goal is to streamline the process of the creation, approval, and dissemination of manufacturing and packaging standards to meet your company's stringent quality requirements. This new distributed documentation application will replace the company's current, outmoded, paper-based processes.

Where does organizational learning fit in this project? What is invisible in the current manufacturing standards process is the actual creation of the standards. Standards are created by the R&D group, with little input from the manufacturing floor. Using the principles of organizational learning, the standards development process becomes a collaborative effort among the R&D, manufacturing, purchasing, and quality-control departments.

By designing the application to solicit input from all participants in the process at the outset, you eliminate cycles of approval and modification, cutting valuable days, weeks, and months off the standards creation cycle. You're also building in the sharing of experience and knowledge across functional workgroups with different skills and opinions. The system captures information about ingredients, weather conditions, batches, and machinery, from all the participants, thus documenting the assumptions on which the manufacturing processes are based. And by instituting a set of work-flow rules that automatically route these standards for approval, you are making explicit a set of organizational procedures that can then be further refined, questioned, and streamlined.

By approaching the development of distributed applications in a way that incorporates these principles of organizational learning, you provide a huge service to your organization. You are also ensuring that the new technology has a chance to take root and make people more productive, because you're confronting the necessary changes in organizational behavior head-on.

A learning organization encourages learning and experimentation among its employees and is masterful at transforming itself to create and meet new market conditions. A learning organization can transform itself over and over again. Dynamic change is no longer feared, but becomes a way of life. Learning to share information, to document assumptions, and to question those assumptions is the first step on the long journey toward improved organizational productivity. ■

Patricia Seybold is the founder and CEO of the Patricia Seybold Group, a consulting and information services firm based in Boston, Massachusetts, and specializing in distributed computing for networked organizations. You can reach her on BIX c/o "editors."

Stop Bit is a forum for informed opinion on personal computing topics. The opinions expressed are those of the author and not necessarily those of BYTE. Your contributions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

ILLUSTRATION: CHRIS SPOLLEN © 1993

World Radio History

OUCH! EEK! OOW! STOP! #@%!

When Dell cut prices up to $300 on its Performance Series, IBM and Compaq reacted with a few choice words. The price cuts aren't the only thing that they reacted to; these systems already offered up to 50% better performance than our previous systems, and at up to 25% lower prices. Yikes!

DELL™

800-348-6151

WHEN CALLING, PLEASE REFERENCE #11E94.
HOURS: 7AM-9PM CT MON-FRI, 8AM-4PM CT SAT, 10AM-3PM CT SUN.
IN CANADA, CALL 800-668-3021. IN MEXICO CITY, 228-7811.

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 write Dell USA L.P., 9505 Arboretum Blvd., Austin TX 78759-7299. Attention Guarantees. Leasing arranged by Leasing Group, Inc. On-site service provided by BancTec Service Corporation. On-site service may not be available in certain remote areas. ‡WINMARKS test results obtained by running WINBENCH ver. 3.1 at 640 x 480 (256 colors). ‡WINMARKS test results obtained by running WINBENCH ver. 2.5 at 1024 x 768. The Intel Inside logo is a registered trademark and Pentium, i486 and i386 are trademarks of Intel Corporation. MS-DOS is a registered trademark and Windows is a trademark of Microsoft Corporation. UNIX is a registered trademark of UNIX System Laboratories, Inc. in the United States and other countries. FORTUNE 500 is a registered trademark of The Time Inc. Magazine Company. Dell disclaims proprietary interest in the marks and names of others. ©1993 Dell Computer Corporation. All rights reserved.

THE DELL 333s/L
i386™ SX 33MHz SYSTEM

- LEASE: $44/MO.
- 2MB RAM
- 120MB (17ms) HARD DRIVE
- 3 ISA EXPANSION SLOTS
- VGA 800 MONITOR (14", 800 X 600, .39mm)
- ONE DISKETTE DRIVE (3.5" OR 5.25")
- MS-DOS 5.0

OUR FASTEST 386SX.
(Don't let it fool you. Actually, it's a lot faster than a speeding bullet.)

GUARANTEED

GUARANTEED RESPONSE.
Amazingly easy to use, and includes comprehensive documentation. But if you ever have questions, call us. We guarantee you'll talk to an expert within 5 minutes, or if you prefer, we'll call back within an hour.*

intel inside

READY TO ROCK 'N' ROLL.
Intel isn't the only thing in this system. Everything can be custom configured: modems, network adapters, and critical software.

THE DELL 425s/L
i486 SX 25MHz SYSTEM

- LEASE: $55/MO.
- 4MB RAM
- 170MB (17ms) HARD DRIVE
- 3 ISA EXPANSION SLOTS
- UPGRADEABLE PROCESSOR
- ACCELERATED LOCAL BUS VIDEO WITH 512KB VIDEO RAM
- SVGA 1024I MONITOR (14", 1024 X 768, .28mm)
- ONE DISKETTE DRIVE (3.5" OR 5.25")
- MS-DOS 5.0

UP TO 65% QUICKER MAINTENANCE.
It's easy to get into this computer. Just loosen a couple of thumbscrews for easy access to the modular chassis.

UP TO 2.6 TIMES THE VIDEO PERFORMANCE.
With our accelerated local bus video revving up your screen, who needs a VCR?

GUARANTEED COMPATIBILITY.
Our computers are network-compatible with Novell, Banyan, and UNIX‡ systems. And we're the only company with a written compatibility guarantee.*

THE DELL 433s/M
i486 SX 33MHz SYSTEM

- LEASE: $74/MO.
- 4MB RAM
- 170MB (17ms) HARD DRIVE
- 6 ISA EXPANSION SLOTS
- UPGRADEABLE PROCESSOR
- ACCELERATED LOCAL BUS VIDEO WITH 1MB VIDEO RAM (UP TO 19 MILLION WINMARKS)‡
- SVGA 1024I MONITOR (14", 1024 X 768, .28mm)
- ONE DISKETTE DRIVE (3.5" OR 5.25")
- MS-DOS 5.0

UP TO 160% FASTER VIDEO.
Faster PageMaker redraws and lightning-quick Windows repaints. Speed freaks, rejoice.

GREATER UPGRADEABILITY.
You can upgrade all the way to the top 486, the 66MHz DX2. You'll even be able to add the Pentium™ technology from Intel.

SYSTEM PERFORMANCE BOOSTED 26%.
With our optimized cache as an option, you can give your system a boost whenever you want.

THE DELL 466/ME
i486 DX2 66MHz SYSTEM

- LEASE: $111/MO.
- 4MB RAM
- 170MB (17ms) HARD DRIVE
- 4 EISA EXPANSION SLOTS
- 2 ISA EXPANSION SLOTS
- UPGRADEABLE PROCESSOR
- ACCELERATED LOCAL BUS VIDEO WITH 1MB VIDEO RAM (UP TO 29 MILLION WINMARKS)‡
- ULTRASCAN™ 14C MONITOR (14", 1024 X 768, .28mm, NI)
- ONE DISKETTE DRIVE (3.5" OR 5.25")
- MS-DOS 5.0

UP TO FOUR TIMES FASTER DATA TRANSFER THAN ISA.
You get a 32-bit EISA expansion bus that transfers data at up to 33 megabytes a second. To understand what it does for your computer, drink about eight million cups of coffee.

GUARANTEED ACCOUNTABILITY.
We're the only computer company to guarantee*—in writing—compatibility, fast response to your questions, and quick service.‡ Two-thirds of the FORTUNE 500* companies rely on us. So should you.

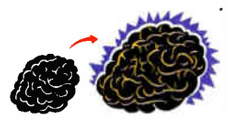
GOOD NEWS FOR THE POWER HUNGRY.
It's easy to upgrade to the top 486, the 66MHz DX2. If you're still power hungry, you can add Pentium technology — the next generation from Intel.

THE DELL 433/T
i486 DX 33MHz SYSTEM

- LEASE: $91/MO.
- 4MB RAM
- 230MB (16ms) HARD DRIVE
- 8 ISA EXPANSION SLOTS
- UPGRADEABLE PROCESSOR
- ACCELERATED LOCAL BUS VIDEO WITH 1MB VIDEO RAM (UP TO 19 MILLION WINMARKS)‡
- SVGA 1024I MONITOR (14", 1024 X 768, .28mm)
- ONE DISKETTE DRIVE (3.5" OR 5.25")
- MS-DOS 5.0

UP TO 18% FASTER SYSTEM PERFORMANCE.
Good thing you don't have to worry about the highway patrol.

33% MORE SLOTS.
With eight slots, you can add the network and communication cards you need for a great low-cost server.



UP TO 86% MORE DISK CAPACITY.
Our floor-standing model has a disk capacity of up to three gigabytes. Talk about mind-expanding performance...

Each system is custom-built. With 18 different models in our 486 line — covering 25MHz, 33MHz, 50MHz, and 66MHz — you can configure just the system you need. In fact, with our complete line of storage, memory, graphics and connectivity products, we can build over 15,000 different configurations.

World Radio History

DELL CUTS PRICES.

IBM AND COMPAQ REACT WITH A FEW CHOICE WORDS.

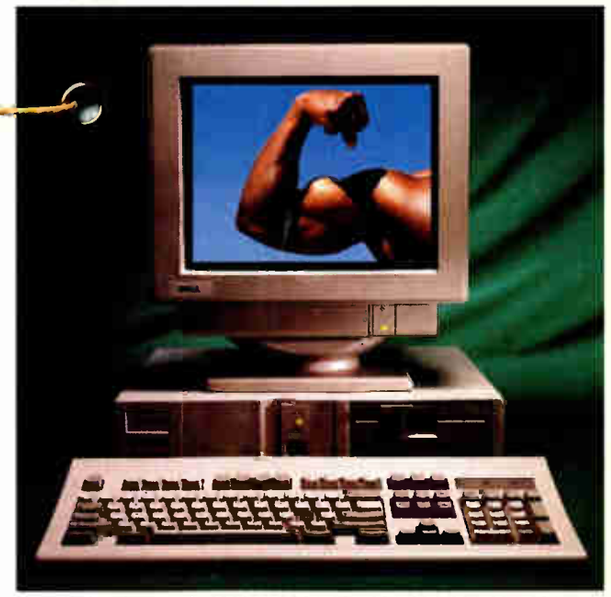
FROM NOW UNTIL APRIL FOOL'S DAY, THE JOKE'S ON IBM AND COMPAQ.

DELL PERFORMANCE SERIES
425s/L i486 SX 25MHz

NOW $1,599

(SAVE $469)

Laugh while you can.
All good things must come to an end. This offer, for instance, ends March 31.



All this for just $1,599? HA HA HA HA HA HA HA HA!

DELL® 425s/L i486™ SX 25MHz SYSTEM

- LEASE◊: $59/MO.
- 4MB RAM
- 170MB (17ms) HARD DRIVE
- 3 ISA EXPANSION SLOTS
- UPGRADEABLE PROCESSOR
- ACCELERATED LOCAL BUS VIDEO WITH 512KB VIDEO RAM
- ULTRASCAN™ 14C MONITOR (14", 1024 x 768, .28mm, NI)
- DUAL DISKETTE DRIVES (3.5" AND 5.25")
- MS-DOS® 5.0/MICROSOFT® WINDOWS™ 3.1/ MOUSE

intel inside®

DELL™

800-348-6149

WHEN CALLING, PLEASE REFERENCE **#11ED3**.
HOURS: 7AM-9PM CT MON-FRI, 8AM-4PM CT SAT, 10AM-3PM CT SUN.
IN CANADA, CALL 800-668-3021. IN MEXICO CITY, 228-7811.

Very Serious Video Performance.
Our accelerated local bus video gives you up to three times the video speed of IBM ValuePoint's or Compaq Prolinea's non-local bus video†. Which makes them look, well, laughable.

World Radio History